The Beekeeper's Role:

Caring for and Protecting Alberta's Honey Bees

The Alberta Beekeepers Education and Enhancement Program

Biosecurity Icon

Throughout the manual, you will see this icon - this represents an important piece of biosecurity information relevant to the section that it is in.

Photo Credits

Cover photos – InGold
Pg 4,5,6 – InGold
Pg 6 – Canva
Pg 7 – InGold
Pg 8,9 – Stock
Pg 10 – Stock
Pg 11 – InGold
Pg 15 – InGold / Canva
Pg 17 – InGold
Pg 18 – InGold / Shelly Hoover
Pg 19 – University of Saskatchewan Honey Bee Health Laboratory / Canva / InGold
Pg 20 – Stock
Pg 21 – InGold
Pg 23 – InGold
Pg 24 – Ron Miksha / Stock
Pg 26 – Andony Melathopoulos / Rosanna Punko
Pg 27 – InGold
Pg 29 – InGold
Pg 32 – InGold
Pg 33 – InGold
Pg 34 – InGold
Pg 35 – Shelly Hoover / Stock
Pg 36 – InGold
Pg 37 – InGold
Pg 39 – InGold
Pg 40, 41, 42 – InGold
Pg 43 – Canva / InGold
Pg 44 – InGold / Canva
Pg 45 – InGold
Pg 46 – InGold
Pg 48 – InGold
Pg 51 – InGold
Pg 52 – Canva
Pg 53 – InGold
Pg 55 – InGold
Pg 56 – Stock
Pg 57, 58 – InGold
Pg 62 – Melissa Moggy
Pg 65 – InGold
Pg 66 – Andony Melathopoulos / Steve Pernal
Pg 67 – Steve Pernal
Pg 68 – Alberta Tech Transfer Program
Pg 70 – Stock / Canva
Pg 71 – Emily Olson
Pg 72 – Emily Olson / Jeff Kearns
Pg 73 – Government of Alberta Bee Health Assurance Team
Ph 78 – Geoffrey Williams
Pg 79 – Government of Alberta/ Canva
Pg 80 -– Government of Alberta / Stock
Pg 81 – Canva
Pg 82/83 – Canva
Pg 83 – Megan Colwell
Pg 84 – Canva
Pg 85 – Canva / Stock
Pg 86 – Stock / Steve Pernal
Pg 87 – Canva
Pg 89, 90, 91, 92, 93 – InGold
Pg 94 – Canva
Pg 95 – Ron Miksha
Pg 96 – Canva
Pg 97 - InGold

Acknowledgments

This manual and accompanying education program is designed to help those who already own or care for honey bees, be it in their backyard or apiary. Animal care and health practices must be optimal for the bees in our care. We aim to provide the best up-to-date information, improve awareness of current regulations, and ensure that all beekeepers conduct best practices. If you ever need help, there is a wealth of information available for you – just drop us a line!

The Alberta Beekeepers Education and Enhancement Program would not have been possible without the contributions and feedback of the following Expert Panel members. The panel comprised beekeepers, industry organization representatives, researchers, and the provincial apiculturalist.

Expert Panel Member	**Organization/Business**
Connie Phillips	Alberta Beekeepers Commission
Dr. Steve Pernal	Beaverlodge Research Farm, Agriculture and Agri-Food Canada
Kristen Hall	Bee My Honey
Sam Muirhead	Provincial Apiculturalist
Dr. Renata Borba	Tech Transfer Team
Ron Miksha	United Beekeepers Association
Tracey Smith	United Beekeepers Association
Dr. Olav Rueppell	University of Alberta
Dr. Shelley Hoover	University of Lethbridge

This project is funded [in part] by the Government of Canada and the Government of Alberta through the Canadian Agricultural Partnership and by Peavey Mart and the Alberta Beekeepers Commission. With special thanks to The Scandia Honey Company.

CONTENT CREATORS:

Rosanna Punko, Apiculture Consultant
Dr. Melissa Moggy, Alberta Farm Animal Care
Kristen Lepp, InGold Communications

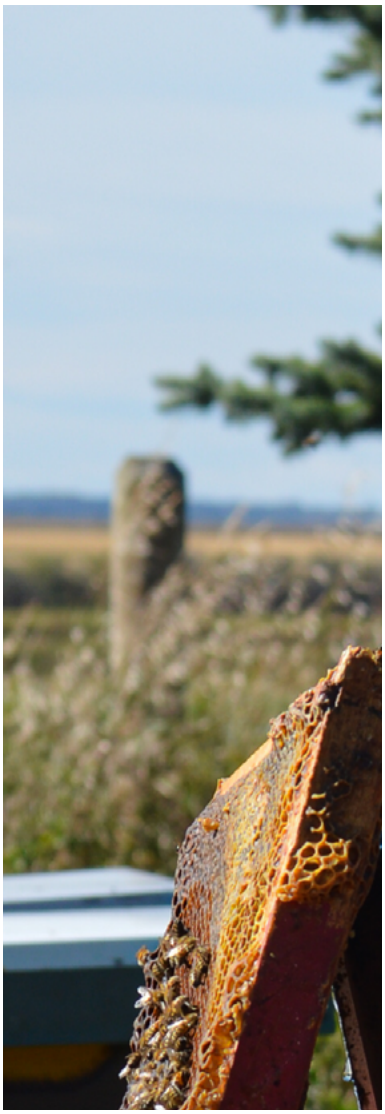


Table of Contents

Honey bees are an important and essential component of Alberta and Canadian agriculture.

Commercial beekeepers in Alberta manage approximately 40% of all honey bee colonies in Canada, producing an average of 18.4 million kilograms of honey each year, making Alberta the #1 honey producer in Canada. In the past ten years, the number of beekeepers in Alberta has increased greatly, in large part due to an increase in hobby beekeepers. There are over 1500 beekeepers in Alberta, with the majority being hobby beekeepers.

Alberta beekeepers also provide pollination services that benefit Alberta's agricultural sector by enhancing crop yield and shortening the growing season. Honey bees are responsible for incidental pollination of forage, native rangeland, agriculture and horticulture crops, and flowering plants. Additionally, bee products, such as honey, wax and pollen, and sales of bees and equipment all add to the economic contributions made through beekeeping.

Every year beekeepers throughout the province work diligently to stay in business with healthy bees, as the health of our bees has been declining over the past years. In addition to weather challenges, honey bees act as a host for a multitude of diseases caused by bacteria, viruses, and parasites. However, beekeepers are commonly uninformed about appropriate biosecurity measures meant to limit the spread of disease and pests among colonies and geographical areas. These concerns threaten not only the sustainability of the beekeeping and honey industries but also the production of fruit and seed crops pollinated by bees.

Purpose

The purpose of this handbook is to provide training to empower beekeepers with husbandry and biosecurity best practices to protect individual beekeepers, regional biosecurity, and the Alberta beekeeping industry as a whole.

Although large apiary owners may be familiar with much of the information included in this handbook, their staff may not, and this handbook will be an easy way to educate them. This handbook is available in English and Spanish, as many hired apiary staff speak Spanish.

In addition to the handbook, task lists have been developed detailing the different responsibilities that beekeepers must complete, such as winterizing hives. Each task list summarizes the equipment needed, appropriate steps, and refers the reader to additional information.

What is a Bee?

Bees are flying insects that are closely related to ants and wasps. Flies are distantly related to bees, and some are often misidentified as bees. Bees have two pairs of wings (which are hooked together to function as one large wing) and long tongues for drinking nectar. Bee antennae are usually longer than flies, most bees are hairier than flies, and their legs are fatter than flies and wasps. Typically recognized bees are black or brown and yellow, but they can be many colours, including blue, green, or orange.

In contrast, flies usually have triangular heads, shorter and thicker antennae than bees, large forward-facing eyes, and one pair of wings.

Wasps have two pairs of wings, like bees, and are often black and yellow, but they are mostly hairless. Wasps do not have long tongues, and their legs are thin and may hang down in flight. Finally, wasps are generally more aggressive than bees.

Left: wasp Right: fly

Types of Bees

Over 300 different species of native bees call Alberta home; this includes mining bees, leafcutter bees (non-managed), mason bees, and bumble bees. Honey bees, however, are not native to Canada, having been introduced from Europe in the 1600s. Despite their similar colouring, wasps and hornets are not bees and can be predators of honey bees.

Bee Sociality

Bee sociality can range from solitary to highly social.

Of all the bees native to Alberta, the majority are solitary bees. Solitary bees live alone and do not store honey but are still essential pollinators. Solitary bees are not aggressive but can sting in self-defence. About 70% of solitary bees nest in the ground (e.g., mining bees); however, some solitary bees nest in hollow twigs, cavities and wood (e.g., leafcutter bees and mason bees).

Social bees live together and require recognition and communication with other colony members. Honey bees and bumble bees are two of the most familiar social bee groups.

Some bees have intermediate sociality, ranging from nest aggregations to communal nests, with some level of solitary behaviour (e.g., collecting food for offspring).

Types of Honeybees

Although other species of honey bees exist, in Canada, we exclusively keep the European honey bee, Apis mellifera. Different ‘breeds’ of this species have different characteristics. It is important to familiarize yourself with the different breeds to help pick one that best suits your needs.

There are some things to consider when buying bees, such as their production capabilities, bee temperament, and disease resistance. It is up to you, as the beekeeper, to decide what characteristics are important to you and discuss those with whomever you choose to buy your bees from.

In Alberta, most of the available bees and queens are from mixed breeds, but primarily they are Italian x Carniolan x Caucasian crosses. Honey bee breeds are not always pure due to honey bees’ mating nature and that bees are not contained in a specific area.

Below we briefly touch on the common bee breeds in Alberta to familiarize yourself with and inform your decisions on what breeds to buy. For more information on types of honey bees, see the NCSU publication in the references section.

The Italian Bee

Italian honey bees are light in colour and favoured in North America for their more extended brood-rearing periods. Extended periods effectively increase their colony population and maintain that population throughout the summer. They are considered to be a gentler honey bee, as they are less defensive of their hive. They are also well known for being more disease-resistant and very good honey producers. Unfortunately, they have a tendency to steal from neighbouring hives, which may spread disease and pests between colonies.

The Carniolan Bee

They are known for quickly increasing their colony population in the spring, which may increase the risk of swarming and are quite gentle and easy to handle. Carniolan bees also are not as prone to robbing honey from neighbouring colonies, which is preferable to prevent disease spread. They are also good wax producers, which may be relevant to those that make wax products.

The Caucasian Bee

The Caucasian honey bee is different from other honey bees. They have a very long tongue, which allows them to forage nectar from flowers that other honey bees cannot. They are known to be very docile but are slow to buildup their spring population, which may impact their honey production. Finally, Caucasian bees tend to use large amounts of propolis (a sticky resin substance used to seal gaps in the hive), making the hive more challenging to work with.

Basic Honey Bee Biology

In a typical hive, there is a queen, many workers, and some drones. There should also be a good number of juveniles (brood). Each type of colony member differs in many ways, including their role in the colony, lifespan, and even genetics. Below we will briefly review these bees and their life cycles.

The Queen

There is usually one queen per colony responsible for laying over 1,500 eggs per day during peak seasons, like spring and summer. She is the biggest bee in the colony, with a long body and a tapered abdomen. Depending on the need for egg production, the abdomen may change in size, larger during the spring and smaller in the winter.

Queens may live up to five years of age but usually die much earlier. The colony will produce a new queen to replace her if her egg production drops. Beekeepers replace queens about every two years to ensure good egg-laying.

To rear a new queen, the queen will lay an egg in several special ‘queen’ cells made by worker bees or artificially placed by the beekeeper, or workers can rear an egg laid by the queen in a worker cell as a new queen. The first queen to eclose (emerge) from the bottom of the queen cell will chew out the sides of the other queen cells and kill the occupants. If another queen has already eclosed, they will fight to the death, and the winner will be the new queen.

Several days later, the queen will fly around outside

the hive to orient herself with the area. She will then mate with drones outside the hive during mating flights over a few days and store the semen for later use. The queen mates with many drones to increase the genetic diversity of her offspring, which benefits the colony. She will never mate again in her life. If poor weather interferes with the mating flights or if there is a low drone population, she may not have stored enough semen and is at risk of not producing enough worker eggs and, as a result, being replaced.

Workers

Worker bees are females with very small ovaries that typically do not lay eggs and have many roles they perform over their life (see table 2.1). They are smaller than the queen (about half her weight) and have a tapered abdomen. There may naturally be 10,000 workers in a colony, but that can increase to about 50,000 in a productive colony well managed by a beekeeper.

Worker bees perform certain tasks based on their age. For the first three weeks of their life, they perform duties within the hive. Then, for the remainder of their life, they will perform foraging activities outside of the hive.

Worker bees live between 15 to 42 days during the foraging season but will survive for several months during the winter. Workers have shorter lifespans during the foraging and brood rearing season because they work so hard, but less energy is expended in the winter. At the end of the active season, bees are produced that are hardier, called winter bees.

WORKER BEE ROLES
Feeding larvae
Building comb
Processing nectar
Storing pollen
Cleaning the hive
Removing dead bees from the hive
Collecting water
Nectar and pollen foraging
Defending the colony

Table 2.1

Drones

Drones are the male bees, and their sole role is to mate with a virgin queen. They are boxier in shape and look like a bigger, broader bee with large wings and large eyes that touch in the middle. These large eyes help the drones successfully locate a queen on their mating flight. Once they have successfully mated a queen, the drones die.

There are approximately 400 drones in the colony from spring to mid-autumn during the brood-rearing season. They become sexually mature at 16 days after eclosion and can live up to 90 days.

Life Cycle

While the developmental length depends on the kind of bee (i.e., queen, worker, or drone), they share many commonalities. It all starts when the queen lays the egg, which is about 1 mm in length and stuck to the bottom of an empty wax cell. The sex of the bee is determined through fertilization: fertilized eggs are female (workers or queens), and unfertilized eggs will become male drones. After three days, the eggs will hatch into a small larva that appears like a small ‘c’ shape at the bottom of a cell.

The larvae grow quickly and are fed royal jelly by the worker bees for the first three days. The larvae that will become queens will continue to receive royal jelly, but worker larvae will be switched to a lower quality feed. After another two days, the larva has almost filled the cell, and a breathable wax cap is placed on the cell by the worker bees.

Within the capped cell, the larva will develop through its pupal stage into an adult. When it is time to eclose, the grown bee will chew the cap off the cell and climb out. From egg to adult, the queen takes about 16 days, workers about 21 days, and drones about 24 days.

Is Beekeeping for You?

Before you start investing in honey bees, ask yourself: what is my reason for wanting to keep bees?

Do you want to protect the pollinators in your area? This can be done without raising honey bees and producing honey. There are many "save the bees" campaigns that can be supported. You can also support local pollinators by building bee hotels, planting native gardens, and leaving areas in their natural condition to be used by bees and pollinators.

Do you want to raise honey bees and extract honey and other products? If so, welcome to the industry! First, determine if your area has any restrictions on raising bees and familiarize yourself with local regulations (see Chapter 13: Legislation). Furthermore, it is strongly recommended to take a beekeeping course listed through the Alberta Beekeepers Commission to familiarize yourself with beekeeping duties.

Beekeeping Community

Beekeepers with 100 or more hives in Alberta must be a member of the Alberta Beekeepers Commission. The Alberta Beekeepers Commission supports the beekeeping industry through supporting research, advocating on issues, sharing information, and offering discounted liability insurance to their producers. The Government of Alberta Provincial Apiculturist is involved in maintaining regulations and monitoring the keeping of bees in the province.

For smaller beekeepers, beekeeping clubs are accessible throughout Alberta, such as the Edmonton District Beekeepers Association and the Calgary and District Beekeepers Association. Online forums are also available, but readers should be cautious of information shared online. Not everything shared online is correct.

Newcomers to the industry may wish to have a mentor guide them through starting an apiary. Local beekeepers in your area can be found through the Alberta Beekeepers Commission website and contacted if they are interested in mentoring.

Time Commitment

The time needed to raise bees successfully varies by how many colonies are managed, the season, forage availability, weather conditions, and other issues (e.g., disease or pests). More time will also be needed if the beekeeper moves their colonies for pollination services.

Additionally, new beekeepers will take more time than experienced beekeepers. Review the estimated hours per visit and frequency of visits outlined below and consider if you have the time to dedicate to beekeeping.

Type of Beekeeper	Hours per Visit
Hobby Beekeeper 1-10 Colonies	Up to 3
Sideline Beekeeper 11-250 Colonies	Up to 50
Commercial Beekeeper >250 Colonies	Up to 120

Season (Approx. months)	Frequency of Visits
Spring (Mar - Jun)	Every week
Summer (Jul - Aug)	Every 2-3 weeks
Fall (Sep - Oct)	Every 3-4 weeks
Winter (Nov - Feb)	Once to twice

Cost of Beekeeping

The costs associated with beekeeping vary depending on the number of hives, the tools the beekeeper elects to use, weather conditions, and treatment requirements of the colony. Beekeeping is an investment that needs to be protected from damage, disease, and pests.

The prices outlined below are based on 2020 pricing and may vary by location and supplier. Prices were also based on buying new supplies. While buying used supplies is cheaper, the buyer must be aware of the supplier's hives' disease status. Disease can be spread through objects shared between apiaries. Used equipment (not comb) should have any wax scrapped off and disinfected by scorching with a torch or bleach water. New equipment can be bought pre-assembled or unassembled, depending on the supplier. Generally, unassembled equipment is less expensive but more time-consuming.

When buying used supplies, ask the seller about their hives' disease status and treatment history to avoid spreading disease to your bees.

Prices were calculated for a single hive apiary with minimal extraction equipment, minimal tools, and without medical treatments. Medical treatments would result in increased costs. Costs involved in packaging, branding, creating, and selling honey and other products are not included.

Some of these items are one-time purchases that would not have to be purchased again with additional hives. For example, you would not need to purchase more extraction equipment if you were to raise more hives unless you wished to improve your extracting capacity. However, some items must be bought as they are used up (e.g., smoker fuel and feed), outlive their usefulness (e.g., frames), or die (e.g., package of bees).

Other Considerations

Beekeeping is physically demanding, with boxes weighing over 50 pounds when full of honey! Make sure you can lift heavy boxes on your own or have someone you can reliably count on to help you.

Even with protective beekeeping attire, you are very likely to get stung at some point. If you are afraid of being stung, beekeeping may not be for you. Furthermore, keeping bees is not recommended if you or someone who will be interacting with the bees are allergic to bee stings.

Equipment	Price	
	Low Range	**High Range**
Bee boxes (~5 per hive)	$16/each	$28/each
Frames w/ foundation (9-10 per box)	$4/each	$6/each
Outer lid	$27	$60
Inner cover	$4	$30
Bottom board	$17	$50
Queen excluder	$5	$13
Smoker	$33	$45
Smoker fuel	$7	$9
Bee suit	$75	$200
Hive tool	$5	$8
Extraction equipment	$210	$225
Individual winter wrap	$27	$30
Total for One Hive	**$670**	**$1110**

Queen and Bees	Average 2020 Prices
Nucs	$450
Packages	$218

Feed	Price	
	Low Range	**High Range**
Sugar (10kg)	$10	$13
Pollen patties	$31	$33
Total for One Hive	**$41**	**$46**

Total cost of one hive = $929 to $1,606*

**Depending on your area, you may be required to pay a licensing fee and obtain liability insurance.*

When, Where, and How to Purchase

Bees can be purchased in one of three forms: a full colony, nucleus colony (nuc), or package. These can be purchased through local beekeeping clubs, beekeeping supply stores (e.g., Peavy Mart), online platforms, and local beekeepers. It is crucial to ensure that the source is trusted and knowledgeable about their colonies' disease status. Furthermore, anyone that owns bees in Alberta is required to register with the Government of Alberta and should be able to provide a registration certificate or premises identification (PID) number upon request (see Chapter 13: Legislation).

A full-sized colony will include 1-2 brood chambers with frames of brood, food stores, a queen, and worker bees. Full-sized colonies are usually purchased locally, and prices range depending on equipment's condition.

A nuc is a smaller version of a full-sized colony. Nucs include a small colony and a queen, shipped in a smaller hive with 3-5 frames (e.g., 2 frames of brood, 1 frame of food, and 1 empty frame). Nucs are usually purchased locally and range between $250-$500.

A package is a screened box (1.0-1.5 kg) that contains

8,000-12,000 bees with a single queen and sugar syrup for food. Packages are usually purchased from an international source and range between $200-$300.

Bees bought from international beekeepers must be imported from a CFIA-approved country and come with a CFIA-recognized health certificate from the country of origin. These measures are to reduce the risk of disease and pest transmission. New Zealand, Australia, and Chile are approved international sources.

Typically, beekeepers receive their new colonies as early as March for packages and May for nucs. This allows the colony enough time to build up the population and food stores needed to survive winter. Beekeepers should use caution when purchasing bees after June, as a stronger colony will be needed. Orders for packages and nucs need to be placed early in the winter to secure your spot. All the necessary equipment should be purchased in advance to avoid supply issues.

Diseases like American Foulbrood can survive on equipment for more than 40 years and infect healthy hives.

Evaluating a Colony or Nuc for Purchase

Both a full-sized colony and nuc should have a queen, worker bees, brood, and food stores. Sellers typically advertise that a nuc will have a certain amount of worker bees by weight or frames covered. Confirm the bee population before taking the nuc home. A full-sized colony may vary in population size and it is up to the buyer to determine whether it is worth the asking price.

The frames should be inspected to evaluate the amount of brood and the presence of a queen. All stages of brood (eggs, larvae, capped pupae) should be present (see Chapter 5: Seasonal Management for more information). The colony should be visually checked for pests and diseases (see Chapter 10: Colony Health). If available, a pre-sale inspection report should show that no pests and diseases were present.

The equipment and comb quality should be evaluated for full-sized colonies and nucs. Equipment and frames should be sturdy and reasonably clean. Avoid very dark comb. The darker the comb, the older it is, and the more likely it carries disease or contains chemical residues.

Questions to Ask a Seller

Are you registered in Alberta?
Anyone that owns bees in Alberta is required to register with the province and should be able to provide a registration certificate upon request.

Did your bees come from another province?
Bees entering Alberta are required to be inspected by the province of origin and have an interprovincial movement permit. The seller should be able to provide both an inspection report and permit. Queens are permitted to be imported from Ontario, but colonies and packages are not.

What diseases have you seen in your colonies?
If the seller has had American Foulbrood in the past, it is not recommended to purchase bees or equipment from them.

What medications or treatments have you used?
Antibiotic treatments, such as Tylosin or Oxytetracycline, can leave residues that may mask the symptoms of American Foulbrood.

Have you had an inspection?
You have the right to request a pre-sale inspection from the seller to ensure you buy a healthy colony. Inspections can be requested from the Government of Alberta Bee Health Assurance Team by the buyer or seller.

Connect with the Bee Health Assurance Team:
Phone: 780-644-8746
Email: bee@gov.ab.ca
Address: Bee Health Assurance Team
Crop Diversification Centre North
17507 Fort Road NW
Edmonton, Alberta T5Y 6H3

Providing fresh water, nutrition, and an appropriate environment is critical to providing good welfare to your colony. No matter how many colonies are under your care, all need these basic requirements.

Water

Bees utilize water in a variety of ways. It is used to maintain hive temperature and humidity.
Bees will fan at the entrance of the hive to disperse water throughout the brood nest to encourage evaporation and cooling. The bees also use water to process nectar and pollen, liquefy crystallized honey, feed brood, flush waste from the bee's body, and as a source of dietary minerals.

It is crucial to provide a clean, accessible water source if natural sources are unavailable. Water can be offered in various containers, but precautions must be taken to prevent drowning. Floating materials (e.g., twigs, straws, corks, wood, straw, or plastic) or perches (e.g., rocks) can be placed in water sources to give the bees something to land on and drink to avoid drowning. If such objects are not put in an open water source, then it should be covered.

Water Container Options
- Trough
- Birdbath
- Kiddie pool
- Bucket
- Rain barrel
- Poultry water dispenser

Water should be offered early to train the bees to use that water source and prevent them from visiting neighbouring areas (e.g., pools). The water source should be placed outside the bees' flight paths to avoid contaminating the water with bee feces that could spread disease. Water should be emptied and refilled often to prevent mosquitos from breeding in the water.

Keep water sources out of bees' flight path and replace water often to avoid fecal contamination, which can spread disease.

Propolis

Propolis is a usually dark brown substance naturally created by honey bees from resins and gums collected from plants and trees while foraging. Worker bees use the resin to seal cracks and openings to protect the hive from the elements, pests, and predators. Honey bees will also cover other surfaces in the hive, such as the frames and hive walls, with propolis to utilize its antimicrobial properties and protect the colony from microorganisms like bacteria and mould. In cases where an invader, such as a mouse, dies in the colony, the worker bees will encase its carcass in propolis to isolate the decay. For humans, propolis can be used for medical purposes, such as wound treatment, and can be collected on warm days when pliable.

Nutrition

Like all insects, honey bees require carbohydrates, proteins, fats, vitamins, sterols, and minerals to support their growth and development. The nectar and pollen collected by the bees provide these components. The hive requires an adequate collection of pollen and honey for the queen to continue laying a sufficient number of eggs and maintaining the worker bee population to raise brood.

Nectar is a sugary fluid produced by plants to attract pollinators. It is composed of water, carbohydrates, and minute amounts of vitamins and minerals. Bees forage this nectar and convert it into honey in the hive. Bees can collect carbohydrates from other sources, like rotting fruit, but nectar is the primary source.

Pollen is the bees' main source of protein, fats, vitamins, fatty acids, minerals, and sterols. Not all pollen sources are the same, and different plants produce pollen with differing protein and amino acid content. Unfortunately, bees are not able to assess the protein content of the pollen. Therefore, a variety of pollens are needed to collect an adequate amount of protein for the colony. Without enough protein, the colony cannot rear brood, grow in size, and is more vulnerable to disease.

Beekeepers must monitor their colonies for signs of starvation and provide supplementary feed if needed. Signs of colony starvation include:

- Cannibalism of brood
- Slow or no brood production
- Decreased population

Beekeepers must be aware of foraging options for their bees when monitoring for starvation. Typically, in the early spring (April - May) and early fall (late August - September), there are limited natural resources (flowers) available for honey bees. Overwintered colonies are particularly vulnerable to starvation in the spring as they have depleted their food stores following winter. In the late summer and early fall, honey bees may opt to rob from other colonies, with stronger colonies stealing from weaker colonies. When flowering plants are limited, beekeepers should assess their options to support their colonies.

Pollen Supplements and Substitutes

When floral sources are limited in the early spring, beekeepers may choose to supplementally feed their colony until natural sources are adequate. A lack of pollen during brood production (spring to fall) will cause reduced brood rearing and, consequently, a decline in colony population and reduced honey yields.

Pollen supplements should be provided when there are low pollen stores within the hive to prevent starvation. Additionally, supplementing the colony can stimulate brood production and increase the spring colony population. If you want a large honey crop, it is recommended to start supplementation about 6 weeks before natural sources are expected. This is to ensure that a colony is large at the beginning of the honey flow.

Once pollen supplements have been given to a colony, a steady supply must be maintained until forageable pollen is available. When pollen becomes available, the bees may ignore the pollen substitutes. However, the bees may choose the substitute over foraging pollen, reducing the amount of pollen collected. Therefore, feeding pollen supplements should be discontinued when many bees carrying pollen are observed.

Beekeepers can either buy supplemental feed or collect pollen for later use. The pollen should have a minimum protein content of 20% and contain ten spe-

cific essential amino acids. Be aware that pollen can be contaminated with pesticide residues and disease. It is recommended to only use irradiated or disease-free pollen.

Use irradiated or disease-free pollen to avoid contaminating your colony when supplementing feed.

Pollen supplements differ from substitutes as they contain pollen while substitutes do not. Supplements can be made by mixing 5-10% pollen into sugar syrup. The resulting mix can create a paste or patty that can be rolled flat between wax paper to avoid drying out. The beekeeper can also purchase pre-made patties from suppliers. The beekeeper is responsible for ensuring that the patty was created using irradiated or disease-free pollen.

PROTEIN SUBSTITUTES:

Brewer's yeast
Egg powder
Soybean flour
Skim milk powder
Torula yeast

Before offering the protein patty in the hive, a few slits should be made into the wax paper to help the bees access the patty. The patty is placed above the frames or to the side of the brood area for easier access.

Offering dry powdered supplements for the bees to collect may appear like a simple way to feed your bees, but it will most likely be thrown out of the hive. Additionally, dry supplements can attract other pollinators and spread disease and pests to your colonies.

Dry powdered supplements can attract other pollinators in the area and spread disease and pests.

Sugar Syrup

When honey bee populations begin to decline in the fall, beekeepers can provide sugar syrup to supply the bees with enough honey stores to survive the winter. Beekeepers may also supplement their colonies with sugar syrup in the spring (April to May) to support them until natural foraging sources are available.

Ideally, sugar syrup is made from sucrose which is found in white granulated sugar. If not available, white high-fructose corn syrup can be used, but it is not ideal for bees. Any other kinds of sugar cannot be digested or are toxic to bees, including brown sugar, raw sugar, or molasses. Dry sugar is not viable as a supplemental feed as the bees ignore it or throw it out of the hive.

Extracted honey can also be used to make sugar syrup. However, honey can contain American Foulbrood spores which will spread the disease, or hydroxymethylfurfural (HMF). High levels of HMF are toxic to honey bees and can be found in old or heat-treated honey. Do not feed your colony honey from unknown sources.

When giving sugar syrup in the spring, it is recommended to provide a 1:1 (sugar: water by weight) concentration. In the fall, a 2:1 ratio (by weight) is encouraged, as it is easier for the bees to convert into honey. If using high-fructose corn syrup, it must be kept at a higher temperature to avoid crystallization. The easiest way to mix sugar syrup is with warm water; hot water can caramelize the sugar and must be allowed to cool before feeding. 1 kg of sugar weighs the same as 1 L of water. For example, to make 2:1 sugar syrup, combine 2 kg of sugar with 1 L of water. Ensure that all the sugar is dissolved before feeding.

In the spring, sugar syrup should not be given when honey supers are on the colony to prevent honey adulteration. If there is a nectar flow, the bees may store the sugar syrup instead of consuming it, and the resulting honey will not be pure.

It is not recommended to store sugar syrup for use later in the season. Stored syrup will degrade or ferment and be unsuitable for feed. Never give previously-stored sugar syrup in the fall as the winter bees are very sensitive and can die from bad feed.

In the fall, 2:1 sugar syrup should be offered as soon as the supers are removed. Feeding should be completed before the temperature falls below 10°C. Each colony should be fed sugar syrup until the hive is heavy (see Chapter 5: Seasonal Management) to prepare for winter in Canada. It is not recommended to remove all the honey from the hive in the fall. Bees use a lot of energy to process the syrup before storing it, and they may not have enough time to process it. In Alberta, winter supplementation can start as early as September and end in early to mid-October.

Feeders

There are various options available to beekeepers to feed sugar syrup to their bees. All types of feeders should be cleaned after feeding is complete to remove old feed and prevent bacteria and mould growth. Each option for beekeepers is reviewed below.

Hive-top Feeders

Hive-top feeders are placed above the brood chamber and have a hole or channel that allows the bees to access the sugar syrup from below. Screens or wooden floats may be used to prevent bees from drowning. These feeders do not require the bees to leave the hive to access the syrup and do not encourage robbing. They hold large amounts of syrup and can easily be changed and refilled without disturbing the hive. Hive-top feeders are ideal for spring or fall feeding.

Inverted Pails

Feeder pails have lids with a mesh-covered hole and rubber ring seal to prevent leakage. Once filled with sugar syrup, the pail is inverted over a hole in the inner cover. A partial vacuum will form, preventing the syrup from pouring into the hive. The inverted pail may leak when it is heated by the sun. This can be prevented by placing a bee box and lid over the pail. This feeder holds large amounts of syrup, does not encourage robbing, and does not require bees to leave the hive to feed. Inverted pails can be used for spring or fall feeding.

Division Boards or Frame Feeders

Division boards or frame feeders are made of wood or plastic and placed inside the top brood chamber, replacing one of the outer frames. Screens or wooden floats are placed inside to improve access and prevent drowning. These feeders hold smaller amounts, making them better for spring feedings. Also, the bees do not need to leave the hive to access the feed and robbing behaviour is not encouraged. Beekeepers must open the hive to refill the feeder, which is not ideal during cold weather.

Resealable Plastic Bags

Resealable plastic bags are a cheaper option for beekeepers to feed their bees. A plastic bag is filled halfway with sugar syrup, the excess air is removed, and the bag is sealed. A small nail, like a pushpin, is then used to puncture 6 to 8 holes into the bag's surface. Then, the bag is placed either on the top of the frames or in place of a wall frame with the bag's holes pointing upwards. The bees will suck the syrup from the holes. As the bag's syrup level reduces, the bag may collapse on itself and make it difficult for the bees to access. This method does require frequent maintenance to maintain the bag, which may not be a viable option for large beekeepers.

Entrance Feeders

Entrance feeders, also called Boardman feeders, sit at the hive entrance and allow bees to access the syrup without leaving the hive. It is not a recommended method to feed bees. They only hold a small amount of syrup, can leak from direct sunlight, and can encourage robbing between hives. Also, the bees will not go to the entrance to feed during cold weather.

Open Feeding

Placing syrup or powdered supplements out in the open for bees to access (e.g., open barrel) may sound like an attractive method to feed one or many hives. However, it is not recommended as it can attract other pollinators and pests (e.g., yellow jackets) and encourages robbing and the spread of disease. Also, the syrup will not be equally shared amongst the colonies, as strong colonies will be able to collect more than weak colonies. This will cause weak colonies to become weaker while strong colonies get stronger.

Feeding methods that encourage robbing can also promote disease transmission to the colony.

The Hive

The physical home of honey bees is called the hive, while the bees themselves are called the colony.

The Langstroth hive is the most common hive used and will be the focus of this chapter. There are many hive options available to beekeepers, such as flow hives and top bar hives.

These options each have advantages and disadvantages that beekeepers must consider before adopting a different type of hive. For instance, top bar hives were designed for tropical areas and may not be appropriate for Canadian weather. Flow hives are an attractive option to some, as it is advertised as an easier option when extracting honey. However, honey can crystalize in the hive, blocking the flow and interfering with extraction. Also, flow hives do not allow beekeepers to monitor the bees closely and may increase the risk of swarming.

Hive Parts and Purposes

A Langstroth hive has a bottom board and lid with bee boxes in between. The bottom board raises the hive off the ground and helps improve ventilation within the hive. Beekeepers may nail the bottom board to the bottom box to make moving the hive easier if needed.

An inner cover with a small rim entrance is usually placed on the top box to improve circulation, provide a secondary entrance, and prevent the bees from 'gluing' the hive lid to the box. The hive lid goes over the top of the inner cover and protects the hive from the weather. A good-fitting cover protects the hive from robbing bees, other insects, and pests, such as mice.

Each bee box has 9 to 10 frames that the bees can utilize. Frames start as a wax sheet or plastic sheet with a thin layer of wax, referred to as a foundation, that acts as a template for the bees to build wax comb on. These are called 'foundation frames'. Frames with wax comb are called 'drawn comb.'

The bottom one or two bee boxes are called 'brood chambers.' This is where the juveniles are raised and honey and pollen are stored. The brood chambers can not start with only foundation frames, as honey (stored in the comb) is needed to produce wax. However, sugar syrup can be supplemented if honey is not available. Ideally, the brood chamber will contain only drawn or mostly drawn comb with a few foundation frames. It is recommended to replace 2 to 4 frames from the brood chamber annually, especially older frames with thick, dark comb and those with more than 10% drone cells. Replacing frames is essential to reduce the risk of pesticides and disease from building up in the wax and contaminating honey or causing disease in the colony.

Frames should be replaced routinely to prevent infections from spore buildup in wax over time.

Hives are built up by adding bee boxes or 'supers' as the honey bee population grows, and the bees need more room. The supers are where the honey crop is stored and extracted by the beekeeper. A queen excluder is a barrier placed between the top brood chamber and the honey supers. The excluder keeps the queen and drones in the brood chambers to keep brood from being raised in the honey supers. Therefore, honey extraction will not interfere with brood production.

Beekeepers should disinfect equipment that comes in contact with live colonies to avoid spreading disease.

Hive Moisture Level

Air circulation within the hive is vital to keeping moisture levels down. The hive's moisture level must stay low enough to discourage fungal growth but high enough to prevent larvae from drying out. To support good air circulation, the area around the hive should be kept clear of anything that may block airflow (e.g., tall grass).

Apiary Setup and Hive Placement

Many features should be considered when deciding where to set up your apiary. The area must be dry to keep the hive's bottom board dry and off the ground. Avoid sites that may be prone to flooding, such as low-lying areas or areas that are exposed to cold and damp air. Hives can be placed on pallets, cinder blocks, or other structures that keep them off the ground to prevent moisture damage to the bottom board. Apiaries should be secluded from the public, livestock, and strong winds to prevent stressing the colonies.

To protect your apiary from strong winds, a beekeeper can use natural barriers (e.g., shrubs or tree lines) or build physical windbreaks (e.g., fencing). If windbreaks aren't available, the hives can be weighted down with rocks or bricks. Fencing and locked gates are also a great way to keep unwanted visitors (e.g., wildlife, livestock, and people) away from the hives. Electric fencing may be considered if bears are a concern in your area.

Keep the area free of vegetation that could affect air circulation and moisture levels within the hive. Avoid mowing methods that cause grass clippings to be sprayed into and block hive entrances. Make sure there is plenty of space to work around the hives without disturbing neighbouring colonies. Spacing your hives apart will also discourage bees from drifting between colonies.

There are a few options to prevent bees from drifting between colonies, which can spread disease and pests between hives. Bees can be encouraged to return to their own hives by pointing the hive entrances in different directions. Painting the hives different colours can help the bees identify and enter their own hive. It is recommended to paint the hives with light colours to reflect heat and prevent overheating. Placing landmarks in the apiary can also help your bees find the apiary.

Consider the size of the area and ask yourself if you have room to expand. This may be an important consideration depending on your future plans. Each hive requires at least 120cm (4ft) of a cleared, levelled area on each side. The apiary should not house more hives than what the resources in the area can support.

The apiary should be in a location that is accessible throughout the year, including during winter in the snow. Honey production may be improved by facing your hive entrances south or east. Early sun exposure encourages the bees to fly early in the day and forage more nectar and pollen.

Bees can forage up to 5km away from the hive in every direction. A grand total of 12,000 acres! Talk to a local beekeeper about the resources available in your area and their opinion on how many hives can be maintained.

Honey bees can forage up to 5km away from the hive in each direction. Beekeepers cannot control what pests and diseases their bees are exposed to in that area and must be vigilant for signs of disease and pests.

The area must have access to abundant forage and clean water, either naturally or provided by the beekeeper. It is essential that the forage is diverse and not contaminated. Areas with only one plant type available may not provide the bees with all the nutrients they need. Leaving areas for other forgeable plants or wildflowers is an option to guard against your colony's nutritional deficiencies.

Speak to neighbouring landowners about the importance of floral diversity and encourage them to plant honey bee-friendly plants. Look into local publications to learn what plants are native to your area that honey bees and other pollinators can use. Pollinator Partnership Canada has a great guide for planting forage for honey bees.

Urban vs. Commercial

It can be challenging to locate an ideal apiary location in an urban area. Urban areas may be abundant in flowering plants, but other apiaries in the area may compete for resources. Therefore, it is vital to monitor your colonies for signs of starvation and encourage people in the area to plant pollinator-friendly flowers.

Urban apiaries should be placed in low vehicular and pedestrian traffic locations, unless a barrier is in place to alter the bees' flight path. The barrier should be at least 1.8m (6ft) tall and span at least 3m (10ft) on both sides of the apiary to separate the apiary from the trafficked area. Another option is to elevate the apiary more than 3m (10ft) above the traffic. Ensure that the barrier does not block first responders from accessing the area in the event of an emergency.

Interactions between the apiary and the public are less likely in rural areas. However, it is still important to assess the risk, especially when apiaries are placed on public land. Beekeepers with apiaries in rural areas must evaluate the resources available to the bees, including how they are managed to determine the risk of pesticide exposure.

A beekeeper should not assume that an area does not already have honey bee colonies. In urban areas, fences can hide backyard colonies in the neighbourhood. In rural areas, apiaries are often tucked behind treed areas, out of sight of passersby. To ensure there are adequate resources in the area, beekeepers should ask property owners if there are other apiaries in the area before placing a new apiary.

Pesticide Exposure and Prevention

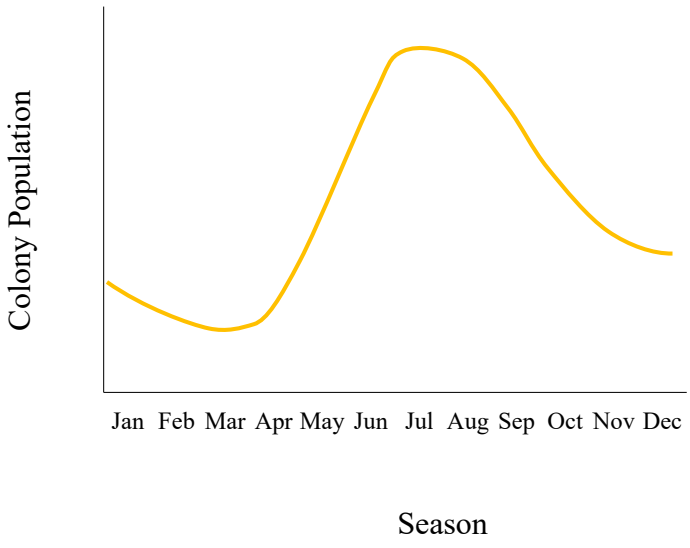
Pesticides are commonly used in environments that are often frequented by honey bees. Pesticides are not harmful to honey bees or other pollinators when used properly. However, the improper use of pesticides can cause poisoning to individual bees and the colony.

The apiary should be in an area that minimizes pesticide exposure by placing it away from fields and a buffer zone between the fields and the apiary. Some beekeepers may choose to move their colonies before pesticide applications to avoid exposure. If water sources are suspected of being contaminated, the beekeeper can offer supplemental water to reduce the risk of bees bringing contaminated water into the hive. When performing pollination services, beekeepers are encouraged to remove colonies as soon as pollination is completed. This is to avoid a post-bloom pesticide application.

For information on pesticide poisoning and prevention, see Chapter 10: Colony Health.

Introduction

Honey bee colonies have seasonal changes in population demographics and activities. Following winter, the colony increases its population rapidly through brood rearing. The colony reaches its maximum population before or during the summer nectar flow when most of the colony's honey is made. The population dwindles during the fall and prepares for winter. Over the winter, the colony clusters together for warmth and survives on food stores within the colony.



The beekeeper's role is to support and care for the colony through these seasons. As the colony's needs change, so does the required management. This chapter covers the management needed for each season and provides information on how to set up your new colony. A detailed breakdown of beekeeping activities by month can be found in Appendix A. Note that the months given for each season are only guidelines as the change of seasons may come sooner or later.

Spring Management (March to June)

In Alberta, spring management begins in March or early April. A good rule of thumb is spring management practices can start on the first calm, sunny day over 10°C. At this temperature, it is safe to lift the hive's lid and check on the health of the colony for a few minutes without the fear of chilling the brood. Spring management practices aim to increase colony size, ultimately contributing to increased honey production.

Feed Assessment

In early spring, the colony usually starts with a low population of surviving winter bees. The colony uses pollen and honey stores leftover from the winter to expand its brood population. As the amount of brood increases, the demand for food also increases. During this time, the risk of colony starvation is high.

It is vital to check on the food stores as soon as possible to determine if the colony is at risk of starvation. However, checking too soon can put the colony at risk as well. Opening the hive too soon during cold weather can break up the colony's cluster and put the bees under stress. The colony needs to remain clustered to keep its temperature around 35°C so the bees can begin to rear brood.

If you need to get a quick idea of how the colony is doing, you can briefly lift the lid and take a peek. You can look down between the frames and see if there is any capped honey. The colony should have at least 4 to 6 frames of capped honey in contact with the cluster.

On a sunny, mild day with no wind, frames can be lifted out to check the amount of honey remaining. Colonies with less than two honey-filled combs are at a higher risk of starvation. Experienced beekeepers will weigh their hives to determine how much food is left.

Beekeepers may use electronic hanging or platform scales to weigh their hives. Experienced beekeepers can heft the back of the hive off the stand and feel if it is too light. This takes time to learn, and electronic scales can help you get a feel for what is too light. Some beekeepers invest in electronic hive monitoring systems that give real-time information on the hive. These are expensive, but the time needed to monitor the hive is reduced while accuracy can be better than other methods.

Another indicator of food availability is the amount of food within the cells of young larva. A lot of white liquid at the back of the cell with the larvae indicates the colony has sufficient food. If the cell is dry, the colony is at high risk of starvation, and the larvae are receiving sub-optimal care, which will affect their size, longevity, and immune defence against pathogens.

Top: dry brood cells Bottom: well-fed brood cells

If starvation is a risk, feeding a 1:1 sugar syrup solution is recommended. See Table 5.1 for a summary of seasonal feed supplementation. The bees will collect the syrup and store it in the comb. This will supplement the colony's food requirements and stimulate brood rearing. See Chapter 4: Basic Colony Requirements and Components for instructions on feeding sugar syrup.

Supplement Type	Early Spring (Feb - Apr)	Spring Build-up (Apr - Jun)	Major Nectar Flow (Jul - Aug)	Honey Harvest (Aug)	Fall (Sep - Oct)	Late Fall (Oct)
Sugar Syrup	Feed 1:1 to light colonies to prevent starvation and/or stimulate brood rearing	Feed 1:1 to splits	Feed 1:1 if poor nectar flow in the location	Feed 1:1 if splitting late	Feed 2:1 syrup (as much as possible) Can also give honey-filled frames to light colonies	Can give honey-filled frames
Pollen Supplement	Feed pollen patty to stimulate brood rearing	Continue patty feeding to colonies used for pollination to encourage build-up or in case of low pollen sources in the location	Feed if low pollen sources in the location	Use patty feeding for splits	Not necessary to feed unless low pollen stores	Not necessary to feed
Water	Provide a clean water source if there is a lack of natural sources					

Table 5.1. Seasonal Nutrition Supplementation

The amount of sugar syrup to give can be determined by assessing the colony's size and the amount of brood present. Small, weak colonies can receive an initial feeding of 1L of sugar syrup. Strong colonies with a lot of brood present can receive up to 3L. Colonies should not be given more food than it can collect and store in a few days. Excess food can attract other pollinators, pests, or predators, causing more stress to the hive. Supplement feeding can stop once the bees can start collecting their own nectar.

Do not feed more sugar syrup than the colony can collect and store in a few days. Excess sugar syrup may attract other pollinators, pests, or predators. Be especially careful not to spill any syrup outside the feeders. These hazards can increase the risk of disease transmission to your colony.

If a colony is at a high risk of starvation (i.e., no or minimal honey remaining), frames of honey can be taken from a donor colony with excess honey stores and given to the colony with depleted stores. However, ensure that the donor colony is free of disease and pests.

If you move combs of honey from one colony to another, ensure that the donor colony is free of disease and pests.

Extracted honey should never be used to feed bees. Honey from retail stores or other beekeepers may contain American foulbrood spores or hydroxymethylfurfural (HMF). The compound HMF is naturally found in honey but becomes more concentrated as the honey ages or is exposed to heat treatments. High levels of HMF are toxic to honey bees. Additionally, using honey as feed is more expensive than using sugar syrup.

Robbing behaviour by bees may occur in the spring if there are limited nectar sources. If robbing behaviour is observed, the beekeeper may wait to work with their colony until after nectar is available. For more information on robbing, see the 'Fall Management' section of this Chapter.

Queen Performance Assessment

As soon as possible, queen performance should be assessed. You do not need to seek out the queen to do this. Queen performance is best evaluated by looking at the pattern of eggs, larvae, and capped brood. Typically, a queen will start laying in the middle of the comb, radiating outwards. Therefore, the oldest brood is in the middle, surrounded by subsequently younger larvae. After the cells are cleaned following emergence, the queen will lay eggs in these cells again.

The brood should have a solid pattern with few empty cells. An irregular pattern will cause the brood to have a spotty appearance, which can indicate a poor-quality queen or brood disease. No eggs indicate that the colony may be queenless.

If there is concern about the queen's performance, the hive should be marked and rechecked during your next inspection. Any feed concerns should be addressed before the next inspection to give the colony the resources it needs to rear brood. If the queen is still doing poorly, it is time to introduce a new queen.

Requeening is easiest in the spring. This is because the colony population is lower, making it easier to find the queen, and spring-reared queens are usually of the highest quality. Furthermore, the colony is more likely to accept the new queen during the spring build-up and develop a larger population than a colony that is not requeened.

See Chapter 7: The Queen for more information about queen health and replacement.

Handling Deadouts

In the event that the colony has died over the winter, the hive should be sealed as soon as possible to prevent robbing. Then, when convenient, the hive should be removed from the apiary and stored in a bee-proof area.

Inspect dead colonies to determine why they died as some causes of death are preventable. First, examine the bee cluster size. If there are only a couple frames of bees, the colony may have been too small to keep itself warm and died from the cold. To improve your management, consider the reasons the colony was small. Causes could include high Varroa mite populations, animal pests, or a poorly-laying queen. If a colony is weak in the fall, it will likely die over winter and could be combined with a larger colony before winter. However, before combining colonies ensure the weak colony is disease free.

Next, examine the honey stores in the colony. If there are no honey frames in the hive, the colony likely died from starvation. Another sign of starvation is many dead bees with their abdomens sticking out of the cells. If there are honey stores only in the top chamber of the hive, there may have been excess moisture that froze and prevented the cluster from accessing the top honey frames (see 'Winter Management' below for how to prevent moisture issues). If this is the case, there may be water on the bottom board or mould on the frames.

Finally, examine the brood frames and bottom board for brood diseases and pests. If varroa mites caused the colony's death, many varroa mites might be found on the bottom board.

All frames from deadouts should be inspected and cleaned before being utilized again in the field. Remove any wax build-up on frames and equipment and dispose of old and broken frames. Any brood frames with signs of brood disease should be destroyed. Mouldy frames should also be disposed of.

Biosecurity tip – Any time a colony dies, the hive must be sealed immediately and preferably removed from the apiary to prevent the potential spread of disease.

Dividing Colonies (Splits)

Beekeepers often choose to split a colony to increase their colony numbers or replace winter losses. The best time to divide or split colonies is often during the spring build-up. Be certain that both the new split and the original colony have sufficient feed reserves.

Dividing colonies in the spring may prevent swarming. Beekeepers may take advantage of swarm queen cells to quickly obtain a queenright split. Here is a step-by-step guide to making a split:

1. Before considering splitting, decide how a new queen will be added to the split. This can be done by either rearing your own or purchasing a queen in advance.
2. Locate the queen in the existing colony so she does not accidentally get transferred to the split. You may want to mark or cage the queen or place the frame she is on into a small empty nuc box while making the split to keep track of her.
3. Remove at least two brood frames and one frame of honey and pollen from a strong, disease-free colony. These frames should be well covered in adult bees from the hive. At least one of the brood frames should be mostly capped.
4. Place these frames in a new hive box. Frames can be put into a nuc box or standard-sized hive.
5. Shake workers bees from two additional frames in the new box.
6. Fill the hive box with additional empty drawn frames.
7. Place a caged queen or queen cell into the new box. See Chapter 7: The Queen for detailed information on introducing a new queen.
8. To prevent the bees from drifting back to their original hive, a screened entrance can be used, or the split can be moved to a new location at least 1 km from the original location.
9. Support the new split with sugar syrup and a pollen patty.
10. Decrease the size of the new split's entrance to allow the colony to defend itself more easily.

Package or Nuc Installation

Package bees are imported in April and usually contain 0.9 – 1.8 kg (approx. 2 – 4 pounds) of bees and a queen. Two-pound packages are most common and produce as much honey as larger packages. Larger packages are sometimes preferred because the population will be larger and need less care.

Package bees are less likely to transport diseases as there is no comb to transfer diseases.

Packages are shipped in screened boxes or cardboard tubes with screened caps. Transportation is a stressful event for the bees, and to minimize additional stress, the bees should be handled as gently as possible. Packages should be immediately introduced into a new or disease-free hive.

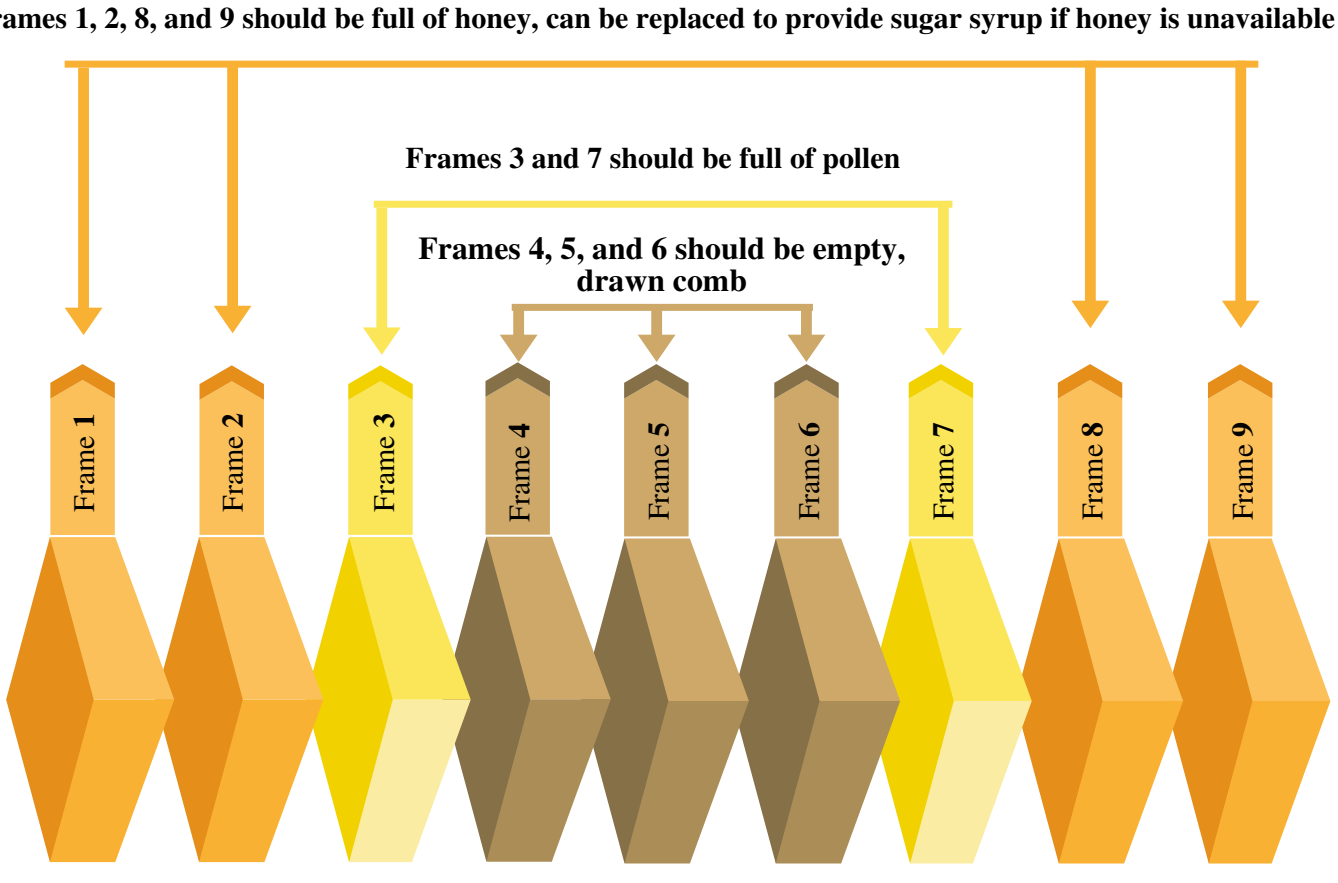
If it is not possible to transfer the bees upon receipt, the package should be stored in a dark area between 15 to 18°C with good ventilation. Tubes should be stored upright with the mesh strip at the top. Water can be lightly sprayed or sprinkled on the screens to keep the bees hydrated. Storage should not exceed more than a day or two.

A nucleus colony (nuc) usually comes ready-to-go in a smaller brood box with an entrance and a lid. The nuc can be immediately placed in the apiary with a reduced entrance. The frames in the nuc box can be moved into a full-sized brood box when most of the nuc frames are covered in bees. Nucs may have up to five frames, so add additional disease-free combs to fill the full-size hive chamber.

Installing Packages

Hiving is best done in the late afternoon or early evening. This discourages the bees from flying away and allows them to have the night to settle into the hive.

Single-storey empty hives (new or disease-free) should be prepared and placed in the apiary before the packages arrive. The brood box should contain nine frames of good-quality comb. To support the establishing colony, frames 1, 2, 8, and 9 should be full of honey and frames 3 and 7 should be full of pollen. If honey is unavailable, a frame feeder can be installed to replace frames 1, 2, 8, or 9 to provide sugar syrup. If pollen is unavailable, protein should be provided (see Chapter 4: Basic Colony Requirements and Components). Frames 4, 5, and 6 should be empty, drawn comb and available for the queen to lay her eggs in.



How to install the package:

1. Remove the lid of the hive.
2. Remove frames 4, 5, and 6 and lean them against the brood box.
3. Sharply knock the package on the brood box. The bees should drop to the bottom of the package.
4. For boxes: Carefully and quickly remove the feeder can and queen cage from the package. For tubes: Remove the cap on the end with the mesh strip. Pull out the strip to remove the queen cage.
5. Place the queen cage in your pocket while using a few raps and shakes to roll the bees out of the package and into the hive.
6. Inspect the queen for any damage (e.g., missing wing, broken legs)
7. If the queen appears healthy and undamaged, she can be released directly into the cluster by lowering the caged queen into the gap created when frames 4, 5, and 6 were removed. In this position, open the queen cage so the opening faces down into the cluster so the queen will escape and join the workers.
8. As soon as the bees start to climb up the frames from the bottom board, frames 4, 5, and 6 can be replaced. Replace the lid.
9. Place the box or tube next to the hive so any remaining bees can find their way into the hive box.

Post-Hiving Inspections

The first visit should not occur until five to seven days after hiving. The centre frames are inspected for the presence and pattern of laid eggs. If eggs are present, there should be one egg per cell arranged in a uniform pattern. At this point, further inspection is not recommended. Bees are easily agitated at this stage and may attack their queen if the colony is manipulated more than this quick inspection. If no eggs are seen, but the queen is present and appears healthy, the hive should be marked for re-inspection in 3 days. If there are still no eggs at the re-inspection, the colony should be requeened.

The second visit takes place 10-14 days after the first (3 weeks post-hiving). The brood is assessed again on one or two frames. If there are signs that the colony is queenless, a new queen must be introduced. Again, the beekeeper must also look for signs of disease or pests (see Chapter 10: Colony Health). Supplemental food (sugar syrup feeders and pollen patties) should also be inspected and refilled as needed.

The third visit should occur 4-6 weeks post-hiving. Again, the queen-laying and food supply is checked. This time, brood pattern and hive space are also evaluated. Add a second brood box if the colony has expanded to cover at least six frames with bees.

Inspection details are described in Table 5.2. Keep detailed notes from each inspection for your records.

Visit #	Time Post-Hiving	To Do	Signs	Solution
1	5-7 days	**Queen Check**	Eggs present (Do not look for queen)	**Queenright:** Close hive
			No eggs Roaring sound Agitated bees	**Queenless:** Requeen or recheck in 3 days
2	3 weeks	**Queen Check**	Brood in all stages	**Queenright:** Do not look for the queen Close hive
			No eggs Roaring sound Agitated bees	**Queenless:** Requeen or unite
			Convex cappings	**Drone layer:** Requeen or unite
			Queen cell(s) on the face of the comb	**Supersedure:** Destroy queen cell(s) Requeen or unite
			Eggs on cell wall No queen	**Laying workers:** Kill colony or dump bees
			Several eggs in the bottom of the cells	**Multiple laying queen:** Do not look for the queen Close hive
		Food Check	Empty cells Starving bees Bees shaking	**Lack of honey:** Feed sugar syrup or add frames of honey
			Eggs and emerging adults present No larvae present	**Lack of pollen:** Feed pollen supplement or substitute
3	4-6 weeks	**Queen Check**	Refer to visits 1 and 2	
		Food Check	Refer to visit 1	
		Brood Pattern Check	Uniform brood with few empty cells	**Good pattern:** Close hive
			Spotty appearance Different sized brood Many empty cells	**Poor pattern:** Requeen or unite
		Space Check	6-8 frames of brood and bees present	**Space needed:** Add 2nd brood chamber
			Less than 6 frames of brood and bees present	**Space adequate:** Check space again in 1 week
4 and up	Every 10-14 days after visit #3	**Food Check**	Refer to visit 1	
		Swarm Check	Queen honeybound No space for eggs Brood boxes full of bees	**Pre-swarming crowding:** Add a honey super Provide ventilation
			Queen cells on sides and bottom of frames	**Swarming starting:** Destroy queen cells Add a honey super Provide ventilation
		Supering	Add 1st honey super before the honey flow Add honey supers as needed	

Table 5.2. Post-Hiving Inspection Schedule

Derived from: Gruszka, J., Currie, R., Dixon, D., Tuckey, K., and van Westendorp, P. 1998. Beekeeping in Western Canada. Alberta Agriculture and Rural Development, Edmonton, Alberta.

Throughout May and June, the colony should be inspected every 10-14 days. During these checks, ask yourself the following questions:

1. How does the brood pattern look? Solid or spotty?
2. Is there brood in all stages?
3. Are there any swarm cells present?
4. Are there any signs of disease or pests?
5. Is there an unusual amount of dead bees on the bottom board or hive entrance?
6. Is there enough stored honey and pollen to support the colony?
7. Is more space needed for bees, brood, or food storage?
8. How are the bees acting? Are they restless and defensive, or are they quiet?

If robbing behaviour is seen at any time during inspections, the beekeeper should complete the inspection, close the hive, and leave the apiary. Continuing to open hives will worsen the robbing.

Summer Management (July to August)

Summer Apiary Location

Ideally, spring apiary locations are appropriate for summer use. If the location is unsuitable for summer use, the beekeeper should select a summer site before the nectar flow begins. Colonies are more easily moved when still low in population and within a single brood chamber. Additional boxes make the hive heavy and more difficult to relocate. For more information, see ‘Apiary Setup and Hive Placement’ in Chapter 4: Basic Colony Requirements and Components.

Inspections

Summer beekeeping management in the prairies spans from mid-June to mid-August. During this time, colonies should be inspected every two weeks until the nectar flow is in progress and supers become heavy. Inspections must focus on the brood and queen, food sources, space, and disease. Write notes to help you remember what you saw for the next inspection.

Brood and Queen

The beekeeper can confirm that the queen is present and active by inspecting frames for the presence of eggs, uncapped larvae, and capped pupae on several frames. A decrease in brood beginning in August is normal.

The brood pattern must also be assessed, and it should appear solid. If there is a mixture of capped and uncapped brood in the same area, the queen may be performing poorly.

If there is only drone brood, the queen is referred to as a drone-layer queen. This queen is no longer laying fertilized eggs, usually due to age, insufficient mating, injury, or illness. In this instance, the queen must be killed and replaced, or the colony can be united with a stronger hive.

If there are multiple eggs on the sides of cells, this is a sign of laying workers. This occurs when the colony goes without a queen for some time and some of the worker bees, which are unmated and under-developed females, lay eggs. Because worker eggs are not fertilized, only drones are made. A queenless colony with laying workers may have drone brood, but not worker brood. Colonies in this state are usually quite weak, and it is recommended to shake the bees onto the ground several metres away from their hive. The workers will then seek another hive.

If the queen is performing poorly, the beekeeper has some options available:

1. Replace the current queen with a newly mated queen.
2. Kill the queen and allow the colony to produce queen cells. This method should be used no later than the end of July. The downside to this option is that the colony will most likely not produce a honey crop but should produce enough for overwintering. A potential risk is that the colony may not rear or accept the replacement queen and become queenless. This method should not be used for weak colonies as they do not have the resources to produce a good quality queen.
3. Kill the queen and unite the colony with another. See 'Fall Management' on the next page for details.

Queenless, weak colonies and those headed by laying workers are susceptible to attack by other colonies and robbing, which may spread pests and diseases.

Food Sources

If there is a delay in the nectar flow (e.g., drought or prolonged rainy spell), there is a risk of the colony starving. In Alberta, there is often a nectar dearth after the spring flowers (trees, dandelions) and before the main nectar flow (clovers, canola). This dearth typically occurs in mid to late June. Therefore, beekeepers must closely monitor food stores during this time.

Space

As the colony's population increases, the bees need more space. Additional comb space will also be needed when the nectar flow begins. A second brood box or honey supers should be added to help prevent swarming. When in doubt, add more space. It is better to add too early than to risk swarming. Usually, one or more honey supers are added before the main nectar flow, and more are added as needed.

A sign that a super should be added is the appearance of white ridges of wax (burr comb) in the top of the uppermost brood chamber. However, the nectar flow in the prairies is often brief and intense, where honey production may happen faster than wax build-up. Therefore, the wax build-up is not always a reliable sign.

As the nectar flow comes to an end, it is important not to over-super the colony. Remove and extract honey promptly when most cells are capped. See Chapter 9: Honey for details on honey extraction.

Disease

Beekeepers are encouraged to familiarize themselves with brood disease signs so they can quickly identify disease when they perform inspections. See Chapter 10: Colony Health for more information on signs of disease.

Honey Extraction

See Chapter 9: Honey for information on honey extraction.

Fall Management (September to October)

At the end of the main nectar flow (around mid-August), all honey supers should be removed, leaving one to two brood chambers. This is the time when the beekeeper prepares the colony to overwinter.

Robbing

Beekeepers must monitor their apiary and equipment for bees engaged in robbing behaviour. These bees steal honey from other hives, extraction equipment, and hive components to supplement their food stores when floral nectar is unavailable. This behaviour is more frequent in the fall after the nectar flow ends. Bees that are robbing may have diseases or pests that can spread to your hives or equipment.

Monitor for bees engaged in robbing behaviour around your hives, facilities, and equipment. These bees can be carriers of pests and diseases.

Bees engaged in robbing behaviour will hover around the hive entrance, between supers, and at ventilation holes. Opening hives and feeding can attract these bees. Weaker colonies can quickly be robbed of all of their food sources if preventative measures are not taken. Robber bees may also kill the bees and queen in the weak colony, resulting in its complete loss.

If robbing is occurring, any open sources of sugar syrup or honey should be closed. Removed honey supers should not be left uncovered. Remove them quickly or during the late afternoon or early evening when bees are not flying. Beekeepers may also choose to feed later in the afternoon to avoid attracting robber bees.

Finally, entrances can be reduced to deter robbing.

Feeding

During winter, bees will starve to death before they freeze to death. Therefore, supplementing their food stores going into the winter improves their chances of surviving. Supplemental feeding should begin as soon as all honey supers are removed, which may begin in late August or early September and end by mid to late October.

Sugar syrup should be fed as soon as possible, so there is enough time for the bees to store the feed and evaporate excess water from the syrup. If not allowed to thicken, it will ferment and not be of use to the bees.

See Chapter 4: Basic Colony Requirements and Components for methods of feeding sugar syrup. Medicated feed may also be offered during this time.

See Chapter 10: Colony Health for treatment options for honey bees.

Bees should also go into winter with 4 to 6 frames of pollen so they can rear brood in late winter and early spring. If pollen stores are lacking, the bees will benefit from adding frames of pollen from healthy colonies with excess pollen stores. A protein supplement can be given if there are no pollen stores in the spring (see Chapter 4).

Colonies with full food stores should weigh:

Double brood chambers = 64 – 73kg (140 – 160lb)
Triple brood chambers = 73 – 82kg (160 – 180lb)

Assuring that the bees have ample honey stores is cheap insurance compared to the cost of replacing a starved colony.

Uniting colonies

If a colony is weak, the beekeeper has the option of uniting that colony with a stronger one. This option is often taken rather than trying to requeen a colony and supporting it back to a stronger state. However, if the colony is weak due to pests or diseases, it should not be united with another colony as it will spread the infection.

If the weak colony has a queen, the first task is to remove and kill the poor-performing queen and remove any queen cells present. Place a sheet of newspaper over the strong colony's upper brood chamber, make a few slits in the newspaper, and set the weaker colony on top. Bees will slowly chew through the newspaper and form a single colony.

Additionally, sugar syrup or a strong odour can be sprayed on both colonies to prevent them from fighting. For odour sprays, it is common for a small amount of vanilla extract to be mixed with water.

Winter Management (November to February)

Winter management practices start in the fall. The goal is to have strong colonies and provide them with sufficient support to survive the winter. Regardless of the preparations taken, beekeepers should plan for at least a 25-30% loss in colony numbers. New beekeepers may see losses as high as 100%.

It is normal for colony populations to shrink over the winter. In addition, the colony will look significantly smaller when tightly clustered in cold weather. In the fall, winter bees are reared, which are physiologically different from summer bees and can live several months longer. This helps maintain the colony population until early spring.

In September, colonies should have plenty of young bees and a healthy fertile queen. The bees will cluster in the hive over the winter and generate enough heat to maintain the population until spring. A larger cluster of bees is more effective at maintaining heat and, therefore, more likely to survive winter than a small cluster. Weak colonies, and those with poor queens, should be combined with a stronger colony.

Do not combine a colony weakened by disease or pests with another colony. Colonies weakened by disease and pests are less likely to survive the winter.

Bees begin to cluster when temperatures fall below 18°C. When temperatures go below -10°C, the colony's temperature is maintained by the cluster of bees pumping their flight muscles. The cluster is comprised of an outer mantle of bees densely packed together with their heads pointed towards the inner core, where bees move freely. The cluster moves as one from empty to full combs as they eat throughout the winter.

Bees have a decreased demand for food during the winter because they stop producing brood in the late fall and early winter. They will begin rearing brood again after the winter solstice (December 21). Even with fewer energy demands, the colony needs plenty of food stores to support it through the winter. Varroa can weaken winter bees and therefore tight Varroa control during the formation of winter bees is important.

Outdoor Wintering

Due to the long, cold winters we experience in Alberta, colonies should be placed in areas that protect them from harsh weather. If you need to move a colony, it should be done before feeding. The hive will not be as heavy, and it gives the bees a chance to get over the stress of moving. To further protect the hive from winter conditions, winter wraps/insulation should cover the outside of the hives. It is recommended that these protections remain on until night temperatures rise above 0°C. After inspecting or feeding colonies, re-wrap them in their insulation. It is common to keep colonies wrapped until late April in Alberta.

Moisture is a beekeeper's enemy, especially in the winter. As warm air leaves the winter cluster of bees, it condenses on the comb. If the moisture level in the hive rises, condensation will drip onto the bees, making it difficult for them to keep warm. The moisture can be vented with an upper entrance, either by using a 1 x 1.5 cm top entrance built into the rim of the inner cover or a 2.5 cm diameter hole drilled into the front of the upper brood box.

Colonies should be slanted slightly forward to drain any moisture collected on the bottom board during the winter. To keep cold drafts and small pests from entering the hive during the winter, any screened bottom board should be closed or exchanged for a solid bottom board and entrance reducers installed.

In much of Eastern and coastal Canada, colonies can survive winter with just light insulation. However, the prairie provinces experience colder winter temperatures, so colonies require heavier insulation. Insulated winter wraps can be homemade or bought commercially. Insulating materials that are commonly used are Styrofoam, fiberfill, or fibreglass. Additionally, thick polyethylene or tar paper is wrapped around the insulating material to protect it from wind and moisture. For longer-term use, the insulating material can be sealed inside the polyethylene to last for multiple winters.

Hives can be wrapped individually or in groups of two or four. Groups of four are wrapped with two sides of each hive exposed and the other two protected. The winter wrap needs to insulate the sides and top of the hive(s). This is usually accomplished by having separate pieces for the sides and top. For individual colonies, insulation can be built into the lid or placed on top of the inner cover. For groups, one large piece of insulation or 'pillow' is placed on top of all the hives. Plywood is often strapped to the top of the hive to protect the pillow from wind and snow. A hole in the front of the wrap must correspond to the hive's top entrance. A piece of wood on the outside of the wrap can be nailed into the hive to ensure that the hole and top entrance stay lined up. Snow should be allowed to drift around the colonies as it provides extra protection and insulation.

Indoor Wintering

Indoor wintering is a complex task that includes strict control of temperatures, air circulation, ventilation, lighting, and moisture levels. Beekeepers in the prairies move their bees inside when daytime temperatures fall below freezing (usually by the end of October). The colonies remain indoors for the next 5 to 6 months.

Indoor wintering facilities should be kept dark, the temperature maintained between 4 and 7°C, and the relative humidity between 50-70%.

As previously stated, moisture is the enemy of beekeepers, and it can accumulate indoors quickly. Indoor wintering buildings require temperature control systems, thermostatically controlled fans, heating and refrigeration units, light traps, window coverings, double door entrances, red lighting, and a backup power supply and heater.

Unacceptable indoor wintering buildings include garages, sheds, and basements. These buildings do not have the temperature, humidity, and ventilation requirements needed to winter colonies indoors. You will likely have bees flying into your home and a dead colony by the end of winter.

This handbook does not go into the details needed to prepare someone for indoor wintering. Beekeepers should consult their provincial apiculturist before building a wintering facility. There are some great resources on indoor wintering listed below:

- Beekeeping in Western Canada - https://www.agric.gov.ab.ca/app08/ppsropintheweb?PubID=295
- Canadian Best Management Practices for Honey Bee Health - http://honeycouncil.ca//wp-content/uploads/2016/12/BMP-manual-for-honey-bee-health-Feb-2017-English.pdf

Human Safety

Raising honey bees comes with its own hazards that beekeepers and their workers must be aware of for their safety. Apiaries of all sizes should provide their personnel with emergency preparedness, safety training, and personal protective equipment (PPE).

Appropriate PPE includes appropriate clothing and footwear. A veil should be worn even when doing simple, fast tasks to protect the neck and face. Light-coloured, loose-fitting clothing should cover your skin to protect you from the sun and stings. Check your clothing routinely for tears and openings that bees could enter. Some beekeepers wear a bee suit, while others only wear personal clothing with a veil. Experience will help you decide what you are most comfortable wearing. When working with bees, it is best not to wear strong smelling scents, as they can attract and/or irritate the bees.

Gloves can be worn to protect your hands and wrists from stings. Tight-fitting gloves are recommended to allow you to feel what you are doing and avoid crushing bees. Many beekeepers choose not to wear gloves to improve their handling. Footwear should protect your feet and ankles from stings, and you may choose to tuck your pants into your shoes to keep bees from crawling up. Additionally, steel-toe shoes should be considered to prevent crush injuries from heavy honey supers. Finally, if using any chemicals, check the instructions for appropriate PPE to wear and what precautions to take.

An emergency plan should be prepared and shared with all personnel. The emergency plan should be posted in a highly visible area if possible. In addition, first aid kits should be readily available and include at least one EpiPen® or similar medical device. Ensure that all personnel know how to administer an EpiPen®.

Preventing injuries begins with identifying the hazard, assessing the risk, and carrying out preventive actions. For example, honey is a good conductor of electricity, and beeswax has a low flash point, increasing fire risk. Therefore, it is advised to develop written standard operating procedures, label emergency shut-offs for power, gas, and water to the honey house and avoid open flames.

Beekeeping can be strenuous and is often done in hot weather. Precautions should be taken to prevent heat illnesses such as heat exhaustion and heatstroke. Drink plenty of cool fluids and take breaks often.

Be aware of the symptoms of heat illness:

- Dizziness or fainting
- Headache
- Nausea or vomiting
- Rapid breathing and heartbeat
- Extreme thirst

Bee Stings

Getting stung is not the highlight of beekeeping, but it happens, and apiaries of all sizes should be prepared. For most people, a bee sting is an annoyance that causes some localized swelling and itchiness. Over time, some people become less sensitive to the bee venom, but some become more sensitive with each sting. People have reported severe reactions after being stung only two or three times. Beekeepers have also reported allergic reactions and local skin irritation (i.e., contact dermatitis) when they come in contact with propolis or dust from dead, dried bees.

A bee's stinger is a barbed shaft attached to a venom sac. When a bee stings, it often leaves behind the whole apparatus, including the venom sac. If you get stung, walk away from the colonies and remove the stinger by scraping it sideways with your nail. Grabbing and pulling at the stinger may release more venom into the wound. To remove residual alarm pheromone, wash or cover the affected area, or apply ample smoke.

If there is a reaction after being stung, an antihistamine can be used to reduce the symptoms. For almost 5% of the population, a bee sting causes an allergic reaction.

Signs of a severe allergic reaction that requires immediate medical attention include:

- Swelling away from the area stung
- Difficulty breathing
- Itching and/or hives
- Nausea
- Abdominal cramps
- Dizziness or confusion
- Unconsciousness

If a severe allergic reaction occurs, an EpiPen® should be administered. Medical care should be sought out if an EpiPen® is used and/or if the reaction continues.

When Bees Attack

Honey bees are not usually aggressive, but if bees attack, you must remain calm and walk quickly away from the hive (up to 200 metres away). Bee eyesight is especially sensitive to quick motions. Do not swing your arms or try to swat away defensive bees. Because bees are looking for movement, it is often possible to evade them by standing in brush or among trees or standing close to a tree trunk. If possible, go into a shelter, like a vehicle or building. Also, avoid working with agitated hives.

If bees get inside your veil, keep your veil on (to prevent more bees from attacking your face) and keep calm. Walk away from the hive and go into a shelter, if possible. Once safe inside a shelter, try to squish the bee inside your veil and then remove the veil. It is recommended to keep your veil on when working with bees, as stings near your airways can cause life-threatening difficulties with breathing, even for individuals without allergic reactions. Furthermore, anyone can develop an allergy with exposure.

Heavy Lifting

There can be a lot of heavy lifting involved in beekeeping, which comes with its own set of risks. Therefore, training on safe lifting practices should be given to personnel. Tips to decrease the risks related to heavy lifting include:

- Safety first – your safety is the priority.
- Lightening the load – break up a load into manageable loads that are easier to lift.
- Work smarter, not harder – if possible, use equipment to do the heavy lifting.
- Work as a team – ask for help and lift as a team.
- Lifting form – avoid bending or twisting motions when lifting heavy items.
- Don't rush – take breaks when needed.

Isolated Workplace

Beekeeping can involve working alone in isolated areas, and safety measures must be taken. If possible, avoid working alone in an isolated area. If this is not possible, keep in touch with a trusted contact or co-worker via phone or radio. Inform them of where you will be and for how long you expect to be gone, especially if you will be in an area without cell service.

Smoker Safety

Where there is smoke, there is a fire hazard. For this reason, always assess the area where you intend to use the smoker and take extra care if conditions are dry. Carrying a bucket of water or a fire extinguisher is recommended to put out any fires. In addition, it is recommended to always place the smoker in a fireproof container before lighting it. A tall metal bucket can do the trick. The container will contain any burning fuel that may come out of the smoker. To further reduce your risk, make sure that you light your smoker in an area cleared of vegetation, such as tall grass or among straw or dried leaves.

To safely light a smoker, place a small amount of your chosen fuel inside the barrel of the smoker and use a long-reach lighter (e.g., a barbecue lighter) to light the fuel. Aim the lighter at the fuel resting on the grate of the barrel. Once the fuel begins to burn, press the bellows to stoke the flame. While working the bellows, put more fuel in the barrel. Do not pack your fuel too tightly, or it will smother the flame. Once the fire is burning well and you have added your fuel, close the smoker's lid and work the bellow. The smoker lid should fit snugly. A good amount of 'cool' smoke should be produced. If the smoker is producing hot smoke or flames, more fuel needs to be added. Monitor your smoker closely to refuel.

When not in use, place the smoker in a fireproof container. Smokers get very hot, and placing one on the grass or hanging one from a hive can easily cause a fire. Some beekeepers choose to place a grate on the bottom of the container to keep the container from overheating. Also, keep the smoker away from your skin, clothing, and flammable materials.

Once finished with the smoker, it should be extinguished immediately. One option is to pour water into the smoker. Another option is to plug the smoker's nozzle to suffocate the flame. A roll of wet material or a cork can be used for the plug. Once extinguished, the smoker can be stored and transported in a fireproof container. Never travel with a lit smoker!

When emptying your smoker, make sure that the fire is entirely out, and the ashes have cooled. Ash and smoker fuel can fall out of the container and spark a fire. Creosote, a health and fire hazard, will build up in the smoker and can be removed with a wire brush as needed. The more you use the smoker, the more it will need to be cleaned.

Handling Frames

A smoker is a beekeeper's best friend while handling bees. The amount of smoke needed depends on many factors, such as the colony's temperament, weather (e.g., winds), food sources, time of day, and the beekeeper's handling skills. Too much smoke can distress and excite the bees, and too little will not effectively subdue the bees. Experience with your hives will help you determine how much smoke is needed. Not using smoke repeatedly when entering the colony can cause the colony to become more aggressive over time.

The smoke interferes with the pheromones bees use to communicate, causes them to stop guarding the hive, and encourages them to eat honey. The bees are much easier to handle when smoked properly. In an urban setting, keeping bees calm is also important for the safety of your neighbours and passersby.

When preparing to open a hive, stand to the side and blow a couple of puffs of smoke at the entrance(s). The cover can then be removed, and more smoke can be applied to the top of the frames. Frames can then be gently and smoothly removed to evaluate the colony, check on the queen, and for signs of disease. It is recommended to start with removing an outer frame and leaning it up against the outside of the colony. This allows for more room to manipulate the other frames within the colony. After evaluation, each frame should be returned to its original position. If you wish to examine other hive chambers, direct more smoke between the chambers and pry the top chamber off and place it on the outer cover. After the hive examination is completed, return the hive to its original orientation.

While handling bees, it is obvious that you must avoid crushing the queen, but you should also avoid crushing any other bees during handling. When crushed, the bees release a pheromone that alarms the colony, and they may become more defensive.

Handling Queens

Beekeepers often decide to replace their queens regularly (usually every year or two) to keep the colony strong. Spring and summer are the best times to replace a queen. Many beekeepers will plan ahead and choose which queens will be replaced and will have new queens to introduce during their first checks in the spring. To avoid harming the queen while handling, a beekeeper must never hold her by the abdomen; preferably, the queen should be held by its wings or legs. If you spot the queen on a frame, a good practice is to place that frame and queen into an empty nuc box, returning the frame and queen to the hive when other manipulations are complete.

Two common methods to introduce a queen are directly releasing her into the colony or indirectly introducing her with a cage. Regardless of the method, the colony should be queenless for one to five days to improve the chance that the queen will be accepted. The colony must have enough young bees if requeening is to be successful. If the colony has mostly older bees due to a failing or dead queen, then there is little chance of them accepting the new queen; in such a case, combining the colony with a queen-right colony is recommended.

When choosing to combine colonies, check for signs of disease or pests. If present, the colonies should not be combined.

Finding a queen can be difficult and take some time. Marked queens are easier to find (see Chapter 7: The Queen for more information). Beekeepers should gently open the hive and take care to move slowly. Some smoke can be used to help keep the bees relaxed. It is easier to find her when the colony is calm, and bees are moving slower. Check the lid for the queen before

If a queen excluder is being used, the beekeeper will only need to search the boxes below the excluder for the queen. Most beekeepers begin their search at the bottom box, as queens are usually found there. Begin searching the combs by first removing the frames second from the hive wall. Search the comb carefully and, if the queen is not found, gently place the frame aside. The frame closest to the wall can then be removed by gently shifting the comb away from the wall, as lifting the frame directly up risks rolling and squishing bees against the wall. Also, the spaces between the frames and those along the bottom of the hive should be checked.

If a queen is not found and the colony is still calm, the beekeeper can perform another search. Identify and search frames with very young brood. If no eggs or open brood is present, the colony is likely queenless. A third search is not recommended, and the beekeeper should let the colony settle and search again at a later date. Before leaving, the beekeeper should check the ground around the hive in case the queen has fallen during the search.

If a queen cannot be found and the beekeeper suspects that the colony is queenless, a comb of very young larvae can be introduced. After two days, the beekeeper must check for queen cells and new eggs laid in worker cells. If queen cells have been started and no eggs are present, the colony is most likely queenless. If no eggs are present and no queen cells are started, the colony most likely has a non-laying queen.

If a queen has been acquired but cannot be introduced, she can be safely stored until it is possible to introduce her to the queenless colony. If the queen is in a cage, consider adding two or three attendants to the cage. They can be kept for no more than a week outside a colony. Store the cage in a warm, dark, and dry location until introduction. While in the cage, keep the queen fed and hydrated by spreading a small drop of water or honey on the cage screen.

Direct Queen Introduction

Before introducing a queen to the colony, it is recommended that the colony be queenless for at least a few hours, but preferably 3 to 5 days. When ready to introduce her, the queen should be placed on the face of a frame among the workers. Lightly spray her and the surrounding bees with a mixture of vanilla extract and sugar syrup. This is to mask any foreign scents that may cause the colony to reject the queen. By the time the worker bees have cleaned off the spray, they have usually accepted the queen.

Indirect Queen Introduction

Again, it is recommended that the colony be queenless for at least a few hours, preferably 3 to 5 days. The opening to the cage should be filled with enough candy that it will take the worker bees a couple of days to free the queen. Candy is made by combining icing sugar and corn syrup to create a stiff candy that does not stretch. This delayed exposure is meant to get the colony used to the new queen, improving the chance of accepting her.

If there are attendants in the cage with the queen, some beekeepers choose to remove them before placing the caged queen in the hive. The attendants may cause the colony to reject the new queen. Also, they may carry pests or diseases. The removal of the attendants should be done in some type of enclosure, such as a vehicle with windows closed, to avoid losing the queen. When ready, place the caged queen with the screen side exposed between the brood frames.

Moving Colonies / Migratory Beekeeping

It is uncommon for small-scale and/or urban beekeepers to move their colonies as they are usually located in an area that can support the colony throughout the year. However, it is common for commercial beekeepers to move their colonies to take advantage of nectar and pollen sources in different areas or for pollination services.

Preparing for Transport

A few days before transporting a colony, beekeepers should remove any excess honey from the supers to lighten the hive's weight. Leave enough honey in the hive to support the colony if anything interferes with the bees' ability to collect nectar and pollen.

To prepare the hive for transport, check if any frames are loose. Loose frames can move during transport and crush bees. A wedge of untreated wood can be used to stabilize the frames. Use hive fasteners or straps to fasten together the hive lid, boxes, and bottom board to stabilize the hive for transport and prevent it from falling apart. Holes and cracks in the hive should be covered with masking tape to prevent bees from escaping during transit.

Before loading the hives, make sure that the bees have stopped flying (usually at night) and close the hive entrance. This can be done with a fixed entrance closure, foam rubber, or insect screen tightly placed into the opening.

Transporting Hives

Most beekeepers transport their hives at night to ensure that most of the bees in the colony are transported and prevent escapes. The closed hives should be loaded parallel to the axle of the trailer or truck. The hives should be all of the same height to make the airflow move over the hives more effectively.

The colony's strength and weather conditions will dictate how long the colony can be transported. During transport in a closed hive, the bees generate a lot of heat and may smother themselves if it gets too hot. Bees should not be transported during hot weather. Take precautions to keep the hives as cool as possible, such as loading the vehicle in the shade and maintaining the vehicle to avoid a breakdown. If the bees are transported for long distances, water can be sprayed over the hives to cool them down.

Secure the hives to prevent the hives from shifting or falling off during transport. If the bees fall off the vehicle, they can be dangerous to the public. Ratchet straps are good for this. The National Safety Code Standard 10 outlines the requirements for cargo securement in Canada. Typically, each row of colonies must be strapped down. If colonies are being stacked on top of each other, each level can be strapped down for additional securement.

Once on the road, try not to stop the vehicle. The vibrations of the vehicle cause the bees to cluster in the hive, but when it stops, the bees will start to become more agitated and are quicker to overheat.

Upon arrival at your destination, the vehicle should be parked in the shade. The hives are unloaded and released as quickly as possible. If there are any concerns that the bees could be aggressive when released, a little smoke can be used. Ensure that all of the hive entrances are opened after unloading and hive installation is complete before leaving.

Queen Health, Care and Replacement

The queen plays a vital role in the colony by laying eggs and producing many pheromones, which regulate worker bee behaviour and reproduction, swarming, and supersedure. A group of worker bees (usually 6 to 11) tend to the queen, feed her, and help spread her pheromones. As long as the queen can produce sufficient pheromone, the colony will function normally.

As the queen ages, she will produce less pheromone, and her egg-laying will decrease. As the level of pheromone drops in the hive, the colony will begin the supersedure process to replace the queen. Colonies with a failing queen are also more likely to swarm due to falling pheromone levels.

Beekeepers often choose to replace the queen regularly (every one or two years) to maintain honey and brood production, avoid swarms, and improve genetics and health. Many beekeepers mark the queen (Table 7.1) to identify her age and help determine which queens need to be replaced.

When a queen is replaced, brood rearing and honey productivity are disrupted. Beekeepers must also monitor colonies for signs that the queen has died (e.g., no eggs, excessive drone brood, multiple eggs per cell) or is failing (e.g., poor brood patterns).

Replacement queens can be purchased, or the beekeeper can let the colony naturally replace her. Beekeepers must be aware that allowing the colony to replace the queen naturally comes with the risk that the queen may mate with drones that carry unfavourable genetics (e.g., greater defensiveness or tendency to swarm).

A colony will naturally replace a queen under the following three scenarios:

Colour	Year Ends With	Mnemonic
White	1 or 6	Will
Yellow	2 or 7	You
Red	3 or 8	Raise
Green	4 or 9	Great
Blue	5 or 0	Bees

Table 7.1. Queen paint marking colour scheme

Emergency Queen Rearing

Emergency queen rearing happens when the colony has suddenly lost their queen. Workers will choose existing worker larvae to rear into queens by feeding them copious amounts of royal jelly. Workers will enlarge the existing worker cell into a vertically-oriented queen cell around the developing larva. Queen cells are peanut-shaped cells with a downward-facing opening. For emergency queen rearing, queen cells are typically found near the middle of the brood comb.

Unfortunately, during emergency queen rearing, worker bees may choose to rear larvae older than those that are newly-hatched, if less brood is available in the hive. Queens reared from older larvae are typically smaller and have reduced egg-laying capacity.

Queens reared from swarm cells or supersedure cells usually start from one-day-old larvae and perform well. For this reason, when emergency queen rearing is found, it is recommended to kill all but the two largest queen cells (in case one is damaged) and let the colony raise only those. This will maintain the colony while the beekeeper plans how, or if, to replace the emergency-reared queen.

Swarm Cell

The colony will produce swarm cells when the colony becomes too populated. Swarm cells are typically found on the lower half of the brood nest or edge of the brood combs. Before the new queen emerges from the swarm cell, the old queen will leave the hive with a court of adult bees.

Supersedure Cell

Of the natural queen replacement options, replacing queens with supersedure queens is preferred because it does not usually interrupt brood production. When the colony senses that the queen is of old age or failing, they begin to build queen cells (usually one to four) to produce her replacement. Unlike emergency queen rearing, the colony will take their time in raising these queens from young larvae while the old queen remains alive. Therefore, supersedure queens are typically good egg layers. Sometimes, the new and old queen will be seen in the same hive.

Queen Raising and Breeding

Requeening is easiest in the spring when there are abundant nectar and pollen sources. Since the colony population is still low from the winter, it is easier to find the old queen, and the newly emerged workers will be plentiful to help raise the new queen. However, some beekeepers requeen when the colony population is highest at the end of the honey flow so that the colony will be stronger going into the winter.

Buying Queens

For beekeepers that choose to buy new queens, it is recommended to plan for replacement and order far in advance. Many choose to do this while they are readying their colonies for winter.

Beekeepers have many options where to buy their queens. Some choose to purchase their queens locally to encourage genetics adapted to the local environment and avoid introducing pests from international sellers. However, others decide to buy internationally for specific breeds and genetic traits. See Chapter 3: Getting Started for questions to ask a seller.

Queens can be purchased mated or as virgins. Mated queens are more expensive than virgin queens but will start laying eggs within a few days of release whereas virgin queens need several weeks to mate and start egg-laying. A seller will confirm that a queen is mated by finding eggs in her colony before caging her for sale. Virgin queens will typically be sold in the queen cell before she hatches.

Biosecurity tip – When buying bees, ask the seller about diseases and medical treatments given to their colonies.

Breeding Bees

Beekeepers often breed their queens for specific genetic traits such as honey production, winter hardiness, tendency to swarm, docility, and disease and pest resistance. In addition to selecting colonies from which to graft larvae to produce virgin queens, selecting drone source colonies with desirable genetics is a large part of successful queen rearing. Drone frames can be used to ensure that there are plenty of desirable drones available to breed with the queen, thereby increasing the chance that she will have a successful mating flight.

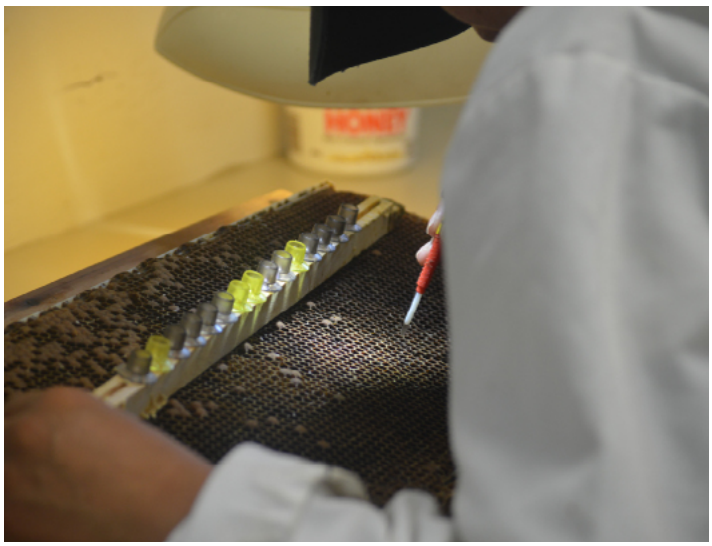
There are many different queen rearing methods that beekeepers can use, broadly classified as grafting and non-grafting methods. They all take advantage of the colony's natural behaviours. Each beekeeper must decide which method works best for their operation. Queen rearing success relies on nectar flow, pollen quality, the weather during mating, colony strength, and the availability of drones.

The best time to rear queens is in the late spring and summer, as forage is high. In general, queen rearing follows these basic steps:

1. Obtain young larvae from a breeder queen with desirable traits.
2. Place larvae in cell builder colonies that will feed the young larvae and build queen cells.
3. Queens cells are moved into a queenless colony or mating nuc where she will hatch and mate.

Grafting Methods

Grafting is the process of moving very young larvae from worker comb into queen cups. Grafting methods (e.g., the Doolittle method) are recommended for large-scale queen rearing.



Queen cups can be made from wax or plastic (purchased from a supplier). To make queen cups at home, cell dipping sticks must be made from 9.5mm dowels with one end rounded smooth. The dipping stick can be tested for appropriate size by placing it in pre-existing natural queen cells. Queen cells are created by dipping the sticks into cold water, then into melted wax (about 1cm deep), allowing the wax to harden, and repeating this several times (dipping shallower with each dip). The wax cup can then be gently twisted and removed from the dipping stick. Up to 15 queen cells can be fastened to a cell bar with melted wax. The bar is then placed on a modified frame so that the queen cells hang vertically.

Grafting should be performed in high humidity and warmer temperatures (around 24°C). Some beekeepers build a room specifically for grafting to control the temperature and humidity, while others manage to graft in their vehicle. Regardless of where grafting is performed, all equipment should be close by to efficiently move the larvae into queen cups without drying them out.

Queen cups should be primed with a 50:50 mixture of water and royal jelly to keep the larvae from drying out, and it makes removing the larvae off the grafting tool easier. There are commercial grafting tools for sale, but some beekeepers find everyday items like a fine paint brush effective. Beekeepers will determine what kind of grafting tool is best for them and, with practice, will gain confidence in their ability to transfer the larvae gently.

When ready to begin grafting, frames of freshly hatched larvae (12-24 hours old) should be gently removed from the breeding colony. Fluorescent or LED lighting can be used to see the larvae better, and it won't overheat them. The chosen grafting tool is gently placed under the larva and transferred to the queen cup. A wet towel should then be laid over the queen cells to keep the larvae moist and then placed into a cell builder between a frame of pollen and a frame of brood. Grafting success ranges between 50% and 95% depending on the strength of the colony, weather conditions and grafting skills.

Non-grafting Methods

To rear queens using a non-grafting method, a breeder queen (a queen with desirable genetics that will be used for breeding) should be given an empty frame of worker comb. Three days after the queen has laid eggs in the comb, the frame can be transferred to a cell builder colony. After two more days, the beekeeper can check for queen cells and mark them with a small nail or pin carefully placed above each queen cell. After a week, the beekeeper must check for new queen cells and destroy them. This ensures that the queens are raised from young larvae.

Cell Builder Colonies

The cell builder colony is prepared in a way that mimics emergency or swarming conditions so the bees will produce queens. A cell builder colony should be strong with many young workers (1 to 2 weeks old) and abundant nectar and pollen in the area. A cell builder should have many frames of honey, pollen, capped and emerging brood, and empty frames. To maintain the cell builder, one or two frames of brood should be added every week, and supplemental sugar syrup and pollen should be given to maximize royal jelly production and wax building.

Cell builder colonies can be prepared as cell starters or cell finishers. Cell starters are made queenless to put the colony into a state of emergency. This causes the colony to make many queen cells. Before the grafted larvae are added, any queen cells are destroyed. However, cell starters will typically not finish raising all the queens they made, which is where cell finishers come in. Cell finishers are queenright with an excluder to prevent the queen from entering the upper part of the hive. After 24-48 hours, queen cells with abundant royal jelly are moved from the cell starter to the cell finisher. A strong cell finisher with plenty of resources will raise many queens to adulthood.

A beekeeper's cell builder setup will vary depending on their queen rearing goals and availability of time and resources. The cell starter/finisher combination of queen rearing is not for every beekeeper and has many variations for setup. A beekeeper can choose to use one colony for starting and finishing queen cells but with reduced queen output.

Finished Queen Cells

Ten days after introducing the larvae to the cell builder, the capped queen cells can be harvested. Avoid roughly handling the frames with the capped queen cells, as this can damage the developing queen. The cells should be kept around 30°C. Queen cells can then be sold, used to requeen a full-sized colony, or placed into a mating nuc. To transport the queen cells, holes can be punched into a sponge or styrofoam to hold the queen cells and put into a small cooler with a hot water bottle.

If using a mating nuc, the nuc should be prepped with a frame of honey, a frame of brood, two empty frames, worker bees and drones. The accompanying bees should not be so plentiful that they risk overheating the developing queen. The nuc should not be moved or opened for the ten days following the queen's emergence. The virgin queen will complete a mating flight and lay eggs approximately 10 to 15 days after queen emergence. Poor weather conditions can cause a queen to only mate with a few drones, resulting in low semen reserves.

Two weeks after the queen emerges, the beekeeper can check the queen's mating by opening the nuc to look for eggs. Queens can also be marked at this time to keep track of the queen's age.

If queens are transported for replacement or sale, the beekeeper must create an environment that does not expose the queen to extreme temperatures. If a mated queen is exposed to extreme heat she is exposed to extreme heat (≥37°C) or cold (≤6 °C) and survives, the viability of the sperm stored in her body will be reduced, which may lead to colony failure.

Selling Queens

Similar to any beekeeper, sellers must be registered with the Government of Alberta and must be prepared to present a registration certification to a buyer. Sellers must be transparent about exposure to disease and any medical treatments to their buyers. Since honey bees can forage up to 5 km away from the hive in every direction, there is a risk that they will come across another apiary, thus spreading disease without the beekeeper being aware. The whole beekeeping community must take precautions to prevent the spread of disease between apiaries (see Chapter 10: Colony Health for more information). Sellers should also consider having a pre-sale inspection performed, as buyers may request a report.

Biosecurity tip – Never sell bees or queens with American or European foulbrood or that have been exposed to contaminated equipment. Contaminated equipment can carry viable American foulbrood spores for over 40 years.

Importance of Pollination

Many crops require pollination to ensure optimal fruit production or a good seed set, and growers often hire beekeepers to provide pollination services. Pollination per se is the transfer of pollen from the male part of a flower (the anthers) to the female part of the flower (the stigma), which fertilizes the plant, leading to fruit and seed production. Honey bees are excellent pollinators, with their hairy body and legs carrying grains of pollen that fall off as they brush against the flowers while they forage.

Some varieties of fruits (e.g., apples, cherries, and plums) need to be pollinated by a tree of a different variety to produce fruit, so insects must transfer the pollen between trees. Other crop species (e.g., pumpkins, zucchinis, and melons) have separate male and female flowers on the same plant and need pollinators to fertilize the female flowers with pollen from the male flowers. Honey bee pollination services increase seed yield and produce larger, more marketable fruit in many crops.

While not all oilseeds (e.g., canola, soybeans) require bee pollination to set seed, many growers use honey bee pollination services to improve the quality of the crop, increase the yield, and produce hybrid seeds. For example, most canola in Canada is from hybrid seed, produced by pollinators transferring pollen from male-fertile plants to male-sterile plants. The value that honey bee pollination services add to agricultural production in Canada has been estimated to be $4.6-6.4 billion annually.

Although honey bees are the most common pollinator managed in Canada, some crops (e.g., alfalfa seed, greenhouse crops) benefit more from pollination by other species of bees (e.g., leafcutter bees, bumble bees). Those species require different care than honey bees, and interested beekeepers should seek out species-specific resources.

Providing Pollination Services

Providing pollination services is not as simple as placing some colonies near a flowering crop. Beekeepers must maintain clear communication with the grower to ensure that quality services are provided and that the colonies are properly cared for. This is best done through a written contract that outlines the agreed-upon terms.

There are several important factors to consider when providing pollination services:

- Colony strength
- Number of colonies per acre (stocking rate)
- Colony placement and field access
- Timing of colony placement and removal
- Pesticide use

Colony Strength & Maintenance

Colonies must have a large, strong population to perform pollination services. A strong colony has proportionally more forager bees than a smaller colony, which in turn increases the pollination rate. A strong colony will have many frames of bees and brood and a laying queen. Honey supers must be added to ensure foraging does not slow due to lack of space, and the colony does not swarm.

Pollination contracts will typically state the number of frames of bees and brood that must be present in the colonies. The number of frames will vary depending on the type of crop being pollinated. It is recommended that colonies used for pollination have at least four to six frames of brood and six to ten frames of healthy adult workers.

Early preparation is necessary for having strong colonies for pollination. Beekeepers may begin to prepare their colonies for pollination as early as in the previous fall by ensuring that the colonies are strong and healthy going into the winter (see Chapter 5: Seasonal Management). Then, in the early spring, beekeepers may feed the colonies to stimulate early brood rearing when natural food sources are deficient.

Stocking Rate

The stocking rate refers to the number of hives per acre of crop for pollination. The stocking rate can be influenced by the attractiveness of the target crop, competing blooms in the surrounding area, and weather conditions. A higher stocking rate may be required if more attractive plants are nearby. If rain or cold are regular occurrences, more colonies will be required to ensure high pollination rates during good weather. Additionally, stocking rates vary for different crops.

Stocking rates are typically determined through past experience and trial and error. The grower may already know what stocking rate has provided good pollination in the past. Other beekeepers pollinating the same crop nearby may also be able to provide information on their stocking rate. Otherwise, the beekeeper will need to use trial and error to find the stocking rate that provides adequate pollination. This involves bringing in colonies and monitoring the number of bees on the crop and the rate of pollination. Generally, it is better to overestimate the number of hives needed for pollination than to underestimate it.

High stocking rates have a higher risk of disease or pests being spread among colonies. Beekeepers should monitor these hives closely (see Chapter 10: Colony Health for signs of disease and pests).

Colony Placement

Beekeepers and growers should visit the field(s) in advance to agree on where the hives will be located. This will prevent the beekeepers from misplacing the hives when moving them at night. The hives should be placed in areas that are accessible, dry, free from pest animals, and protected from strong winds. Colonies should be placed at least 6 meters from the edge of the crop to prevent being directly sprayed with pesticides. See Chapter 6: Handling for information on safely moving hives. Hives should remain where they are placed in a field until pollination services are completed. Moving a hive around a small area can cause the bees to become confused, lost and aggressive.

Once moved to the pollination location, the bees need to orient themselves in their new environment, and some drifting may occur. Local people may observe many bees flying around the hives; however, the bees will become less active once familiar with their surroundings.

The beekeeper should ask if there are any other hives in the area and if pesticides are used on the field and adjacent fields. A beekeeper may wish to negotiate to be the sole pollination provider for the grower to avoid mixing with other local hives. If the beekeeper plans to move their bees between provinces, an inspection and permit(s) are needed (see Chapter 13: Legislation for legal requirements of beekeepers).

Beekeepers should check for any other hives before placing their own in a field. If present, it is suggested that the beekeeper request a third-party inspection of the other hives for signs of disease or pests. If sick, the beekeeper should refuse to pollinate the field until the sick hive has been treated, removed, or destroyed.

Many beekeepers choose to label their hives for their records using hive labels or livestock identification tags. However, it is recommended to also label hives with the beekeeper's contact information in large font so that it can be easily read from a distance. Growers in the area can then contact the beekeeper if they plan to spray pesticides.

The transportation of any livestock comes with the risk of exposure to disease and pests. Keep records of everywhere the hives are transported to help trace exposure and properly manage pathogens.

Timing

It is recommended not to introduce honey bees to a field until 10% of the crop has bloomed. This ensures the bees have enough flowers to forage and keeps the bees from orienting to a better forage source elsewhere.

If conditions change and the flowers have been damaged to the extent that there is insufficient food to support the colony, the colonies must be removed from the field. In addition, beekeepers should communicate to the growers that they must notify them of any issues affecting the bees (e.g., hail damage, hives knocked over, swarming).

Beekeepers should begin discussing removal timing when the crop has reached 50% bloom.

The bees should be removed as soon as pollination is completed to avoid starvation due to lack of forage and unwanted pesticide exposure. Some beekeepers/growers choose to stagger the removal of the bees to provide pollination for as long as possible. Removing the colonies can be time-consuming, so the growers should give plenty of notice when pollination is close to being finished. Many beekeepers choose to include hive removal dates in their pollination contracts to help coordinate transportation.

Pesticide Use

Beekeepers and growers must communicate about the use of pesticides on pollinated crops. Pesticide poisoning in honey bees can result in the death of individuals or colonies. Beekeepers must clearly explain the importance of minimizing the bees' exposure to pesticides.

Ideally, any pesticides will be applied before the colonies are moved in. However, the need to apply pesticides may arise during pollination. It should be stated in the contract that the grower must consult the beekeeper 48 hours in advance.

Many precautions must be taken when applying pesticides in the presence of bees. Pesticides must be applied when bees are not present or active, ideally late in the evening. Bees are active during daylight hours and when temperatures exceed 13 – 18°C. Wind speed and direction must be accounted for as it can cause spray to drift towards colonies. Growers should also attempt to select pesticides with the following characteristics:

- Low pollinator precaution level
- Short residual toxicity
- Least hazardous formulation

See 'Pesticide Poisoning' in Chapter 10: Colony Health for information on how to prevent and identify pesticide poisoning in bees.

Pollination Contracts

When providing pollination services, there must be clear communication between the grower and the beekeeper. A written pollination contract is highly recommended so that all parties are aware of their responsibilities and to prevent misunderstandings. See Appendix B for an example of a pollination agreement. Pollination contracts should include the following:

- Names and addresses of the parties involved and the date of the agreement
- Location and type of the crop(s)
- Number of colonies to be provided
- Minimum colony strength (number of frames of brood and bees)
- Timing for hive introduction and removal
- Placement of colonies within the crop
- Length of notices for colony introduction and removal and pesticide use
- The agreed-upon responsibilities of the beekeeper and grower
- Rental fees and terms of payment
- Compensation for damages

The grower may request that the colonies be audited to determine the strength of the colonies that have been provided. This may be important for determining the total rental fee as different colony strengths may receive different rental fees. Details regarding who will be performing the audit and the conditions under which the audit must be performed (time of day and outside temperature) should be included in the contract.

Pollination services can be a profitable option for beekeepers. Hive rental fees range from $80 to over $200, depending on the crop and colony strength. Beekeepers must consider all of the expenses listed below when calculating their prices.

- Preparation management costs
- Transportation costs, including installation, maintenance, and removal of hives
- Supplemental feed and labour costs (if needed)
- Lost honey production

In Canada, honey is defined as food derived from blossom nectar or secretions of or on living plants that meet the standard set out in Canada's Food and Drug Regulations (see Table 9.1). It is a viscous fluid that can be partially or wholly crystallized.

This chapter will concentrate on extracting, processing, and marketing honey and honey-related products (e.g., beeswax or propolis). The importance of biosecurity practices will be highlighted to prevent transmitting pests or diseases throughout or between colonies.

Food safety will be discussed; however, this handbook is not intended to serve as a food safety guide. Beekeepers who intend to produce and sell honey and related products should reference the appropriate provincial and federal regulations and food safety guides. In addition, the Canadian Food Inspection Agency (CFIA) has food-specific guidance for honey.

Table 9.1 Standards for honey as set out in Canada's Food and Drug Regulations

Honey composition	Standards set out in Canada's Food and Drug Regulations		
	Honey derived from blossom nectar*	Honey derived from the nectar of lavender, rubinia, alfalfa, or banksia menziesii	Honey derived from secretions of or on living plants
Invert sugar	>65%	>65%	>60%
Moisture	<20%	<20%	<20%
Sucrose	<5%	<10%	<10%
Water-insoluble solids, if not pressed	<0.1%	<0.1%	<0.1%
Water-insoluble solids, if pressed	<0.5%	<0.5%	<0.1%
Ash	<0.6%	<0.6%	<1.0%
Acid	<40 mEq/kg	<40 mEq/kg	<40 mEq/kg

Adapted from the Government of Canada. 2021. Food and Drug Regulations. Available from: https://laws-lois.justice.gc.ca/eng/regulations/c.r.c.,_c._870/page-44.html#h-573598
*Other than honey derived from the nectar of lavender, rubinia, alfalfa, or banksia menziesii

Honey House Preparation and Safety

In preparation for collecting the honey crop, beekeepers must have a place, referred to as a honey house, to process, store, and package the extracted honey and related products. A honey house can range from a shed or garage for a hobby beekeeper to a specially-designed temperature and humidity-controlled building for a large commercial beekeeper. Many beekeepers opt to remodel a pre-existing structure to reduce expenses. Beekeepers must consult their local bylaws and building codes before building or remodelling a honey house. Whatever location is selected for the honey house, the following features should be considered: space, cleanliness, food safety, temperature, and humidity.

The Alberta Beekeepers Commission contracted a report that explains an affordable, optimal honey house design that aligns with the Safe Food for Canadians Act.

Space, Temperature and Humidity

The honey house must be large enough to move equipment around easily and store honey supers before and after extraction. The honey house should be laid out in a flow-through design to reduce the risk of contaminating the honey. A standard layout for a honey house is displayed below.

The loading area is an area where vehicles can be loaded and unloaded. This may be a driveway for a hobby beekeeper, while commercial beekeepers may choose to have a specific area with a raised deck for easier handling. The loading area must be protected from robbing bees and poor weather contaminating the honey.

The hot room is a room or area kept between 26 to 32°C to keep the honey warm and make the honey easier to work with. Honey supers are stacked on pallets designed to catch any dripping honey. It is recommended that the hot room be large enough to store up to three days worth of extraction, with an area of 0.26m^2 per single stack of honey supers. The hot room should be kept at 30% relative humidity. A humidity gauge can be installed to monitor the room's humidity. The dry air will circulate in the room to lower the honey's moisture content. If honey is too low in moisture, water can be sprinkled on the ground to add moisture to the air.

The extracting room is the area that houses the equipment for uncapping combs and extracting honey. The room must be large enough to move around the equipment safely and access the equipment to maintain its cleanliness.

The tank and filling room is where the honey is stored short-term in tanks or buckets. The room should be heated to prevent the honey from crystallizing (known as granulation) and encourage the honey to settle (wax and other materials will float to the top). The rate at which honey will crystalize depends on the sugar composition. For example, honey higher in dextrose (e.g., canola honey) will crystalize faster than honey higher in levulose (e.g., fireweed honey). Crystallization will not occur when the honey is stored above 27°C but will quickly occur when stored between 10-18°C. Once settled, the honey can be poured from a spout at the bottom of the container into barrels, buckets, or other containers.

Honey should not be stored in any heated room for an extended period, as the heat will cause the honey to darken and affect its quality. Once poured, the honey containers can be stored in the storage area. This area is also often used to store hive equipment.

Cleanliness and Food Safety

The honey at the honey house can attract and encourage robbing behaviour in bees, creating a biosecurity and food safety risk. Therefore, efforts should be made to prevent bees and pests from entering the honey house and encourage them to leave. For example, if there are windows in the honey house, stray bees will be attracted to the light, and a bee escape can be added to allow them to escape and not return.

The honey house must be kept clean to prevent contamination of the honey and related products. The walls of the honey house should be lightly coloured to see specks of debris that accumulate and be easily cleaned. Floors must be kept clean of any honey and free of pooling water. When water mixes with honey, it will ferment and produce a foul odour and an off-taste. Wall and floor joints can be sealed or covered to prevent water and honey from accumulating in the joints and fermenting.

All personnel that work in the honey house must practice good personal hygiene and wear appropriate clothing and a hair net when working in the honey house. Any loose clothing or hair could become entangled in the machinery and contaminate the honey. In addition, personnel must never work around food products, including honey, when ill with a contagious disease.

Any honey or wax spills should be immediately cleaned up. Leaving spills for too long will allow any dirt, debris, honey, and wax to mix, which will be more challenging to clean. Scoop up as much honey or wax as possible before using water. Use plenty of hot water to dissolve the remaining honey, then remove the water by pushing it down a drain or picking it up with a mop. Any leftover honey or water will make the floor sticky and smelly. Cold water may be more effective at helping scrape off wax as it will harden the wax.

All areas should be cleaned regularly to avoid debris build-up. Dead bees can be removed with a shop vac or broom. A dust mask should be worn to prevent mould or dust from being inhaled. All waste should be disposed of away from the honey house and hives, as it can attract bees and pests.

Waste must be disposed of away from the honey house and apiary to avoid attracting bees and pests, resulting in robbing and spreading disease and pests.

If a beekeeper wants to export their honey or related products or move them across provincial or territorial boundaries, they are required to hold a Safe Food for Canadians licence. Licence holders must demonstrate how hazards and food safety risks are being addressed to the Canadian Food Inspection Agency (CFIA). The CFIA has an online interactive tool to help you determine if you need a license. For more information, see Chapter 13: Legislation.

Materials used to extract, process, and package the honey and related products must be made of appropriate materials that are easily cleaned and will not affect the honey. For example, most equipment is made of stainless steel, but older equipment may be galvanized steel or welded with lead-containing solder and must be avoided as the honey can absorb the lead. See Appendix C for a contamination checklist to identify contamination risks and plan accordingly.

Removing Honey Supers

The first step in extracting honey is removing the honey supers from the apiary. Beekeepers should closely monitor the honey supers to decide when to pull the supers. When and how often a beekeeper may remove honey supers will depend on many factors, such as the colony's strength, nectar flow, weather, operation size, and beekeeper preference. Honey supers must be removed if sugar syrup is available from yourself or neighbouring apiaries to avoid honey adulteration.

Smaller hobby beekeepers may not remove honey supers until the main nectar flow has stopped. Large commercial beekeepers often try to harvest as much honey as possible and will remove honey supers two to three times during the main nectar flow. Honey bees will slow down their honey production as the available storage in the hive runs out. The beekeeper continuously encourages the bees to keep producing honey by removing honey.

Not all honey within a hive will be ready for extraction. The nectar that honey bees bring in is very high in moisture which the bees must remove to create honey. Honey that has greater than 20% moisture is at risk of fermenting and must remain in the hive for the bees to finish processing it, or the beekeeper will need to remove moisture at the honey house. However, this is not feasible for most beekeepers. It is recommended that beginner beekeepers only extract frames that contain entirely capped honey as it has the lowest moisture. Frames of partially capped honey may be extracted depending on the amount and moisture content of the capped and uncapped honey and the humidity in the extraction area. If the honey in the frame easily shakes or drips out, the moisture content is too high for extraction. Some beekeepers use a refractometer to measure the honey's moisture content before extracting it. High humidity in the extraction area can increase honey moisture as honey can absorb moisture from the air. Beekeepers should be careful when extracting honey during or following rain.

Removing honey supers in the early morning before the bees start foraging to avoid robbing is recommended. If brood (including eggs) are seen laid in the honey supers, those frames must be moved into the brood chambers to prevent contaminating the honey. All bees must be removed from the honey supers before being removed for extraction to make the process easier for the beekeeper and the colony. Bees taken with honey supers will have difficulty returning to the hive, weakening the colony. Methods of removing bees for honey supers are described below. New empty honey supers must then be placed on the hive for the bees to continue storing honey. All honey supers should be removed at the end of the nectar flow.

Beekeepers must never extract honey from the brood chambers. Chemicals used in the brood chamber will build up in the wax and honey. Additionally, the colony needs honey stores in the brood chamber to survive the winter.

Take measures to prevent robbing when extracting and processing honey to avoid spreading pests and diseases between colonies.

Shaking and Brushing Bees

After removing a honey super, each frame is shaken in front of the hive to remove the bees. Smoke can be used to keep the bees calm (see Chapter 6: Handling for details on using a smoker). Ensure your smoker is not puffing out ashes, as this will contaminate the honey. Any remaining bees can be removed by gently brushing the bees off the frame with a bee brush. It may be easier to have an empty super available for the bee-free frames to be placed in. However, this method can be physically demanding and is usually used by smaller beekeepers.

Bee Escape Boards

Bee escape boards are a one-way passage between the brood chambers and honey supers, allowing bees to move from the honey super to the brood chamber but not the opposite. The board is usually placed the night before the beekeeper plans to remove the honey supers to give the bees time to move out of the honey supers. Any other exits (inner cover entrances or holes) must be blocked to force the bees to exit the honey supers through the bee escape board.

It can take longer than one day for all the bees to exit the honey supers but leaving the bee escape boards on for several days could cause overheating issues and induce swarming. Placing a shallow frameless super under the bee escape board can help avoid this by giving the bees space to cluster. The downside of this method is that it requires the beekeeper to make two trips to the apiary, once to place the board and then again to remove the honey supers. It also requires them to lift the heavy honey supers each time. Therefore, this method is usually used by smaller beekeepers.

Fume Boards

Fume boards are commonly used to drive the bees down from the honey supers into the brood chamber. Fume boards are wooden frames with two layers of absorbent material attached to one side of the frame, placed under a layer of black corrugated plastic or tin. Butyric anhydride is lightly sprinkled on the absorbent material as too much will confuse the bees causing them not to leave the supers. Next, the hive lid is removed, bees are smoked down into the hive, and the fume board is placed on top. Under warm conditions, the fumes from the butyric anhydride will quickly force the bees down further into the hive, and the top honey super can be removed within a few minutes. After removing the top honey super, the fume board can be placed on the next super. This process is repeated until all the honey supers have been removed.

Beekeepers that use fume boards must ensure that the rim of fume boards is at least 5 cm so the board does not contact the frames and contaminate the honey. Beekeepers must use only a few drops of butyric anhydride to prevent it from dripping onto the frames. Follow all safety precautions when handling butyric anhydride due to its acidic nature. Additionally, butyric anhydride has a foul odour that may not be ideal for urban beekeepers.

Bee Blowers

Bee blowers are commonly used with queen excluders by commercial beekeepers to remove bees from the honey supers. The blowers use forced air to remove the bees, and the queen excluder keeps the queen down in the brood chamber, so there is less of a chance that she will be blown away.

First, the honey supers must be removed, placed on top of another hive or waist-high object for easy access, and then the blower is used to force air between each frame. Ensure that the bees are being blown into the air in front of their hive, not into the hive, to prevent injury or agitation. Bee blowers are a faster option to remove bees from honey supers, but there is a risk of losing the queen if she is blown away and cannot find her way back. This can be prevented with the use of a queen excluder. Bee blowers cause many bees to be in flight compared to other methods; therefore, urban beekeepers may want to refrain from using bee blowers for neighbour comfort and safety.

Abandonment

Some beekeepers choose the abandonment method when there is a good nectar flow, but it should be avoided if the flow is slow, as this method can encourage robbing. To perform, the beekeeper must remove the honey supers, place the full supers vertically on top of pallets (shorter side of the box down), and leave them for a few hours. Then, the bees will naturally return to their hive. Like bee blowers, this method should be used with queen excluders to prevent losing the queen. This method should not be used when the honey flow is not strong as it will encourage robbing. Beekeepers should be aware of rain in the forecast before using this method, as the moisture will dilute the honey.

Moving Honey Supers to the Honey House

After the honey supers have been removed from the hives, they must be transported to the honey house. For a small hobby beekeeper, this may be a short walk from their hives to their garage. This may involve heavy equipment for a large commercial beekeeper, such as a forklift. Regardless of the apiary size, all equipment and the supers must be free of potential contaminants, such as dirt, dust, or plant material. Beekeepers should keep detailed records of the location and date of super removal and extraction so that honey can be traced back if there is an issue. See Chapter 6: Handling for resources on cargo securement requirements.

As previously discussed, honey supers are stored in a hot room to make it easier to work with. Beekeepers can manipulate the hot room's temperature and humidity to adjust the moisture content and viscosity of the honey. Honey naturally contains yeasts that can live in a high-sugar environment. At lower moisture content, the yeast spores in honey will stay dormant and not harm the honey's quality. However, high moisture honey is more likely to ferment, resulting in sour or off-tasting honey. Table 9.2 explains the risk of fermentation with increasing moisture content.

Moisture Content	Risk of fermenting
<17.1%	Lowest risk – the yeast will remain dormant in the honey
17.1 – 18%	Medium-low risk – the yeast will most likely remain dormant and not ferment
18.1 – 19%	Medium-high risk – fermentation will most likely occur within a year
>19%	High risk – fermentation will occur within a year

Table 9.2 The risk of honey fermenting at differing levels of moisture

Deboxing and Uncapping

The deboxing process is the removal of frames from the honey supers. It can be done by hand or with the assistance of machinery. This is another opportunity to check the frames for any brood present. Frames with brood present should not be extracted.

Before the beekeeper can extract the honey from the frames, the wax cappings must be removed from the frames, referred to as uncapping. There are many methods of uncapping, depending on the operation size, labour and financial limitations, and beekeeper preference. Small, hobby beekeepers often use manual uncapping tools, while larger beekeepers may opt for an uncapping machine.

Once the honey is warm, and at the desired moisture level, it is ready to be uncapped. Something as simple as a clean fork can uncap by scrapping the fork down the frames. Many hand-held uncapping devices have a heated, sharp edge that is scrapped along the frame. Jiggle knives are heated blades that rattle, and the beekeeper moves the frames across them to remove the wax cappings. Finally, uncapping machines uncap the frames through heat or scraping as they move down an assembly line.

These machines often miss cappings on the top or bottom of the frames, which can be removed by scraping. Uncapped wax can then be stored for further processing (see 'Beeswax' section below) or sold for the buyer to process. The uncapped frames can be placed directly into the extraction equipment or a clean empty hive box over a drip tray before extracting the honey.

Extraction

Extraction equipment varies from operation to operation and will depend on the beekeeper's preference, operation size, available space, the desired extraction rate, and equipment and labour availability and costs. Extractors use centrifugal force to extract the honey from the combs. Most extractors are made of stainless steel; they are food-safe, easy to clean, and won't affect the quality of the honey. If buying used extractor equipment, beekeepers should ask what the extractor is made from, as lead from lead-containing solder or metals will be absorbed by the honey.

Tangential extractors are an excellent option for small beekeepers and can hold between 2 and 16 frames.

The frames are placed in a metal basket and spun by hand or an electric motor, generating the centrifugal force to extract honey from the frames. Some tangential extractors automatically rotate the basket, but most extract one side of the frame at a time and require the beekeeper to rotate the frame. The time it takes to remove the honey largely depends on the temperature; warmer honey will extract faster than cold honey.

Radial extractors have a larger capacity and can simultaneously hold between 10 and 120 frames. Frames are loaded into the extractor in a radial pattern. The bottom bars face the centre, and the top bars face outwards. Unlike tangential extractors, radial extractors extract honey from both sides of the frame at once, so they do not need to be rotated. Frames placed in either tangential or radial extractors should be evenly balanced to prevent breaking frames, excessive wear on the bushings, or tipping the extractor.

Finally, some extracting lines automate the process of uncapping and loading the frames into an extractor. These systems are more efficient than non-automated lines but are more expensive and require more floor space. In more extensive operations, the extractor drains into a holding tank where the honey will be stored and kept warm before being pumped out and processed further. Small beekeepers can drain the extractor into a clean food-safe container before straining.

Processing Honey

Beekeepers may choose to strain or allow the honey to settle to remove any foreign material, such as honey bee parts. Canadian Food Inspection Agency (CFIA) licensed beekeepers can assign a grade to their honey based on the size of the screen openings used to strain the honey and moisture content (see Table 9.4). Larger operations that sell honey in bulk use settling tanks where honey is stored for at least two days, and the foreign material rises to the top.

Some beekeepers will pasteurize their honey to discourage fermentation and crystallization. As the risk of fermentation is low when the honey has a moisture content of less than 18%, it is a personal preference to pasteurize. To pasteurize, honey must be brought up

to a high enough temperature for enough time to kill any yeast spores and dissolve crystals (see Table 9.3). It should be noted that only CFIA-licensed beekeepers can label their honey as pasteurized.

Temperature	Time Duration
52°C	470 minutes
54°C	170 minutes
57°C	60 minutes
60°C	22 minutes
63°C	7.5 minutes
66°C	2.8 minutes (168 seconds)
68°C	1 minute

Taken from Alberta Agriculture and Forestry. 1998. Beekeeping in Western Canada.

Table 9.3 Temperature and duration for pasteurizing honey

After the honey has been processed, it can be stored in air-tight containers made of food-safe material, such as glass or food-grade plastic jars, tubs, and pails. Since honey can absorb moisture from the air, it is crucial to ensure that whatever container is used is air-tight to prevent fermentation. Honey should be stored at less than 10°C to avoid damaging the honey's quality.

Beeswax Processing

The cappings removed during honey extraction are a major source of beeswax for beekeepers. Still, it can also be sourced from frame scrappings and old or damaged combs. Not all beekeepers choose to process beeswax for sale as it is an investment of equipment and time. If not interested in processing beeswax, beekeepers can look into other beekeepers or businesses that will process beeswax at a cost or in return for keeping a share of the wax produced.

If storing scrappings and cappings for future processing, they must be protected from wax moths and small hive beetle larvae (see Chapter 10: Colony Health). The larvae can be hidden in wax and chew through a significant amount in a short time. Cappings mixed with honey should not be stored for long periods. The honey will crystalize and make separation very difficult.

Rendering Beeswax Cappings

Cappings removed during extraction are often of higher quality than wax taken from brood comb, old frames and scrappings and should be rendered separately. The cappings will still have remnants of honey that must be separated to produce beeswax.

Methods for rendering cappings utilize indirect heat, in some form, to separate the honey and wax. Direct heat should never be used because beeswax is highly flammable and difficult to extinguish. The melting point of beeswax is between 61°C and 66 °C, and it has a flashpoint between 254°C and 274°C, which means that at those high temperatures, beeswax vapours can ignite without a spark. Some beekeepers process beeswax in a different building than the honey house so that if there is a fire, not all their equipment is at risk. Whatever method is used, wax rendering should be done using stainless steel, as other metals cause the wax to discolour.

Beekeepers can try to remove as much honey as possible from the wax using physical methods before using an indirect heat method to remove any residual honey. A simple option is to keep the cappings in a warm room for at least 24 hours and allow them to drain into a tub. Capping spinners can also force the honey out with centrifugal force. Another option is a wax press that forces the honey out and presses the cappings into a solid block. Beekeepers should never allow bees to scavenge honey from the cappings to separate the honey and wax. This encourages robbing and increases the risk of spreading disease and pests to the bees.

Honey bees should never be used to remove honey from cappings. It encourages robbing and increases the risk of spreading disease and pests.

After the beeswax has been rendered, it can be made into cakes by pouring melted wax into food-safe containers. Once cooled and hardened, the cake can be removed and is ready for sale. Over time, the beeswax cakes can develop a white bloom. This is natural and does not affect the wax quality. If desired, it can be removed by gently rubbing it off with a soft cloth. The beeswax should be stored away from any chemical, as the wax can absorb the chemical and become contaminated.

Cappings Melter

Cappings melters, also known as wax melters, efficiently separate the wax and honey. The melter is a drum with a thermostat and an electric heating element. The drum is filled with clean water to cover the element, and wax is added. The melted wax will then rise to the top. Hot water is added slowly when the wax has completely melted to lift it and allow it to flow through a strainer. The strained wax can then be removed.

Melting Cappings in Water

Melting cappings in water is an excellent option for a small beekeeper with small amounts of wax. A pot of wax, filled one-quarter with water, is heated on a stove, causing the honey to dissolve, particles to sink to the bottom, and melted wax will rise to the surface. The melted wax can then be spooned off, or the pot can be removed from heat and allowed to cool overnight. The wax will then harden and is easily removed. The bottom of the wax piece may need to be scrapped to remove any foreign particles.

Steam Chest

A steam chest is another piece of equipment that can separate cappings and honey. The chest uses steam from boiling water to melt the wax. Pressurized steam should never be used, as it can affect the quality of the wax.

Solar Wax Melter

Solar wax melters are a cost-effective way of melting wax and can be made at home. A solar wax melter is a sloped glass-covered box, often painted black to improve heat conduction, with a metal tray on the bottom. During summer, beekeepers place their cappings on the metal tray and point the box towards the sun. The solar heat will melt the wax, causing wax and honey to flow down the slope, through the screen, and into a container. The honey will settle on the bottom, and the wax will rise to the top of the container.

Selling Honey and Related Products

Beekeepers in Alberta have many options for selling their honey and related products in domestic or export markets. It is the beekeepers' responsibility to familiarize themselves with the applicable provincial and federal regulations about honey sales for their intended market. Regulations on beekeeping and honey sales are discussed in Chapter 13: Legislation.

Domestically, the beekeeper can sell their honey directly to the customer at farm gate sales or farmers' markets. Honey sold elsewhere must be graded before being sold under the Alberta Honey Grading Regulation. To grade honey, the beekeeper must be licensed with the CFIA as part of the Safe Food for Canadians Regulations. Finally, beekeepers can choose to sell their honey in bulk to Bee Maid Honey Limited, owned partially by the Alberta Honey Producers Co-operative. A co-operative membership is needed, and members are expected to ship 2,268kg (5,000lb) of honey. Approximately 40 colonies are needed to yield enough honey to meet the co-operative membership requirements, so this is not a viable option for very small beekeepers.

If choosing to trade honey outside their province, import or export honey, beekeepers must have an SFC licence from the CFIA and be familiar with federal regulations. Then, beekeepers can sell their honey in bulk to packers or directly to a buyer through a broker.

Labelling Requirements

Depending on where the honey is sold, the labelling requirements will vary. In Alberta, honey that a beekeeper sells directly to customers at their residence, honey house, or at a farmers' market must be labelled with the following:

- The word honey
- Name and address of the beekeeper
- Net weight of contents

Honey that is imported, exported, and interprovincially traded is subjected to federal regulations and must be labelled with the following:

- The common name, honey
- List of ingredients
- Net quantity (in metric units)
- Name and principal place of business
- Country of origin
- Grade name of honey
- Colour class of honey
- When applicable, label with "liquid," "creamed," "pasteurized," or "pressed"
- Lot code

There is a Food Labelling Requirement Checklist available to assess your labelling. The CFIA has a webpage that describes in further detail the labelling requirements for honey.

Beekeepers that have a CFIA license can add honey grades to their labels. There are three grades of honey in Canada, each with its own specific characteristics (see Table 9.4). There are also four colour classes: white, golden, amber, and dark.

Characteristics	Canada No. 1	Canada No. 2	Canada No. 3
Moisture level	≤17.8%, or ≤18.6% if pasteurized	≤18.6%, or ≤20% if pasteurized	≤20%
Screen filtration	Sieve opening of 0.1778mm and made of wire with a diameter of 0.09mm	Sieve opening of 0.2489mm and made of wire with a diameter of 0.125mm	
Flavour	Flavour of its colour class and free of unpleasant flavours, aromas, or taints	Flavour might be slightly off	Flavour might be slightly off

Table 9.4. Characteristics of the different honey grades in Canada

Adapted from Government of Canada. 2021. Canadian Grade Compendium: Volume 6 - Honey. Available from: https://inspection.canada.ca/about-cfia/acts-and-regulations/list-of-acts-and-regulations/documents-incorporated-by-reference/canadian-grade-compendium-volume-6/eng/1523388139064/1523388171017

Types of honey

Raw Honey- Extracted honey that has not been treated or processed in any way.

Filtered Honey- Honey that has been filtered to remove foreign particles, air bubbles, and other unwanted material.

Pressed Honey- Honey collected from pressing broodless comb.

Pasteurized Honey- Honey that has undergone heat treatments to kill yeast spores and dissolve honey crystals. Honey can only be labelled as pasteurized if licensed by the CFIA. Otherwise, the honey may be labelled as liquid.

Creamed Honey- Honey that has undergone a controlled crystallization to obtain a semisolid consistency that is smooth and spreadable. Also referred to as whipped, spun or churned honey.

Chunk Comb Honey- Honey that is marketed as a container of honeycomb filled with liquid honey.

Honey-Related Products

Pollen

Pollen is in demand by health food markets and bee and animal feed. Pollen traps can be added to the hive and collected every two to three days, depending on outside humidity and the amount of pollen being brought in. Pollen must then be immediately frozen or dried to kill any insects or pests present. Long-term pollen trapping is not recommended as it can deprive the colony of pollen needed for brood rearing.

Beeswax

Beeswax can be sold to the cosmetics, pharmaceutical, candle, and industrial industries. Large commercial beekeepers may opt to sell bulk beeswax using a broker.

Propolis

Propolis is commonly used in cosmetics. However, it is difficult to collect propolis, and the quality can vary from colony to colony. Different federal regulations apply to propolis as it is a pharmaceutical product rather than a food product.

Royal jelly

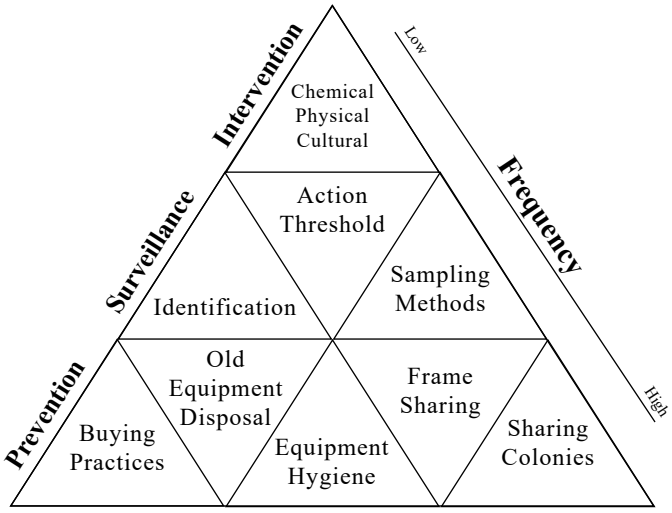
Royal jelly is thought to improve ageing skin's appearance and can be added to lotions. However, collecting royal jelly is a complex process that should be researched ahead of time.

Similar to other animals, honey bees are susceptible to various diseases and pests. These can affect colony development, productivity, and survival. An important part of beekeeping management is protecting colonies from these diseases and pests. To do this, beekeepers must have a basic understanding of disease identification, prevention, and control.

General symptoms that may indicate a sick hive include spotty brood, decreased population of bees, abnormal cappings, delayed or slow production , and low food supplies. There are more specific symptoms that help us identify specific diseases. Those will be discussed later in this chapter.

The Integrated Pest Management Strategy

Integrated Pest Management (IPM) is a decision-making process for managing pests in an effective, economical, and environmentally-sensitive way. IPM is science-based and used to minimize the risks from pests and management strategies (e.g., resistance, loss of beneficial or non-target organisms, etc.). Implementing IPM ensures the long-term sustainable control of diseases and pests. IPM has three elements: Prevention, Surveillance, and Intervention, which can be visualized as a pyramid.



At the base of the pyramid is Prevention, which involves cultural practices that prevent the introduction or spread of diseases and pests in your colonies and apiaries, and should be practiced most frequently. In the middle of the pyramid is Surveillance which includes detecting diseases and pests, determining when to enact control measures, and the effectiveness of those controls. Surveillance is an important part of the decision-making process and is performed often. Prevention and surveillance often occur simultaneously. At the top of the pyramid is Intervention, when physical, chemical, and cultural controls are used to prevent harm to the colony or death by diseases and pests when an established threshold is reached. Intervention is only done when necessary as it is costly, harmful to the environment, and lacks long-term sustainability.

Prevention

The best way to protect your colonies from diseases and pests is to prevent infections and infestations from occurring. Any beekeeping equipment purchased should be disease-free as some diseases and pests can reside on these surfaces. Ask the sellers about past diseases and treatments before buying any used equipment (see Chapter 3: Getting Started for questions to ask a seller). Every year, 2 to 4 brood chamber frames per colony, especially those with dark comb, should be replaced as disease and chemical residues build up on the brood comb over time. If starting with new frames, this process can begin after a few years.

If diseases or pests are present in a colony, they can be spread when bees from the diseased colony come in contact with bees from other colonies through drifting and robbing behaviour. Taking steps to reduce these behaviours will slow the spread of diseases and pests between your colonies. See 'Apiary Setup and Hive Placement' in Chapter 4: Basic Colony Requirements and Components for how to prevent drifting. Also, see 'Fall Management' in Chapter 5: Seasonal Management for how to prevent robbing behaviour.

The best way to prevent spread from a colony with diseases or pests is to move the infected colony to a quarantine or 'hospital' apiary. The hospital apiary should be at least 2-3 kilometres from surrounding apiaries. Isolating infected colonies from healthy colonies greatly decreases the chance of disease and pest spread. Colonies in the healthy apiary still need to be monitored as spread may have already occurred.

Beekeepers can also spread diseases and pests between colonies and apiaries through poor management practices and equipment hygiene. Before sharing frames or bees between colonies, confirm that the donor colony is disease-free. This is particularly true for the reuse of equipment from colonies that have died. Anything that touches the hive equipment or comb can transmit disease. Wear disposable gloves or ensure fabric/leather gloves are washed or disinfected regularly between uses. Between apiaries, hive tools should be cleaned by scraping off any wax and sanitized with a propane torch or bleach solution. Other tools (smokers, etc.) should be disinfected regularly. For more biosecurity practices, see Chapter 11: Biosecurity.

Surveillance

Regular surveillance allows for the early detection of diseases and pests and determines whether control measures are needed. The first step of surveillance is identifying diseases and pests in your colonies. Brood diseases can be difficult to distinguish as some symptoms look similar. Therefore, recognizing differences from normal brood is the easiest way to know that your colony might have a disease. Be familiar with the surveillance methods and symptoms for each disease and pest and implement them in your colony inspections.

After applying control measures, surveillance is still needed to determine whether the control was successful. Furthermore, diseases and pests always have the potential to return. Keep records of each hive visit to easily remember past infestation levels and treatments.

The Bee Health app developed by the Bee Health Assurance Team (BHAT) is a convenient tool that can be used to diagnose diseases and pests in the field. Beekeepers can also use the app to send pest identification results and pictures to the BHAT. Another helpful resource is the BeeMD website.

Regular surveillance of colony health will allow for quick identification, treatment, and control of diseases and pests. It will also allow you to familiarize yourself with the signs of a healthy colony.

Intervention

Many diseases and pests have established action thresholds to indicate when intervention is necessary to prevent harm to the colony or death. Disease and pest intervention can include physical, cultural, and chemical controls. Chemical control measures should only be used when required to minimize the risk of resistance. Ideally, all colonies requiring treatment within an apiary will be treated simultaneously for easy record-keeping.

Only use chemicals registered for use in honey bee colonies in Canada. It should be noted that chemicals have both an active ingredient and a trade name. The

active ingredient is what kills the disease or pest, and the trade name is what the company calls its formulation. Always read the label to determine if it is the right chemical to use, what the expiry date is, and for instructions on mixing, proper administration (method, dose, and frequency to avoid resistance), storing and disposing of a chemical. Expired chemical must never be used. Use appropriate personal protective equipment when applying any chemicals and ensure that your honey crop does not get contaminated.

Reporting Diseases and Pests

Of the many diseases and pests that affect honey bees, only the small hive beetle (Aethina tumida) is required to be immediately reported to the Canadian Food Inspection Agency (CFIA) as it is considered an exotic pest to Canadian honey bee colonies. If you suspect a colony has small hive beetle, contact the Government of Alberta BHAT for an inspection. If BHAT confirms the presence of the small hive beetle, they will notify the CFIA.

It is also strongly recommended to contact the BHAT if you suspect a colony has American foulbrood (AFB) or European foulbrood (EFB). The BHAT will be able to assist with diagnosis and the development of a management plan.

Overview of Diseases and Pests

Recommendations and treatment options for honey bee diseases and pests are continuously being updated. For the most up-to-date information, refer to the latest 'Honey bee pests and diseases guide' by the Government of Alberta BHAT.

If there is a disagreement between the instructions described here and the chemical label of the specific product, always follow the label instructions.

Bacterial Diseases

American Foulbrood

American foulbrood (AFB) is one of the most serious honey bee diseases. It is highly contagious and can easily spread to neighbouring colonies and apiaries. Without intervention, the bacteria will kill infected colonies.

AFB is caused by the spore-forming bacterium Paenibacillus larvae, which infects only larvae. Very young larvae (1-2 days old) are most susceptible to AFB and become infected from consuming spores in contaminated brood food. The AFB life cycle has two stages: vegetative and spore. The vegetative stage occurs as the bacteria multiply in the gut of a larva after it has ingested spores. The larva typically dies during the prepupal stage just after the cell has been capped. The dead larva will deteriorate, desiccate, and become a hard scale that adheres to the lower surface of the cell. During this process, the AFB bacteria produce infective spores, which can survive in the environment and spread the disease.

A single larval scale can contain over 2 billion infective spores, which is significant as it takes fewer than ten spores to infect a young larva. House-cleaning bees will attempt to remove the dead larvae and scale and, in the process, become contaminated with spores. The spores are spread throughout the colony through food sharing and larval feeding. Spores can remain on comb and equipment for over 35 years and are resistant to heat, cold, and many disinfectants.

AFB can be prevented through good management and hygiene practices and disposing of old comb. If supplementary feeding colonies, only use pollen and honey known to originate from healthy hives or ensure it has been irradiated before use to kill any AFB spores.

<u>Identification & Surveillance</u>

Early detection is crucial in preventing severe AFB infections. During routine colony inspections, a minimum of three brood frames should be examined for symptoms of AFB. The bees should be shaken off the frame for a better look at the brood. It can be difficult to detect the early stages of AFB as infected larvae are hidden underneath capped cells. In such cases, open up cells with sunken, greasy and/or perforated cappings to look at the larvae inside. Spores can exist within the colony without causing clinical symptoms. Clinical AFB is defined as a colony with the symptoms below and a laboratory confirmation.

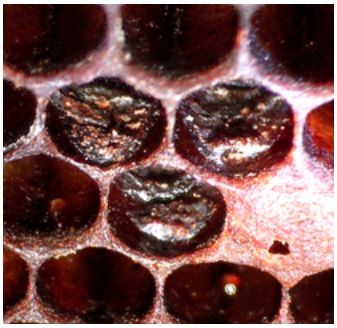
Symptoms of American foulbrood may include:

- Spotty brood pattern
- Perforated or sunken cappings
- Brown/coffee-coloured larvae at the bottom of the cell
- Dark larval scale that can not be removed easily
- Foul odour (often compared to dead fish)

Spotty brood pattern

Perforated cappings

Roped out larvae



Scale

A test of ropiness can be performed to further aid in diagnosis. Select a diseased larva that was underneath a capping. A twig or toothpick is gently swirled inside the cell to break up the larva. The contents are then slowly pulled out of the cell, causing the larval remains to string out. This may take several attempts. If the larval remains strung out about 2 cm, it is considered infected with AFB. This test should not be used as confirmation of AFB alone. Early-stage diseased larvae or those drying out may not rope out to 2 cm. Therefore, AFB should be positively confirmed through laboratory testing. Contact the Government of Alberta BHAT for assistance in diagnosis and management planning.

Important: an AFB diagnosis should be positively determined through laboratory testing.

Intervention

Once AFB has been identified in a colony, it must be dealt with immediately to prevent its spread. Any comb containing infected larvae/pupae or scale must be removed and destroyed to eliminate the source of the infection. Which control measures to use will depend on the level of infection, the number of colonies infected, resources, and time of year.

Inspect all colonies within an apiary with an AFB-infected colony to find any other infections. Within an AFB-infected colony, inspect all brood frames for infected larvae or scale and count the number of infected cells to determine the level of infection. After applying control measures, colonies must be monitored for signs of AFB to determine whether the control was successful.

Low to Medium Infections (1-100 infected cells)

At these infection levels, the 'shook swarm' method can be used to eliminate clinical symptoms. With this method, the bees are shaken into a new or disinfected hive with frames of drawn comb or foundation. This should reduce the number of spores in the colony to where clinical symptoms are not exhibited. However, this method should not be used any later than June, so the colony has enough time to build up its population and food stores for winter.

The lid, bottom board, and boxes from the infected colony must be disinfected. First, scrape off any wax from the equipment. Wooden equipment can be scorched on the insides with a propane torch. Alternatively, the equipment can be disinfected with bleach water (1 part bleach:9 parts water) for 30 minutes and then rinsed with water. Note that this may not destroy all AFB spores but reduce them to a level where clinical symptoms are not seen. Frames with comb should not be disinfected with bleach water as the bees will not use it after. Equipment and frames from the brood chamber and honey super can be irradiated to eliminate spores. Again, any frames with infected larvae or scale must be destroyed.

AFB can be treated with antibiotics prescribed by a veterinarian. However, antibiotics only kill the vegetative stage of the bacteria, not the AFB spores.

Therefore, antibiotics only suppress the clinical symptoms of AFB and do not cure the colony as the spores remain in the hive environment. Oxytetracycline hydrochloride (OTC) is the first choice of antibiotic prescribed for AFB. However, some strains of AFB are resistant to OTC, which can be determined through laboratory testing. If your colonies are infected with OTC-resistant AFB, a veterinarian may prescribe tylosin tartrate or lincomycin hydrochloride.

All antibiotics, particularly tylosin and lincomycin, can leave residues in the honey. A four-week withdrawal period is mandated between the last application and the addition of honey supers. The antibiotics are mixed with icing sugar and applied along the margin of the brood chamber (do not apply on open brood). OTC can also be mixed in syrup. Refer to the product label for dosage, application amount, and withdrawal period instructions.

High Infections (more than 100 infected cells)

Highly infected colonies are extremely unlikely to have clinical symptoms eliminated through the shook swarm method or antibiotics. The large number of spores within the colony will continue to infect larvae. Therefore, the bees must be destroyed. Frames from the brood chamber and honey supers need to be destroyed or irradiated. The lid, bottom board, and boxes from the infected colony can be disinfected.

European Foulbrood

European foulbrood (EFB) is another serious disease that affects honey bee brood. EFB infections most often occur in the spring when the colony grows rapidly. This sudden growth can result in a shortage of food and nurse bees, especially during poor forage conditions. Typically, symptoms clear up after a strong honey flow, but EFB infections have persisted into the summer months in recent years. Infected colonies have reduced brood production, weakened bee population, and may die without intervention.

EFB is caused by the bacterium Melissococcus plutonius. The larvae become infected by consuming food contaminated with the bacteria, with young larvae being the most susceptible. It is believed that the bacteria do not outright kill the larva but compete for nutrients within it. If food is abundant, the infected larva will develop into an undersized adult that will spread the bacteria. Otherwise, the larva will starve and usually die before the cell is capped.

EFB can be prevented through good management and hygiene practices, disposing of old comb, and keeping hygienic honey bee stock.

Identification & Surveillance

Look for symptoms of EFB during your routine colony inspections. A minimum of three frames of brood should be inspected. Shake the bees off the frame for a better look at the brood.

Symptoms of European foulbrood may include:

- Spotty brood pattern
- Yellow to brown larvae
- Twisted larvae that are not the usual ‘C’ shape
- Visible tracheae
- Rubbery scale that is easy to remove
- Absence of ropiness

Often, the dead larva will be secondarily invaded by other opportunistic bacteria, making diagnosis more difficult. When the ropiness test is performed on a larva infected with EFB, it does not string out to 2 cm like AFB. EFB can only be confirmed through laboratory testing.

Control

The control measures for EFB are very similar to those for AFB. Within an EFB-infected colony, inspect all brood frames for infected larvae or scale to determine the level of infection. Any comb containing infected larvae or scale must be removed and destroyed to eliminate the source of infection.

EFB is a disease brought on by stress in the colony. Reducing sources of stress can resolve low infections of EFB. Provide the colony with supplementary pollen and sugar syrup if forage is scarce or poor weather (cold or rain) interferes with the bees' ability to forage.

The shook swarm method can be used to eliminate clinical symptoms for low infections. Colonies that are very weak or have a high EFB infection should be destroyed. Equipment should be disinfected in the same way as for AFB infections (see above).

EFB can be treated with the antibiotic oxytetracycline hydrochloride, prescribed by a veterinarian. However, the antibiotic only prevents the reproduction of the bacteria in the larvae. Therefore, the bacteria within the colony can still cause infections after treatment. Tylosin or lincomycin are not registered for its control.

All antibiotics can leave residues in the honey. A four-week withdrawal period is mandated between the last application and the main honey flow. The antibiotics are mixed with icing sugar and applied along the margin of the brood chamber (do not apply on open brood). The mixture is applied three times every 4-5 days. Refer to the product label for dosage, application amount, and withdrawal period instructions. After applying control measures, colonies must be monitored for signs of EFB to determine whether the control was successful.

Fungal Diseases

Chalkbrood

Chalkbrood is a common brood disease that usually causes minimal damage to the colony. However, high infection levels can affect spring build-up, honey production, and winter survival. Chalkbrood appears to be a stress-related disease that most often occurs in the spring and early summer. The more stressed the colony, the more they will be impacted by the infection. Stress factors such as low bee population, excessive hive moisture, poor weather, poor foraging, and the presence of other diseases and pests may increase the severity of chalkbrood.

Chalkbrood is caused by the fungus Ascophaera apis, which infects larvae and occasionally pupae. The chalkbrood spores are ingested in contaminated brood food, with young larvae more likely to become infected. The fungus begins to grow in the body cavity until it breaks through the body wall. It will start growing at the back of the larva and will expand to the front until it covers the entire larva. Eventually, the fungus-covered larva fills the entire cell. Over time, the larva will dry out, becoming a chalkbrood 'mummy.' These mummies release spores to continue the infection cycle.

Identification & Surveillance

Look for symptoms of chalkbrood during your routine colony inspections. Check the brood, bottom board, and ground by the entrance for signs of chalkbrood mummies. The dead larvae will be white, grey, or black, and the tip of the larvae will be dry and pale yellow. Mummies will be shrunken and hard and found in open or sealed cells. Workers may detect the dead larvae in closed cells and chew small holes in the cappings. Mummies are easily removed from the cell.

Prevention

Beekeepers should reduce colony stress within the colony. Maintain strong colonies free of other diseases and pests and provide feed during poor foraging conditions. Also, prevent the transfer of spores between colonies by practicing good hive hygiene and not sharing infected frames with healthy colonies. Avoid conditions that promote cooler nest temperatures or excessive moisture. Only feed pollen known to originate from healthy hives or ensure it has been irradiated before use.

Intervention

Chalkbrood is managed primarily through physical and cultural control (above), as there are currently no registered treatments in Canada. Colonies of hygienic stock are more effective at removing infected larvae and mummies from the hive, reducing spread within the colony.

Frames that contain chalkbrood mummies can be tapped with the cell openings facing the ground to dislodge the mummies. Frames that are highly infected should be removed and destroyed to reduce the spore load. Mummies can also be found on the bottom board and should be scrapped off away from the hive.

Avoid sharing frames with chalkbrood with healthy colonies.

Nosema

Nosema is a prevalent fungal parasite that affects the gut of honey bees. In the past, Nosema was only caused by Nosema apis. However, Nosema ceranae is now the most common species in Canada. Generally, Nosema infections are highest in the spring (around May) and are lowest in the summer, with a small peak in infection level sometimes in the fall. Nosema shortens adult bee lifespan, which can cause the colony's population to dwindle and may reduce honey production in severe cases. Nosema is also associated with poor queen performance and supersedure.

Nosema exists in the environment as resistant spores and infects adult bees of all castes. Infection begins with a bee ingesting spores from contaminated food or cleaning comb contaminated with feces. The spores germinate in the gut and penetrate cells in the gut lining. Within the cell, Nosema multiples and produces many new spores. The infection will spread within the gut, and the new spores will be excreted to spread the infection.

Identification & Surveillance

Nosema is not easily identified as infected bees show few outward symptoms. Most indicators, such as distended abdomens or feces on the front of the hive, can be caused by other ailments and should not be used for definitive diagnosis.

Nosema infection can only be reliably identified by examining gut contents for spores under a light microscope. Sampling adult (ideally forager) bees is recommended in the spring and fall to determine Nosema infection levels. Samples of at least 30 bees are collected from the honey frames or entrance to find older forager bees. Samples can be sent to the National Bee Diagnostic Centre (NBDC) for analysis. Nosema analysis is possible at home, though specialized equipment (microscope and hemocytometer) and training are needed for accurate results. Laboratory testing using molecular methods can confirm the species of Nosema present, though management recommendations are similar.

Intervention

Nosema can be controlled with the antifungal fumagillin powder mixed with sugar syrup. Note that fumagillin does not kill spores in the environment, only the multiplying stages within the gut. Treatment is typically applied in the spring and fall. A nominal threshold of 1 million spores per bee has been used to decide when treatment is required.

Do not expose the medication or medicated syrup to sunlight, as it will render the medication ineffective. As such, medicated syrups should be stored in dark containers or covered feeders to avoid sun exposure. Medicated syrup is best administered to individual colonies using hive-top feeders, opaque pails, or frame feeders to ensure each colony receives the correct dosage. **Refer to the product label for instructions on dosage and application amount.**

Hive equipment and frames can be irradiated to eliminate Nosema spores.

Parasitic Mites

Varroa Mites

The varroa mite (Varroa destructor) is one of the most common and damaging honey bee pests. Varroa mites were originally parasites of the Asian honey bee (Apis cerana) before shifting to the European honey bee (Apis mellifera). After several decades, the varroa mite was able to spread worldwide. Colonies easily become infested with varroa mites through robbing or drifting. Now, almost all colonies have some level of varroa infestation. High varroa infestation levels cause irreversible damage that reduces longevity and increases winter mortality. In addition, varroa mites are known vectors for several viruses, and if left unchecked, varroa populations will build up and cause colony death.

The varroa mite is an external parasite that feeds on the fat body (similar to the liver in mammals) of adult bees and brood. It has two distinct life stages: the reproductive and dispersal stages. The reproductive stage occurs within the brood cells. Female mites will enter a worker or drone larva cell just before capping. However, varroa mites prefer drone brood as their longer development time allows more offspring to be produced. Initially, the 'foundress' mite hides within the brood food at the bottom of the cell. She emerges once the cell is capped and the larva enters the prepupal stage. After feeding on the developing pupa, the foundress will lay an unfertilized egg that will develop into a male. Next, she will lay several more fertilized eggs that will develop into females. The foundress and offspring will feed on the pupae until the offspring reach maturity. The female offspring will then mate with their male sibling. After the adult bee completes development and emerges from the cell, the impregnated female mites move into the dispersal stage, and the male mite and immature female mites die. On average, a foundress mite produces 1.5 offspring from a worker cell and 2-2.5 offspring from a drone cell.

During the dispersal stage, the female mite will climb onto a nurse bee to feed and be transported within the colony. Typically, the mite will feed on the adult bee's fat body for a week on average to improve her reproductive capabilities. However, in a broodless colony, a female mite can survive on a host bee for several months. Mites may also move to a forager bee and end up being to be transported to a new colony as a result of drifting.

Identification & Surveillance

Female varroa mites are small (1.1mm long by 1.6mm wide) and reddish-brown. They are oval and flat, with eight legs at the front of their body. Varroa can be found in cells with larva or on the honey bee's thorax or abdomen. Note that a similar-looking pest, the bee louse, may be seen during inspections. See the 'Insect Pests' section below for more information on the bee louse.

Colonies that are highly infested will contain workers with deformed wings (see Deformed Wing Virus below) and show the following symptoms referred to as parasitic mite syndrome (PMS):

- Spotty brood pattern
- 'Melted' larvae, often with mites present
- Uncapped pupae that are missing their head and/or thorax

Varroa mite infestation levels should be determined at every colony inspection in the spring and fall. Infestation levels can dramatically increase in the fall due to a decrease in brood production and exponential growth of the varroa population during the summer. Varroa infestations should not be ascertained visually as varroa mites are often difficult to spot between the abdominal segments on the underside of the bee. Generally, the colony is already highly infested if varroa mites are visible on the bees.

Every apiary within an operation should be sampled as varroa infestations can vary widely. If possible, every colony in an apiary should be sampled. For larger operations (~50 colonies per apiary), a minimum of eight colonies per apiary should be sampled. Beekeepers must always sample before and after treatments to determine the effectiveness of the treatment.

Several sampling methods can be used to determine varroa mite infestation levels. Each method has its advantages and disadvantages, and it is up to the beekeeper to choose what method works best for them.

Except for sticky boards, all methods require a sample of 300 bees to be taken from the colony. Bees should be taken from the brood frames as this is where the mites can be found. Before sampling, ensure the queen is not on the frame to avoid harming her. Sampling at least 300 bees is important for detecting mite levels near the treatment threshold. Three hundred bees are approximately equal to ½ cup of lightly packed bees. This can be measured using a measuring scoop or by marking the fluid line on the collection jar when filled with ½ cup of water. It is best to practice your collection technique to ensure that you consistently sample 300 bees. Bees can be sampled directly from the frame by gently dragging the collection container over the bees. This action causes the bees to let go of the frame and fall backwards into the container. Alternatively, the frame of bees can be shaken into a container and measured with a scoop.

Monitor varroa mite infestations in the spring and fall. Every apiary should be sampled. Ideally, every colony in the apiary should be sampled or at least eight colonies per apiary in large beekeeping operations.

Alcohol Wash

The alcohol wash is a quick and accurate method of determining mite levels. The downside of this method is that it kills the sampled bees in the process. The alcohol wash can be done with a few household items or commercially available hand shakers. Follow the instructions provided for commercial products. If using windshield washer fluid, use the winter or all-season branded fluid as it has greater alcohol content and produces less soap suds than summer fluid.

Materials:

- 2 basins (light-coloured)
- ½ measuring cup
- Collection jar with lid
- 70% alcohol or winter windshield washer fluid
- #8 mesh strainer or screen

Instructions:

1. Pre-fill the collection jar 1/3 full with alcohol or winter washer fluid. Take a 300-bee sample (see above). There should be enough alcohol to cover the bees.
2. Tightly screw on the lid and shake vigorously for 2 minutes to dislodge the mites from the bees.
3. Place the mesh screen above an empty basin and pour the bee sample over the mesh. This will separate the mites from the bees.
4. Count the number of mites in the basin and divide by 3 to determine the number of mites per 100 bees. This calculation is only accurate if there are 300 bees in the sample.

Sugar Roll

The sugar roll method involves covering the bees with powdered sugar, causing them to groom each other and dislodge the mites. The benefit of the sugar roll is that it does not kill the sampled bees and does not involve harmful chemicals. However, this method is less accurate in cold or humid conditions as the bees may not groom each other, or the sugar may become damp and clump.

Materials:

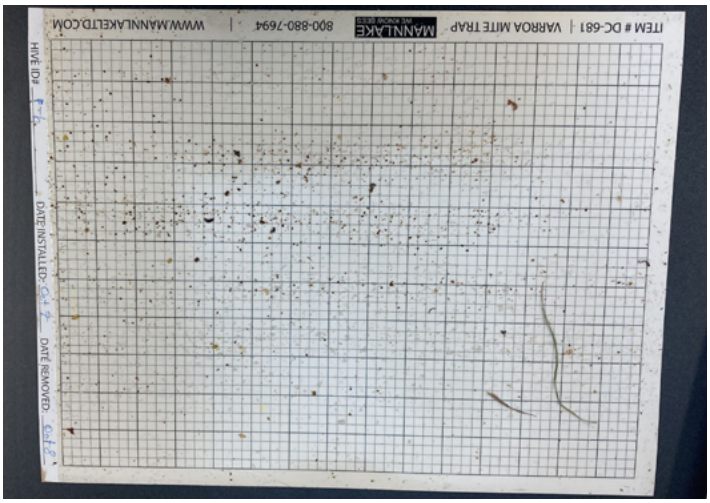
- Jar with #8 mesh lid
- Icing (powdered) sugar
- 1 tbsp. measuring spoon
- White surface (paper or basin with water)

Instructions:

1. After sampling, pour 1-2 tablespoons of powdered sugar through the mesh onto the bees.
2. Roll the jar to cover all the bees thoroughly with sugar. Do NOT tip the jar upside down, or the mites may fall out.
3. Let stand for 1-2 minutes.
4. Turn the jar upside down and shake it over a white surface for 1 minute. A white basin with water will dissolve the sugar and make it easier to count the mites.
5. Count the number of mites and divide by 3 to determine the number of mites per 100 bees. This calculation is only accurate if there are 300 bees in the sample.

Sticky Board

The sticky board method avoids killing bees to determine mite levels and monitors the entire hive. However, the results are time-consuming and will vary depending on colony size. Also, it does not assess the mite level still on the bees. Sticky boards can be made at home or bought commercially. Regular bottom boards can be used, although screened bottom boards make monitoring easier as you do not disturb the bees.



Materials:

- Thick paper sheet the size of the bottom board
- Permanent marker and ruler
- Adhesive material such as insect trap glue or petroleum jelly
- #8 mesh screen the size of the bottom board

Instructions:

1. To help with counting, draw a grid using the marker and ruler onto the paper sheet.
2. Cover the sheet with a layer of 50/50 shortening/petroleum jelly mix or insect trap glue.
3. Place the board with the sticky side up on the bottom board and cover it with a screen to prevent bees from getting stuck.
4. Leave in the hive for three days, then remove. A 24-hour drop can be used for high infestations.
5. Count the number of varroa mites on the sticky board and divide by 3 to get the number of mites dropped per 24 hours.

Intervention

There are physical control options for varroa mites that are not harmful and can be continuously implemented without any risk of mite resistance. Additionally, physical controls can be used in conjunction with a chemical control when the treatment threshold has been reached. Varroa mites can be trapped and killed using special drone brood frames. As mentioned, the mites are more attracted to drone brood and will enter just before capping. Once the cells are capped, the frame of drone brood must be removed and frozen to kill any trapped mites. Do NOT leave the trap frame in the colony for more than 20 days, as the drones will emerge and mites will be produced instead of removed. Screened bottom boards can be used to prevent fallen varroa mites from finding a new host. Powdered sugar can be sprinkled onto the bees to encourage grooming behaviour and cause more mites to drop onto the bottom boards. To reduce mite population, 30-40 g of powdered sugar per hive can be blown in between the top bars of the brood chamber every 7 days.

Varroa population growth can also be slowed by creating a gap in the brood-rearing cycle. The simplest way to do this is to cage the queen within the colony for about three weeks or let a queenless colony naturally requeen itself. During this time, all the brood will hatch and force the mites onto the bees. This approach may lessen the need for chemical treatments and make treatments during this time more effective as the mites are fully exposed to the chemicals instead of hiding inside brood cells. However, creating a brood gap will result in a lower bee population, which may reduce honey yields. This method is not ideal for small colonies as it could prevent the colony from reaching the population size needed to survive the winter.

There are many chemical control options for varroa mites. Only use chemicals that have been registered for the treatment of varroa mites in your colonies. Non-registered chemicals have not been proven effective or safe for use. It is illegal to apply a treatment that has not been registered and approved by the Pest Management Regulatory Agency (PMRA). By applying a non-registered treatment, a beekeeper is putting the health and safety of themselves and their bees at risk and potentially contaminating their honey. Always refer to the product label for instructions on dosage, correct application, and length of treatment. NEVER use expired chemicals.

Based on the mite infestation level, treatment thresholds have been established for varroa mites. Following these thresholds prevents unnecessary costs and slows the evolution of varroa resistance to a treatment. The treatment threshold for the spring is lower than that for the fall due to the reproductive ability of the mites and sampling accuracy. One mite in the spring can produce many offspring by the end of the year, so mite levels should be kept low. In the fall, the mite population will barely increase in the coming winter months as brood-rearing slows. Additionally, when brood is present in the colony, most of the mite population is within the brood cells and can not be accounted for when sampling. To account for this decreased accuracy in determining the mite population, the threshold is lower in the spring when the most brood is present.

Monitoring Method	Spring Threshold	Fall Threshold
Alcohol wash, Sugar roll	1 mite/100 bees	3 mites/100 bees
Sticky board	9 mites/24h drop	12 mites/24h drop

Surveillance of varroa mite infestation using one of the methods described above is necessary to determine when the treatment thresholds have been met. Furthermore, surveillance following treatment is also necessary to determine whether the treatment was effective and if another treatment is needed.

Chemical controls can be separated into synthetic, organic acids, and essential oils. Beekeepers should not rely on a single chemical to control varroa mites as this will quickly lead to the mites becoming resistant to the treatment.

Instead, beekeepers should use chemicals with different modes of action in the spring and fall. Synthetic miticides are assigned to an International Resistance Action Committee (IRAC) chemical group number based on their mode of action. Organic acids and essential oils have not been assigned to an IRAC group but should be considered as belonging to different groups.

Most chemicals must not be applied when honey supers are present on the hive. Some chemicals have a withdrawal period during which honey supers cannot be added to the hive. This is because the chemicals can contaminate the honey, making it unsafe for consumption or sale. The only chemicals approved for use during the honey flow are Mite Away Quick Strips®, Formic ProTM, and HopGuard® II. NEVER put chemical treatments in the honey supers.

Synthetic

Synthetic miticides come in the form of a strip inserted into the interframe space. The strips must come in contact with the bees to be effective. Therefore, the strips are placed within the bee cluster, typically where the brood is located. All treatments are applied at a rate of 1 strip per 5 frames of bees per brood chamber, with a maximum of 4 strips for a two-chambered colony (e.g., 8 frames of bees would receive 2 strips). There should be two frames between strips in the same brood chamber. The same miticide should NOT be applied more than once per calendar year. Do NOT reuse strips.

Resistance to fluvalinate and coumaphos has been identified in Canada. There may be cross-resistance for flumethrin as it belongs to the same chemical group as fluvalinate. When chemical treatments prove ineffective (by measuring mite levels before and after treatment), beekeepers should confirm whether their colonies have resistant varroa mites by performing a resistance test. The Alberta Tech Transfer Program (TTP) offers resistance testing to beekeepers. For more information and availability, see the TTP Miticide Resistance Program.

Trade Name	Active Ingredient (IRAC Group)	Length of Treatment	Withdrawal Period
Apivar®	Amitraz (19)	42-56 days	14 days
Apistan®	Fluvalinate (3A)	42 days	0 days
Bayvarol®	Flumethrin (3A)	42 days	0 days

Organic Acids

Currently, three types of organic acids are registered for varroa mite treatment: formic acid, oxalic acid dihydrate, and hop beta acid. All organic acid treatments are best used when there is **little to no brood present** in the colony, except for Mite Away Quick Strips®. For maximum efficacy, organic acid treatments must be used within their temperature requirements.

Treatment	Active Ingredient	Temperature Requirements	Withdrawal Period
Formic acid 65%	Formic acid	10-30°C	14 days
Mite Away Quick Strips®	Formic acid	10-29.5°C	Safe during honey flow
Formic Pro™	Formic acid	10-29.5°C	Safe during honey flow
MiteGone®	Formic acid	10-30°C	14 days
Oxalic Acid Dihydrate	Oxalic acid	Above 0°C	0 days
HopGuard® II	Hop beta acid	11-33°C	Safe during honey flow

Formic acid is used as the active ingredient in several varroa treatments. Formic acid is a fumigant meaning that the hive space is filled with vapour that kills the varroa mites. For maximum efficacy, solid bottom boards should be used, and any holes closed off. The full width of the entrance must be open and at least 1.3 cm in height to prevent excessive damage to the colony. Additionally, the colony should not be disturbed during treatment, so the vapours do not escape.

Note that temperatures above 30°C during the first few days of treatment may lead to excessive bee, brood, and queen loss. It is recommended to only use formic acid in colonies with more than 6 frames of bees.

Take all necessary precautions when handling formic acid products, as they are corrosive.

Mite Away Quick Strips®

These are the only strips that kill mites under capped brood.

- Place strips on the top of the frames in the lower brood chamber.
- Option 1: Full dose
  - Two strips staggered over brood (5 cm between strips)
  - At least one month between applications
- Option 2: Half dose
  - One strip in the center
  - Two to six weeks between applications
- Maximum of two full doses per calendar year (4 strips total)

Formic acid 65%

- 4-6 applications total; subsequent applications are applied immediately following the previous application
- 5-7 days per application
- Formic acid can be applied to absorbent paper/paper towels on the bottom board or top of frames in the upper brood chamber
- Formic acid can also be pre-soaked into ready-to-use pads and placed on the top of frames in the upper brood chamber
- Amount of formic acid
  - Single chamber (4-10 frames of bees): 15-20 ml
  - Double chamber (8-20 frames of bees): 30-40 ml

Formic ProTM

- Place strips on top of the frames in the lower brood chamber
- Option 1: 14-day treatment
  - Two strips staggered over brood (5 cm between strips)
- Option 2: 20-day treatment
  - One strip in the center, replace with another strip after 10 days
- More than one treatment may be required if mite levels are still above the treatment threshold. Allow at least 30 days between treatments if using the 14-day treatment option.

MiteGone®

The beekeeper must prepare pads by soaking the pads in formic acid.

- 1 pad per 5 frames of bees
- Orient pads vertically with the open cut end facing down in the space between the outermost frame and hive wall and staple to hive wall
- Do NOT place on top of frames
- Leave pads in the hive until they are dry
- Maximum two applications per calendar year (one spring application and one late summer application)

Oxalic Acid Dihydrate 99.65%

More than one consecutive treatment is likely needed. Treatment is less effective if bees are clustering due to cold temperatures. Oxalic acid is most effective when there is little to no brood in the colony.

Solution (Trickling) Method:

- Mix 35 g of oxalic acid powder in 1 L of warm 1:1 sugar syrup.
- Using a syringe, trickle 5 ml of the solution onto the bees within a single interframe space
- Maximum dose of 50 ml per colony (nucs to double-chambered)
- 7 days between applications

Sublimation (Vapourizer) Method:

- Wear a respirator fitted with organic acid filters.
- Seal the upper entrance and other holes in the colony to prevent the vapour from escaping
- Reduce the bottom board entrance
- Place 2 g of oxalic acid powder into a vaporizer. Follow the vaporizer manufacturer's directions for use.
- Insert the vaporizer in the bottom entrance and apply heat until all the powder vaporizes
- 7 days between applications

HopGuard® II

HopGuard® II comes as folded strips soaked in liquid. The bees must come in contact with the strip. This product can be messy due to excess liquid in the package.

Treatment:

- 2 applications applied consecutively
- 10-15 days per application
- 1 strip per 5 frames of bees, with a maximum of two strips per brood chamber
- Strips are hung over a brood frame so that half of the strip is on either side of the frame
- Two frames between strips in the same brood chamber
- Do NOT use more than 4 applications of HopGuard® II per calendar year

Essential Oils

The main mode of entry for essential oils is through fumigation. For maximum efficacy, solid bottom boards should be used, entrances reduced, and any holes closed off. Additionally, the colony should not be disturbed during treatment, so the vapours do not escape. To be effective, treatments should be applied when there is little to no brood in the colony. For maximum efficacy, essential oil treatments must be used within their temperature requirements.

Do NOT use during the honey flow as oils can impart off-flavours to honey. Do NOT feed during treatment.

Treatment	Temperature Requirements	Withdrawal Period
Thymovar®	12-30°C	0 days
Apilife Var®	18-35°C	30 days

Thymovar® (Thymol)

For nucleus to double-chambered colonies

- 2 applications total; the second application is applied immediately following the first application
- 3-4 weeks per application
- Place wafers on either side of the edge of the brood area (at least 4 cm away) on top of the frames in the top brood chamber. For single wafer applications, cut the wafer in half. Do NOT place over the brood.
- Remove wafers at the end of each application

Apilife Var® (Thymol, Eucalyptol, Camphor, Menthol)
For single to double-chambered colonies

- 3 applications total; subsequent applications are applied immediately following the previous application
- 7-10 days per application, leave the last tablet in for 12 days
- 1 tablet per application; Break the tablet into 4 pieces and place in the top corners of the brood box.
- Remove tablets at the end of each application (7-10 days)
- Maximum two treatments per calendar year (6 tablets per year)

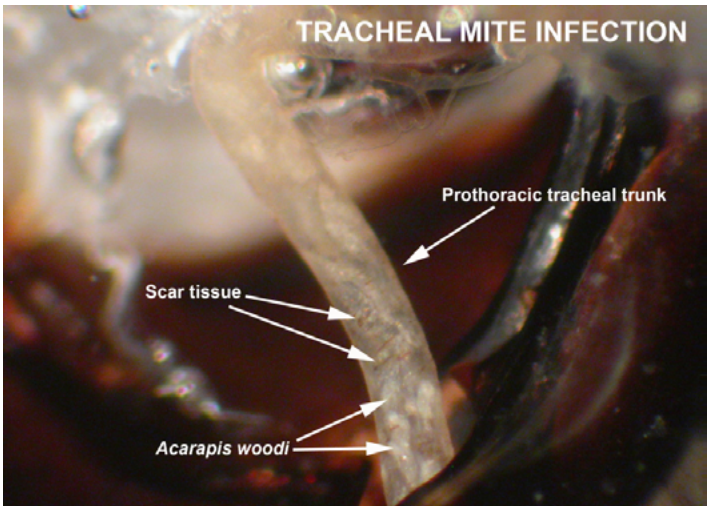
Tracheal Mites

The tracheal mite (Acarapis woodi) is a parasite that lives within the trachea (air tubes) of adult bees. The mites cause damage to the trachea, resulting in bee death. High infestations can lead to colony losses over the winter if left untreated. Tracheal mite infestations have become increasingly rare in recent years due to the use of formic acid treatments for Varroa mites.

Female mites enter the trachea through the largest spiracle found under the wing. Once inside, they pierce the tracheal wall to feed on the hemolymph (bee "blood"). After 3-4 days, the female mite will lay 5-7 eggs over several days. The male mites will mature first and mate with their sisters. Then, the newly mated female mites will leave the trachea to find a new host.

Identification & Surveillance

Tracheal mites are not visible to the naked eye and are hidden within the bee trachea. Symptoms such as dying outside the hive and colony death in the spring can be attributed to many factors. Examining a dissected honey bee trachea under a microscope is the only way to positively identify tracheal mites. A sample of 100 bees from the honey frames or entrance stored in 70% ethanol can be sent for laboratory analysis.



Control

Tracheal mite infestations can be reduced by using queens from tracheal mite-resistant stock. Otherwise, infestations greater than 10% of bees require treatment with formic acid. There are several options for applying formic acid in the colony. All formic acid treatments must be used within their required temperature range to be effective and reduce harm to the colony.

For maximum efficacy, solid bottom boards should be used, and any holes closed off. The full width of the entrance must be open and at least 1.3 cm in height to prevent excessive damage to the colony. Additionally, the colony should not be disturbed during treatment, so the vapours do not escape.

Treatment	Temperature Requirements	Withdrawal Period
Formic acid 65%	10-30°C	14 days
Mite Away Quick Strips®	10-29.5°C	Safe during honey flow
MiteGone®	10-30°C	14 days

Always refer to the product label for instructions on dosage, correct application, and length of treatment. The application of Mite Away Quick Strips® and MiteGone® have been summarized above in the 'Varroa Mites' control section.

Formic acid 65%

- 3 applications total; subsequent applications are applied immediately following the previous application
- 5-7 days per application
- Formic acid can be applied to absorbent paper/paper towels on the bottom board or top of frames in the upper brood chamber
- Formic acid can also be pre-soaked into ready-to-use pads and placed on the top of frames in the upper brood chamber
- Amount of formic acid
  - Single chamber (4-10 frames of bees): 15-20 ml
  - Double chamber (8-20 frames of bees): 30-40 ml

Tropilaelaps Mites

The Tropilaelaps mite is native to Southeast Asia and is a parasite of giant Asian honey bees. However, it has shifted to honey bee (Apis mellifera) colonies in its native range. Fortunately, it has not spread outside Asia but is a great economic threat to Canadian beekeepers.

Like varroa mites, Tropilaelaps mites parasitize the brood, but it has a shorter lifecycle and, as such, has a greater reproductive rate than varroa mites. Unlike varroa mites, the Tropilaelaps mite cannot feed on the adult bees and requires brood to survive. Tropilaelaps mites weaken and kill brood and have been associated with viral infections. The feeding wounds caused by the Tropilaelaps mite cause a range of deformities in adult bees. High infestations can arise quickly, causing colony decline and death. Additionally, honey bee colonies in Asia have been found to be parasitized by both varroa and Tropilaelaps mites.

Tropilaelaps mites are longer than wide, light brown, and smaller than the varroa mite (1 x 0.6 mm).

Restrictions are in place to prevent the importation of this parasite into Canada. However, beekeepers should remain vigilant of its possible presence.

Tropilaelaps (left) and varroa (right)

Viral Diseases

Honey bees can become infected by a number of viruses. Viruses require a host to survive and replicate. Viruses can readily kill honey bees. However, most viruses will not cause any overt symptoms at all times, and symptoms may overlap, making viruses difficult to identify. Therefore, laboratory testing is required to determine what viruses may be infecting a colony.

Viruses can be transmitted in a variety of ways. However, many honey bee viruses have been associated with other diseases and parasites, particularly the varroa mite. Unfortunately, there are currently no anti-viral treatments available to combat these viruses. Therefore, good beekeeping practices must be used to prevent virus spread and the impacts of viruses.

Management practices include:

- Disinfecting hive tools
- Keeping strong colonies
- Controlling mites and other diseases
- Replacing old queens
- Replacing old dark comb and old equipment
- Reducing movement of bees and frames among hives

This section will cover a few of the commonly seen honey bee viruses.

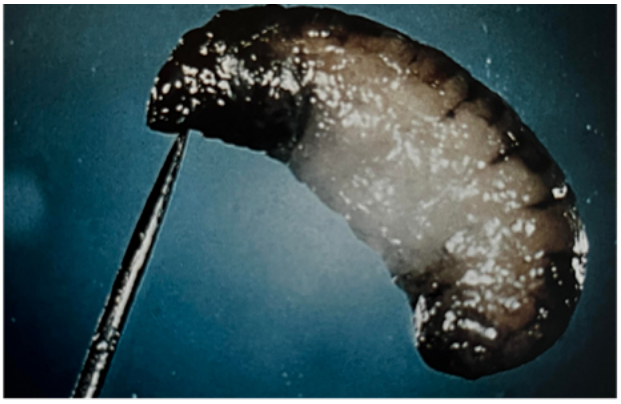
Sacbrood

Sacbrood is a virus that beekeepers will likely encounter. Typically, sacbrood is more common in the spring and summer compared to other seasons. Sacbrood infects the brood and adult bees, though 2-day-old larvae are the most susceptible. Infected adults do not show any outward symptoms but will have a shortened life span. Often, infected larvae will fail to pupate and die following cell capping.

Look for symptoms of sacbrood during your routine colony inspections. A minimum of three frames of brood should be inspected. Shake the bees off the frame for a better look at the brood. Remove the capping from brood cells that appear sunken or with perforations.

Symptoms of sacbrood include:

- Spotty brood pattern
- Outstretched larva with the head pointing upward (canoe-shaped)
- Yellowish to brown larva; darkening begins at the head and spreads to the rest of the body
- Larva skin becomes a leathery fluid-filled sac; easily removed intact



Sacbrood can be mistaken for AFB due to similar symptoms and appearance. However, larva infected with sacbrood can be removed intact from the cell and will not rope out like AFB-infected larva.

Varroa mites may improve the transmission of the sacbrood virus. Therefore, controlling varroa mite levels may reduce the incidence of sacbrood. Remove and destroy affected comb areas.

Deformed Wing Virus

Deformed wing virus (DWV) can infect every life stage of the honey bee. It rarely kills brood but can cause deformity and reduced life span in adult bees. Depending on the amount of virus transmitted and the particular variant, the bee may show no to severe symptoms. Deformities are typically associated with high virus loads.

Symptoms of DWV include:

- Shrunken or crumpled wings
- Decreased body size
- Discoloration of adults

There is a strong relationship between varroa mite infestation and DWV load. Therefore, the best, most effective way to reduce DWV load is to keep varroa mites under control.

Black Queen Cell Virus

Black queen cell virus (BQCV) primarily infects queen pupae. Although BQCV can infect adult worker bees, they do not show symptoms. Initially, infected pupae are pale yellow and sac-like, as seen with sacbrood. However, the dead pupae quickly darken following death.

Symptoms of BQCV include:
- Dark brown to black queen pupae
- Exterior of the queen cell is dark brown to black

BQCV is associated with Nosema and may be transmitted by varroa mites. Therefore, controlling nosema and varroa mites may reduce BQCV incidence.

Bee Paralysis Viruses

Numerous viruses can be categorized as paralysis viruses that affect adult bees.

Symptoms of bee paralysis viruses include:
- Darkened and hairless thoraxes and abdomens
- Trembling body and/or wings
- Wings are in a K-shape
- Crawling or unable to fly
- Paralysis or restricted movement
- Bloated abdomen
- Dead and dying bees outside the entrance of the colony

Bee paralysis viruses are known to be transmitted by varroa mites. Therefore, controlling varroa mites is the best way to reduce virus transmission.

Insect Pests

Wax Moth

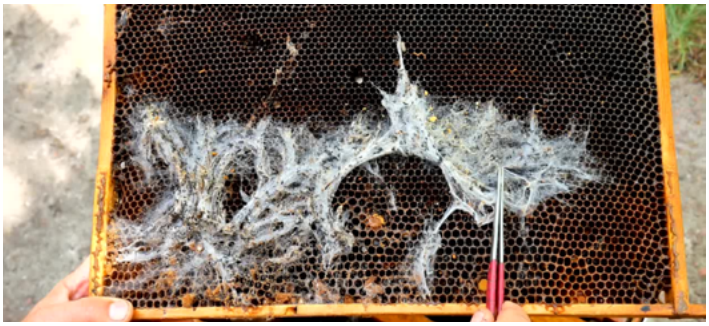
Wax moths cause damage to the comb and equipment as they feed on pollen, honey, and hive debris. Wax moths are not typically seen in hives occupied by bees as the bees will attack most foreign insects. However, a weak colony may become infested as it cannot defend itself properly. Stored comb and boxes are most vulnerable to wax moth infestations.

There are two species of wax moth found in Alberta: the Greater wax moth (Galleria mellonella) and the Lesser wax moth (Achroia grisella). The female moths will lay their eggs on the comb, preferring dark comb and hive debris. After hatching, the larvae will tunnel through the wax, leaving behind silk-like fibres. Eventually, they spin a white cocoon to pupate in before emerging as adults.

<u>Identification & Surveillance</u>

Inspect the comb, brood boxes, and bottom board for signs of larvae and adults. Adult moths are small (13-19 mm) and greyish brown. At rest, their wings are held roof-like over their body. The larvae change from pinkish white to grey as they grow in size, up to 25 mm. The larvae have a dark brown head followed by three pairs of legs and five pairs of prolegs under the middle and back of the body. Eggs are very small, making them difficult to detect.

The comb will have white silk-like webbing on its surface. Frass (insect larvae excrement) is often visible on the bottom board or frames among the webbing. Wooden equipment may have boat-shaped gouges.



Control

Bottom boards should be cleaned of debris in the spring to remove potential egg-laying sites. Keep stored equipment in a cool, well-sealed building. Avoid storing equipment for more than one season without use to reduce the chance of an infestation. Comb being stored can be sorted into dark and light, which can reduce the number of frames damaged as the infestation will be concentrated in the dark comb.

A cold treatment can effectively kill all wax moth life stages (Table 10.1). The colder the temperature, the faster the adults and larvae are killed. Equipment should be loosely stacked to allow for proper airflow and cooling. Highly damaged comb should be thrown out as the webbing is difficult for bees to remove.

Cold Treatment Time (Hours)	°C	°F
240	2	36
4.5	-7	20
3	-12	10
2	-15	5

Table 10.1. Cold treatment time and temperatures for controlling Greater Wax Moth.

There are no chemical options registered in Canada for the wax moth.

Small Hive Beetle

The Small Hive Beetle (Aethina tumida) or SHB is a honey pest native to Africa that has primarily spread to other countries through the movement of bees, bee products, and equipment. SHB was introduced to Alberta, British Columbia, Manitoba, and New Brunswick, but it did not establish. It has established in Ontario and areas of the United States of America and may become established in Quebec. The SHB causes damage to the comb and honey in weak colonies and honey houses. The larvae defecate in the comb, causing the honey to ferment and be unfit for consumption. Familiarity with this pest is necessary to prevent its spread.

The female beetle lays egg masses on or near the comb within cracks and crevices in the hive. The larvae will chew through the comb, feeding on brood, pollen, and honey. After 10-16 days in ideal conditions, the larvae will leave the hive to pupate in the soil near the hive entrance. The adult beetle usually emerges after 15-30 days. The development rate of beetles depends on temperature and moisture. The beetles are capable of flying up to 10 km.

Identification & Surveillance

The adult beetles are very small (5-7 mm) and have a reddish-brown to black oblong body. They have short club-shaped antennae, and their elytra (wing covering) do not reach the end of their abdomen. The larvae are a long, whitish grub with short spines on their back. They have three pairs of legs near the head and no prolegs. They also do not produce silk like the wax moth. Adult SHB is difficult to identify as it is similar to other small native beetles.

Adult beetles can be seen on the top bars and bottom board. They are light-sensitive and will run away and hide when the hive is opened. Larvae can be found on frames or pollen patties. The fermented honey smells like rotting oranges and may run out of the cells onto the bottom board. Low infestations are difficult to detect.

The small hive beetle (Aethina tumida) is required to be reported to the Canadian Food Inspection Agency (CFIA). If you suspect a colony has small hive beetle, contact the Government of Alberta BHAT for an inspection. They will contact the CFIA if they confirm the presence of SHB.

Control

Preventing the establishment of SHB in Alberta is the first line of defence. SHB infestations can be prevented by not purchasing colonies, packages, and

equipment from areas with known SHB infestations. Mechanical control measures can also be used, such as beetle traps. Biosecurity questions to ask a seller are outlined in Chapter 3: Getting Started.

Strong colonies are more likely to prevent beetles from getting into the hive. Honey houses are also at risk of SHB infestations. Therefore, honey should be extracted within 48 hours after storage and stored in rooms with less than 50% relative humidity. Extracted honey should be stored in sealed drums, and wax cappings should be processed promptly to avoid infestation.

Bee Louse

The bee louse (Braula coeca) is not considered an important pest of honey bees. Contrary to its name, the bee louse is a small, wingless fly. It lives on adult bees, preferably workers or queens, and steals nectar and pollen from its hosts' mouth when they transfer food to other bees. One bee can be a host to one or more bee lice.

The adult bee louse lays its eggs on cells of capped honey. The larvae tunnel through the capping to feed on the wax and pollen. This causes only aesthetic damage, though this may be significant for beekeepers that sell comb honey products. There are no chemicals registered for the bee louse in Canada.

Identification

The bee louse is often confused for the varroa mite as they are both similar in size and colour. However, the bee louse is smaller and rounder, with three legs on each side of the body (six legs total). The varroa mite is oval and flat, with eight legs at the front of its body.

Images of varroa (left) and bee louse (right)

Wasps and Hornets

Yellowjackets (Vespula species) and bald-faced hornets (Dolichovespula maculata) are common visitors to honey bee colonies. They will enter hives to steal honey and brood. Usually, they are a minor nuisance. However, some years have more nests with larger populations that can kill a weak colony.

Adult yellowjackets feed on sugar from nectar, fruit juice, and tree sap. They also forage for protein such as meat, fish, or insects to feed their young. Peak yellowjacket population size occurs in late summer. Population growth slows in the fall as food becomes scarce, and the yellowjacket colony dies when temperatures drop below 0°C. Several mated daughters will seek refuge within crevices for the winter and emerge in the spring to start a new colony.

Identification

Yellowjackets are similar in size to honey bees but have bright yellow and black alternating stripes, hairless bodies, and yellow legs. They make paper nests both above ground and underground. Bald-faced hornets are larger than yellowjackets and mostly black with some pale yellow to white stripes. They only build their paper nests above ground.

Image of yellowjacket and bald-faced hornets.

Control

Maintaining strong colonies will keep robbing wasps and hornets out of the hive. Plugging holes and using an entrance reducer can help a smaller colony protect itself from predation. Remove paper nests if found. Unlike honey bees, they can sting multiple times, so beekeepers should wear protective clothing. Do not use traps baited with sugary substances, as it will likely attract honey bees and other beneficial pollinators.

Ants

Ants can cause issues for both the bees and beekeepers. They are attracted to the honey and pollen within the hive and may nest inside or underneath the hive. Repeated visits by ants may irritate the bees, causing them to become more aggressive towards the beekeeper. Ants within the apiary can be a nuisance for the beekeeper, as disturbing the nest will cause the ants to crawl onto the beekeeper. Some species, such as carpenter ants, can cause structural damage to wooden hive parts.

Keep the area surrounding the colony clear of brush and wood, which are common nesting materials for ants. Access to the colony can be prevented by covering hive stands with sticky paste or placing the legs in oil-filled cans. Ant nests can be treated with registered ant control products. Follow the label to ensure effective control of the ants. Avoid getting any chemicals on the hive or bottom board to prevent bee death.

Animal Pests

Mice

Mice can be destructive to both stored equipment and outdoor wintered colonies. Mice will build nests inside colonies and hive equipment, often destroying frames of comb to make room for their nest. They will also feed on honey, pollen, and dead bees and may chew holes in insulated winter wraps and pillows for nesting.

Furthermore, the deer mouse (Peromyscus maniculatus) is a vector of Hantavirus in Canada, a rare but potentially fatal viral disease. Hantavirus is transmitted by breathing airborne particles from infected rodent droppings, urine, and saliva. This poses a health risk to beekeepers when working with an infested hive.

Stored hive equipment should have the top and bottom of the stack sealed to keep mice out. To prevent entry, outdoor-wintered hives should have their entrance reduced to 1.3 cm (1/2 inch).

Commercially available poison or traps can be placed where equipment is stored. Poison bait can be placed on top of the inner covers and below the hives to protect outdoor-wintered colonies. Ensure bait is properly disposed of after use to prevent non-target poisoning.

Skunks

Skunks are nocturnal foragers that will scratch at the entrance to cause bees to come out and eat them. Over time, this disturbance can increase the aggressiveness of the colony.

Signs of skunk predation include:
- Destroyed vegetation surrounding the hive
- Small holes dug in front of the hive entrance
- Dislodged or removed entrance reducers

Relocate hives from areas that have high skunk activity. Remove deadouts and other hive equipment from the apiary to avoid attracting skunks. Elevating the colony will force the intruder to expose their belly to bee stings. Electric fences can keep out skunks if used properly.

Skunks can be hunted or trapped year-round by the landowner or with permission from the landowner. Either option may result in the skunk releasing its stinky spray, which will linger long after its removal. Follow the Alberta Government's Hunting and Trapping regulations. Contact your local Fish and Wildlife office for additional information.

Raccoons

Raccoons are nocturnal, opportunistic foragers that will feed on brood and honey. An adult raccoon is capable of toppling a small hive. They are quite agile and can lift off hive lids to gain access. Typically, they are more common in urban and suburban areas.

Remove deadouts from the apiary to reduce the chance of attracting raccoons. Using a heavy lid or placing a rock or brick on top of the lid can make it too heavy for the raccoons to remove. Electric fencing is also effective at deterring raccoons.

Raccoons can be hunted or trapped year-round by the landowner or with permission from the landowner.

Follow the Alberta Government's Hunting and Trapping regulations. Contact your local Fish and Wildlife office for additional information.

Bears

Bears are a well-known predator of honey bee colonies. Typically, black bears enter apiaries in the evening or at dusk to feed on the brood and honey. They can easily push over a colony to gain access. Bears that have learned colonies are a food source will return to the apiary or seek out other apiaries. Colonies that survive a bear attack will likely become very aggressive. The damage caused by bears to equipment can be quite substantial.

Signs of bear predation include:
- Toppled hives
- Scattered equipment
- Broken frames and boxes

Preventative measures must be put in place before a bear attack. It is hard to deter a bear who knows a good meal is waiting. Remove attractants such as deadouts and empty equipment from the apiary. Avoid placing apiaries in ideal bear habitats such as forested areas and near streams.

Electric fences can be effective at deterring bears. A good electric fence will include an energizer, a ground rod, and several wires held up by posts. The fence should use 1.25 to 1.5 m tall posts, placed 6-8 m apart. There should be at least five to six wires at heights of 20 cm, 40 cm, 60 cm, 85 cm, 110 cm, and 135 cm. The wires should be fairly tight, so they will make contact with the bear's skin when touched. A 12-volt battery and a good quality energizer that deliveries 5,000+ volts with a joule rating of at least 0.7 are necessary. Solar fencers are preferred over battery-powered fencers as battery replacements can be hard to time or forgotten. Energizer should be placed inside the fence. For the ground rod, a six-foot-long steel rod is pounded into the ground. The rod may need to be longer if the ground is very dry as moisture is needed for the electricity to reach the energizer and adequately shock the bear. Vegetation around the fence must be kept short as long grass touching it will ground it, rendering it ineffective. For more information, see Bear Smart: Electric fences and bears.

If a bear has become a recurring problem, contact your local Fish and Wildlife office on how to proceed.

Livestock

Pastures stocked with livestock are regularly used to house apiaries. Livestock are curious and may accidentally disturb honey bee colonies. Livestock may get spooked if stung and may injure themselves. If allowed to graze among the colonies, livestock may use the colonies as scratching posts and push them over. They may also be attracted to barrels of sugar syrup which can make them sick if they consume the syrup.

Fencing is the most effective way of preventing encounters between livestock and the colonies. This can be done with barbed wire or electric fencing. Note that the vegetation must be maintained, so electric fences do not become ineffective. Sugar syrup feed should be kept within a secured area. If not possible, barrel feeding should not be used.

Humans

Humans can be responsible for the vandalism or theft of colonies and hive equipment. Typically, the theft of colonies or equipment is committed by other beekeepers. Often, it is difficult to identify the perpetrator, so preventative action is best.

Place apiaries away from the road and out of sight. Marking or branding equipment is useful for identifying stolen equipment. Modern solutions such as tracking chips and security cameras can be used; however, this may not be practical for all beekeepers. Strapping down colonies or surrounding them with fencing can deter thieves and vandals.

Pesticide Poisoning

Honey bee colonies can be exposed to pesticides in the surrounding environment and the hive. Pesticides and their use in Canada must meet the requirements of the Pest Control Products Act that is enforced by Health Canada's Pest Management Regulatory Agency. When used as directed on the label, pesticides approved for use in Canada are not considered a risk to honey bees and other pollinators.

Inappropriate use of pesticides can result in bee poisoning at either an individual or colony level. Poisonous plants (e.g., death camas, corn lily, spotted locoweed, timber milkvetch) can poison and occasionally kill bees. Poisoning can occur in several ways.

Ways that Bees can be Poisoned with Pesticides

- Pesticides are applied when bees are actively foraging on the plants
- Pesticides are applied to a pollinated crop during bloom
- Pesticides are applied to weeds in or around a blooming field
- Pesticides drift onto neighbouring plants
- Pesticides contaminate water that is used by the bees
- Inappropriate use due to lack of communication between growers and beekeepers
- Larvae are poisoned through exposure to contaminated nectar and pollen
- Inappropriate chemical treatment of hives

<u>Identification</u>

Pesticide poisoning will impair or kill bees which can cause colony-level effects. Be aware that some of these signs can also be associated with other causes, such as diseases or starvation.

Signs of pesticide poisoning in individual bees may include:

- More dead and/or dying bees than normally found outside the hive
- Dead bees with their tongues out, wings unhooked, and back legs pointed backwards
- Bees moving erratically (e.g., jerky or wobbly) or appear weak and immobile
- Wet appearance due to regurgitating honey from their stomach

Signs of pesticide poisoning at the colony level:

- Dead brood or a large amount of brood with only a few adult bees inside the hive
- Lower foraging activity due to increased bee death
- Presence of stress-related diseases, such as chalkbrood

Another sign of poisoning is the presence of entombed pollen cells. It is theorized that if the bees sense that the pollen has been contaminated, they will cover the cells with propolis to prevent the spreading of the contaminant.

Beekeepers are encouraged to monitor colonies for behavioural changes and/or poor colony performance. Beekeepers should be aware of pesticides used in their area and familiarize themselves with new products. If a pesticide incident is suspected, beekeepers are encouraged to report it to Health Canada's Pest Management Regulatory Agency (1-800-267-6315) and the provincial apiculturist.

Below is a list of items to document for the report:

- Prevailing winds in the area affected
- Product name and/or active ingredients (if known or suspected)
- Note the method of exposure (if known or suspected)
- Take photos and videos of the event
- Collect ¼ cup of adult bees, brood, pollen, honey/nectar, or wax, store in labelled containers, and immediately freeze and protect them from moisture and light
- Note the previous health status of the colony
- Note any pesticide treatments used
- Note any other important details

<u>Prevention</u>

If the colony has not lost too many foragers, there should be enough brood and stored food for the colony to recover on its own. To prevent continual exposure, hives may be moved to a pesticide-free area. If the poisoning occurs when little forage is available, the beekeeper might need to supplement the colony with sugar syrup, pollen, and clean water. If there is a risk of pesticide build-up in the comb, beekeepers may replace the comb or move the bees to a new hive.

There are a variety of practices that beekeepers can utilize to prevent exposing their bees to pesticides. One of the most helpful methods is communicating with neighbouring growers, farmers, landowners, and pesticide applicators. Clearly identify where your apiary is and explain the importance of following the directions on pesticide labels and being aware of weather conditions to reduce drift. Maintain that communication with neighbours and notify them if a problem occurs.

For information on pesticides and using them safely, visit:

- Pesticides in Canada – https://www.canada.ca/en/health-canada/services/consumer-product-safety/pesticides-pest-management/public.html
- Practices to Reduce Bee Poisoning from Agricultural Pesticides in Canada – https://pollinator-partnership.ca/assets/generalFiles/Reduce.Bee_.Poisoning.CanadaGuide.FINAL_.noCrops2.pdf

Important Contacts

Inspection Services and Resources
Government of Alberta Bee Health Assurance Team
Phone: 780-644-8746
Email: bee@gov.ab.ca
Website: https://www.alberta.ca/bees-and-apiculture.aspx
Bee Health App available on Android and iPhone

Diagnostic Services
National Bee Diagnostic Centre
Phone: 780-357-7737
Email: nbdc@gprc.ab.ca
Website: https://www.gprc.ab.ca/research/nbdc/

Irradiation Services
Sterigenics (formerly Iotron Industries Canada Inc.)
Website: https://sterigenics.com/
Nearest facility: Port Coquitlam, British Columbia

Hunting and Trapping Information
Government of Alberta Fish and Wildlife
Hunting and Trapping regulations: https://albertaregulations.ca/
Office contact information: https://www.alberta.ca/fish-and-wildlife-contacts.aspx

The Importance of Biosecurity

Unlike other livestock, honey bees cannot be contained by fencing, and it is hugely, some may argue impossible, to control their exposure to pests and diseases and pesticides. This intertwines the beekeeping industry like no other. Beekeepers of all sizes have a responsibility to protect their bees and the industry through appropriate biosecurity practices. Risks to a colony's biosecurity can result in increased care costs (e.g., increased labour and treatment costs) and decreased colony health and production.

Biosecurity can be defined as practices used to minimize the transmission of pests and diseases in animal and plant populations. This includes minimizing the introduction, spread, and release of pests and/or diseases. Working together, Alberta's beekeepers can improve the monitoring, detection, and control of biosecurity risks to our honey bees. Beekeepers should review Appendix D: Biosecurity Checklist to determine if they are following biosecurity practices.

Be Aware of Threats

Everyone responsible for caring for the honey bees must be familiar with native and invasive biosecurity threats and the symptoms of those threats. Chapter 10: Colony Health details the pest and disease risks that face Alberta's honey bee colonies and gives tips on the signs and symptoms of these biosecurity risks.

Everyone responsible for the care of the bees must be educated on the apiary's biosecurity practices. If you are a large or commercial beekeeper, this education may be in the form of a training session. For smaller beekeepers, it may be a one-on-one mentoring session. A written biosecurity plan is preferred to ensure consistent biosecurity precautions and responses. Keep training up-to-date so that everyone is aware of changes to biosecurity practices and risks.

Written biosecurity plans are preferred to keep everyone aware of and up-to-date on appropriate practices, monitoring, and response.

Buy Clean Bees and Equipment

Diseases like American Foulbrood can survive on equipment for more than 40 years and infect healthy hives.

Diseases and pests can enter an apiary in numerous ways, and not all are under the control of the beekeeper. However, beekeepers can minimize the risks introduced through the bees and equipment they bring in.

Beekeepers should ask sellers about diseases, pests, and treatments that have been done with their colonies to judge the biosecurity risk they could be exposing their bees to. Chapter 3: Getting Started includes where and how to purchase bees and questions to ask a seller.

When buying bees and used supplies, ask the seller about their hives' disease status to avoid spreading disease to your bees.

Everything that encounters the bees, directly or indirectly, should be kept clean to avoid spreading disease between colonies. People, vehicles, and equipment can all be carriers of disease and pests. Before entering and leaving the apiary, checks should be made to ensure that biosecurity risks are not brought into or spread from the apiary.

All residues (e.g., wax, propolis, honey) must be removed before equipment and tools can be cleaned. A chlorinated cleanser is often recommended, but rubbing alcohol can also be used. Hive tools can be scorched with a propane torch to remove any diseases.

Remove all residue on tools to properly sanitize them.

If hives are not well maintained, colonies may become weakened, more vulnerable to pests and disease, and susceptible to robbing. Strong colonies that can protect themselves from robbers and other pests are less likely to become exposed to biosecurity risks. To further avoid robbing and attracting other pests, honey, comb, wax, and propolis should never be left out in the open. Honey must be cleaned up as soon as possible. See Chapter 5: Seasonal Management for more information on robbing behaviour.

An essential aspect of maintaining a hive is regularly replacing two to four frames per colony every year. The older comb is usually darker in colour and easily identified. New beekeepers can wait to start replacing their frames until they see darker comb. Beekeepers often choose to replace frames when they remove deadouts in the spring. If possible, brood frames should not be older than five years.

Annually replace 20% of the frames in each colony.

Monitor

Beekeepers and staff must constantly monitor each colony and apiary and document any new or concerning events, pests, or signs of disease. Written records are always preferred, and images are encouraged. Pictures are easier to reference than a memory! Constant and consistent monitoring is crucial to detecting a biosecurity risk.

Accurate records are vital to a biosecurity plan and are critical to detecting and controlling pests and disease risks.

Know the Law

All beekeepers must be aware of laws and regulations to protect the health and safety of the honey bee industry. Chapter 13: Legislation summarizes the laws and regulations that all Alberta beekeepers, big and small, should be aware of.

Visitors

All visitors to an apiary should know what biosecurity measures are in place. However, sometimes visitors come unexpectedly, and biosecurity signs can be a helpful tool. They alert the visitor that they have entered the apiary and who they should contact for additional information.

An example of an A4 corrugated plastic sign that can be posted at each apiary or moved around with each load of hives can be found in Appendix E.

Animal rights vs. animal welfare

Animal rights are the philosophical view that animals have the same or similar rights as humans. Animal rights advocates may believe that humans do not have the right to use animals as pets or for food, research, or clothing.

Animal welfare supports the belief that humans have the right to use animals and have a responsibility to treat them humanely.

Five Freedoms

The Five Freedoms are the foundation of appropriate animal care practices. Everyone responsible for the care of animals, including honey bees, must be familiar with the Five Freedoms.

1. **Freedom from hunger and thirst:** By providing ready access to water and an appropriate diet to maintain good body condition, health, and vigour.
2. **Freedom from discomfort:** By providing an environment with appropriate shelter that protects the animal from harmful heat or cold.
3. **Freedom from pain, injury, and disease:** By the prevention, diagnosis, and treatment of injury and disease.
4. **Freedom from fear and distress:** By providing conditions and treatment that promote mental well-being and avoids suffering.
5. **Freedom to express normal behaviour:** By providing an appropriate environment, with enough space, that allows the animal to express their normal behaviour.

Honey bee colonies as a "superorganism"

Honey bee colonies are often referred to as a superorganism. The colony forms a collective social unit that functions like a single organism and performs all the necessary functions for survival: reproduction, brood rearing, foraging, comb building, defending, etc. A single or few individual honey bees cannot carry out all these functions and will die without the colony unit.

The caste system (queen, workers, and drones) reinforces the need for the colony to work collectively. The queen produces pheromones that bring together the colony to support their queen as the sole reproductive female. The workers perform all other tasks, including bringing in food to support the brood and adults and monitoring for threats to the colony. As the workers age, their jobs in the colony change and younger bees take over their last task, known as temporal polyethism.

Normal behaviour

Beekeepers must be familiar with the normal behaviour of honey bees to quickly detect abnormal behaviour that may indicate aggressiveness or the presence of disease or pests.

Honey bees communicate with each other through touch, sound, chemical, and visual signals and cues. As humans, we cannot detect all of these signals and cues. Still, we can use visual and auditory indicators to assess the bees' behaviour. By working closely with the colony, beekeepers will become familiar with the everyday movements and sounds that the bees make when working with them. For example, bees should be seen to walk calmly across the frames, and a low hum is normal. When a healthy hive is first opened, the bees may show signs of aggression to the intrusion (e.g., erratic movements and a loud hum). Still, they should quickly return to their normal behaviours, especially after using a small amount of smoke.

The hive environment can also give the beekeeper information on the behaviour of the bees. Typically, honey bees coordinate together to construct the hive, raise young, and maintain a healthy environment. Honey bees will maintain the hive's internal temperatures in colder weather by clustering together and exercising their wing muscles to generate heat. In hotter weather, bees will disperse to spread out their heat, fan their wings, and collect water.

The colony will also maintain the cleanliness of the hive by removing mould, fungi, pests, and foreign bees. Worker bees can be seen cleaning surfaces where they are leaning forwards and using their front feet to scrape the surface and move particles to their outer mouthparts. Items that can not be removed will be covered with propolis. Bees will also remove dead bees from the nest to maintain their cleanliness and decrease the risk of disease and pests. Dead bees will usually be found outside the hive.

Do bees feel pain?

The question 'do bees feel pain?' has been asked by scientists for decades. Unfortunately, we don't know. Honey bees, like other insects, have a different nervous system than humans and may perceive experiences differently.

Research has shown that honey bees respond to painful stimuli, but whether or not they experience pain is unknown. Studies have tried to determine if bees under painful stimuli would eat more food that had a pain medication than food without. But, again, these studies have been inconclusive. Regardless of whether bees can feel pain, the beekeeper's responsibility is to ensure that the bees are well cared for and minimize risks to their welfare.

Unwanted behaviour

Like other livestock, honey bees have some undesirable behaviours that beekeepers should monitor to protect human safety or prevent honey bee health issues.

Swarming

A new colony is produced through the swarming of an established colony. Swarming happens just before a new queen is ready to emerge in the hive. The old queen and about half of the colony will leave the hive, searching for a new home. The swarm of bees will fly until they reach an area they can rest for a few hours, such as a tree limb or fence post (usually within 100 meters of the original hive). Some bees will scout for a new location, such as a hollow tree, attic, etc. (usually within 5 km from the original hive). The new queen and remaining colony will stay at the old hive.

Although swarming is normal behaviour, it reduces the colony size dramatically and, therefore, reduces the amount of honey that can be produced. Additionally, swarms can be a nuisance to neighbours, especially if they become established in a nearby structure. To prevent swarming, beekeepers must monitor their colony's strength and space, replace the queen when there are signs of weakness (see Chapter 5: Seasonal Management), and regularly replace their queens (every year or two; see Chapter 6: Handling for queen introduction methods).

Swarming happens most commonly when there is an increase in hive temperature and humidity and/or the colony runs out of space in the hive. This signals to the bees that their colony is outgrowing their hive and must swarm. Swarming usually occurs in the late morning and early afternoon when temperatures are highest. Beekeepers can prevent swarming by giving the bees plenty of space and good ventilation in the hive (e.g., removing entrance reducers) and ensuring that queens are young (1-2 years) and of high quality.

When preparing to swarm, the colony no longer focuses on their routine jobs in the hive. The workers will lower the amount they feed the queen so that she is lighter and able to fly further, and, in return, she lays fewer eggs. The workers will stop foraging and start gorging themselves on honey in preparation to swarm. A hive often loses half of its nectar stores before swarming—all the more reason to prevent swarming.

Especially during high nectar flow, beekeepers must regularly inspect the hives to respond quickly when the colony needs space to process and store honey and lay and raise brood. The beekeeper should check for swarm cells along the bottom and sides of the brood frames. Swarm cells should be removed every nine to 10 days to prevent swarming.

Some beekeepers choose to clip one of their queen's wings to prevent her from swarming. However, this is a very delicate task in which the queen can be harmed or killed. Regardless, if a queen does have a clipped wing, the colony can still try to swarm but will return when they realize that the queen is not with them. Once the new queen emerges, she may be the one to leave with the swarm.

Swarms can be captured and rehived to add to the beekeepers' apiary. A brood chamber with a bottom board and cover should be prepared to capture the swarm. Sometimes, when the swarm is easily accessible, it can be shaken into a brood chamber. Bees in a swarm are less likely to sting when handled. If the swarm is not easily reached, a container can be used to collect the bees and move them to the brood chamber. The queen must be in the new hive, or the bees will leave to be with her.

A swarm captured in May or June has the chance to grow strong and prepare for winter. Swarms caught later in the year (e.g., July and August) will not have as much time to grow and are more likely not to survive the winter. Like any addition to an apiary, captured swarms should be closely monitored for brood development and signs of disease and pests. New beekeepers can contact their local beekeeping clubs and neighbouring beekeepers for help.

Captured swarms should be monitored for signs of disease or pests that could be spread to other colonies in the apiary.

Aggression

Adult honey bees work together and communicate through signals to defend their hive from robbing bees, pests, and predators. A queenless colony will also be more aggressive. While aggression does have a genetic component, past experiences influence how honey bees react. For example, a colony pestered by predators (e.g., skunks) is more likely to be aggressive than a colony free of predators.

Aggressive bees beat their wings harder, resulting in a loud hum, walk erratically across the frame, and are more likely to sting. When opening a hive, it is normal for the bees to produce a louder hum initially, but they should calm down quickly. However, aggressive bees will not calm down, and the bees may be pointing their abdomen upwards, ready to sting. If signs of aggression persist after opening a hive, it is best to close the hive and check back later. Colonies that are consistently aggressive should be removed from the apiary.

For urban beekeepers, it is important to protect neighbours and pedestrians from defensive or aggressive bees. In Chapter 4: Basic Colony Requirements and Components, the 'Apiary Setup and Hive Placement' section describes where to place hives or barriers to minimize the interactions between the honey bees and the public.

Robbing

When there is little forage available, bees are attracted to the smell of honey in other hives and on beekeeping equipment and will try to steal the food. Robbing bees can carry diseases and pests that could be spread to other bees when entering other hives and comingling with other bees on equipment. In addition, robbing bees will often target weaker colonies and are more susceptible to picking up diseases and pests.

Prevent robbing in the apiary to reduce the risk of disease and pests.

Beekeepers should monitor their hives for signs of robbing by watching for robbing bees nervously hovering around entrances and hive joints. Bees may also be seen fighting at the entrance, on equipment, or on the ground outside of the hive. When the nectar flow is slow, beekeepers should perform beekeeping tasks in the late afternoon. If robbing does occur, the bees will soon be returning to their hives for the night. If robbing is noted earlier in the day, beekeeping tasks should be put on hold for a later time.

Beekeepers should ensure that the hives are correctly closed to not attract robbers. If robbing is becoming an issue, entrance reducers can be used to help colonies defend themselves from robbing bees. However, reducers should not be used if there is a concern about high temperatures or humidity in the hive. Beekeeping equipment should be cleaned of honey and stored away from the bees. The goal is to avoid circumstances that attract robbers and cause bees from other hives to comingle.

More information on preventing robbing can be found in Chapter 5: Seasonal Management. Methods for feeding honey bees that minimize the risk of robbing are described in Chapter 4: Basic Colony Requirements and Components.

Spring defecation

In the spring, when temperatures rise above 10°C, honey bees will leave their hives to eliminate waste (called cleansing flights) they have been holding in all winter. The bees will also take advantage of the warmer temperatures to clean out any dead bees from the hive. As a result, it is normal to see droppings of waste and dead bees on and outside the hive during this time.

In urban areas, hives should not be placed too close to neighbours' properties as the bees could defecate on the neighbouring property during the cleansing flights. While this is normal and not harmful, it is an annoyance. See Chapter 4: Basic Colony Requirements and Components for methods of minimizing interactions between bees and the public.

Attraction to water

As described in Chapter 4: Basic Colony Requirements and Components, water is crucial for honey bee welfare, both for their intake and maintaining hive temperature and humidity. Bees will be drawn to water sources to meet those needs. Unfortunately, if the beekeeper does not offer a water source, they will search for it. This could be a neighbour's pool or water fountain in urban areas.

To prevent bees from becoming annoying to neighbours, beekeepers should offer and maintain a water source for their bees. It is best to establish this water source early in the spring so that the bees know where to find water and will not go searching. Methods to offer water are described in Chapter 4: Basic Colony Requirements and Components.

Local Regulations

Before investing in beekeeping, ensure that you are permitted to keep honey bees in your area and familiarize yourself with applicable regulations. Many communities across Alberta have passed policies or bylaws for raising bees with specific requirements that can usually be found on the municipality office website. This chapter reviews beekeeping laws that beekeepers must be familiar with and links to the formal regulations and interpretive tools. In these regulations, the term livestock includes honey bees.

Municipal Bylaws and Policies may include:

- Restriction on the number of hives (1 to 2 is typical),
- Requirement for residents to apply for and pay to maintain an annual license,
- Requirement to notify or gain permission from adjacent neighbours,
- Completion of an educational course from an approved organization or association,
- Location and placement restrictions for the hive(s),
- Size restrictions of the hive(s),
- Restricting honey and honey-related products for personal use only,
- Requirement to obtain liability insurance,
- Permission from the property owner,
- Require proof of support from a qualified mentor for the first year,
- Require a disease and swarm control plan,
- Require adequate water be available to bees at all times,
- Proof of registration with Provincial Apiculturist, and
- Proof of Premises Identification.

Those who live on acreages outside the municipalities must follow bylaws specific to their county, municipal district, or special area. These bylaws are usually called Animal Control Bylaws or Land Use Bylaws and specify how many animals may be owned, housed, and controlled. County bylaws and policies are usually found on the county's official website.

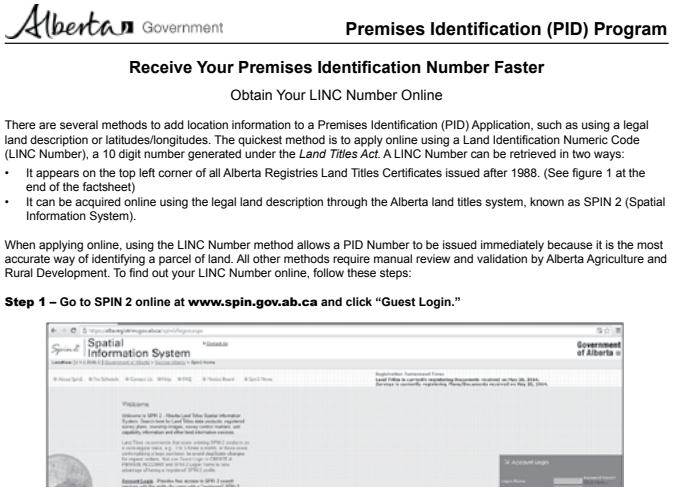
County Bylaws and Policies may include:

- Restrictions on the number of hives per acre,
- Requirement of a permit, and
- Location and placement restrictions for the hive(s).

Premise Identification Number

In Alberta, anyone that owns livestock or poultry must apply for a Premise Identification (PID) account and get a PID number for the area(s) where the animal(s) are located. A PID is not needed if the animals are kept at a commingling site, such as a stable, which does not apply to honey bees. A PID number is mandatory under the Animal Health Act and is used to plan for, control, and prevent the spread of disease. The PID number has also been used to notify owners of an emergency, such as flooding.

A PID number must be gained within 30 days of acquiring the animal(s); however, many municipal bylaws require the applicant to have a PID number before being approved.



Alberta Government — Premises Identification (PID) Program

Receive Your Premises Identification Number Faster

Obtain Your LINC Number Online

There are several methods to add location information to a Premises Identification (PID) Application, such as using a legal land description or latitudes/longitudes. The quickest method is to apply online using a Land Identification Numeric Code (LINC Number), a 10 digit number generated under the *Land Titles Act*. A LINC Number can be retrieved in two ways:

- It appears on the top left corner of all Alberta Registries Land Titles Certificates issued after 1988. (See figure 1 at the end of the factsheet)
- It can be acquired online using the legal land description through the Alberta land titles system, known as SPIN 2 (Spatial Information System).

When applying online, using the LINC Number method allows a PID Number to be issued immediately because it is the most accurate way of identifying a parcel of land. All other methods require manual review and validation by Alberta Agriculture and Rural Development. To find out your LINC Number online, follow these steps:

Step 1 – Go to SPIN 2 online at www.spin.gov.ab.ca and click "Guest Login."

PID Number is needed to:

- Buy medications from licensed retail outlets (e.g., Peavy Mart),
- Transport livestock,
- Sell livestock, and
- Apply for agricultural government-sponsored grants, licenses, and programs.

Animal Health Act

The Animal Health Act was designed to control disease spread and allows the province to respond to diseases that may affect human health, animal health, and food safety.

Bee Act and its Regulation

The Bee Act and its Regulation regulate the beekeeping industry in Alberta. The Act and its Regulation have established a system to address threats to the industry, such as disease outbreaks. Under the *Bee Act,* bees and/or beekeeping equipment owners must register with the Provincial Apiculturist by June 29 of each year. A certificate of registration can be requested if needed. There is no cost to registering with the Provincial Apiculturist.

The *Bee Act* also bans the importation of bees in hives, package bees, queens, or used beekeeping equipment into the province without a permit. A permit request form and inspection report from the exporting province's inspectors must be sent to the Provincial Apiculturist. This information will be used to issue a permit. Note that all provinces in Canada require that bees or used equipment not be imported into their province without prior written consent. If you intend on moving bees or used equipment to another province, you will need to contact the Bee Health Assurance Team for an inspection.

Live bee purchases must be reported to the Provincial Apiculturist. In addition, beekeepers must provide an apiculture inspector with a descriptive list of the land(s) where bee colonies are located within 24 hours after being requested.

An apiculture inspector can enter land or a building, other than a private dwelling, to ensure compliance with the Bee Act. When present, if requested, the inspector must produce identification.

An apiculture inspector can:

- Inspect bees and beekeeping equipment,
- Read and make copies of any records related to the transportation, possession, or sale of bees and beekeeping equipment, and
- Remove bees and/or beekeeping equipment to test for the presence of Africanized bees or regulated disease.

If a regulated disease or Africanized bees are suspected, an apiculture inspector can:

- Instruct the beekeeper to quarantine bees and beekeeping equipment,
- Instruct the beekeeper to take steps to eradicate the disease, and/or
- Instruct the beekeeper to treat the bees for disease.

If an inspector has proof that a regulated disease or Africanized bees are present, they may instruct the beekeeper to destroy the bees and beekeeping equipment. However, destruction will only be required if all control options have failed or if the infection is severe.

Contact the Bee Health Assurance Team:
Phone: 780-644-8746
Email: bee@gov.ab.ca
Website: https://www.alberta.ca/bees-and-apiculture.aspx

Selling Honey and Related Products

Municipal bylaws often prohibit urban beekeepers from selling their products, while others may require special permits to sell. Beekeepers who wish to sell their products must follow provincial and federal regulations. Beekeepers that are interested in selling at farmer's markets must consult with that market to determine what licensing or permits are required.

This section is not an exhaustive list of all applicable regulations.

Honey Grading Regulation

The Honey Grading Regulation outlines requirements for grading, packaging, and labelling honey created and sold in Alberta. Honey must be graded before being sold unless sold directly to a customer at the beekeeper's home, honey house, or farmer's market. To grade honey, the beekeeper must be licensed with the CFIA as part of the Safe Food for Canadians Regulations.

Honey sold directly to the customer via farm gate and farmer's markets must be labelled with:

- The beekeeper's name and address
- Net weight of the contents

Safe Food for Canadians Regulations

The Safe Food for Canadians Regulations (SFCR) came into effect on January 15, 2019, and united 14 previous food regulations to improve consistency between food sectors and Canadian consumers' food quality and safety. Businesses now need a licence from the Canadian Food Inspection Agency to trade food products outside their province, import or export food, or sell at the retail level. To obtain a licence, businesses must have a food safety program, as required by the SFCR.

Not all business activities will need a licence. There is an online licensing interactive tool to help determine if you need a license, and it only takes five minutes.

Honey imported, exported, or interprovincially traded is subjected to federal regulations and must be labelled appropriately. For more information on labelling, see Chapter 9: Honey. In addition, a Food Labelling Requirement Checklist is available to assess your labelling.

All food businesses (licenced or not) are required to follow preventative controls outlined in Part 4 of the SFCR to address food safety hazards. Food businesses may also be required to have a written preventive control plan (PCP) describing how food hazards and risks are identified, controlled, and prevented. The plan's content will depend on what activities the business performs. The online preventative control plan interactive tool will help determine if a written plan is needed and when it must be implemented. Businesses will also be required to show evidence that the control measures described in the plan are in effect.

Additionally, businesses that trade food products outside their province, import or export food, or sell at the retail level must meet the SFCR's traceability requirements for recall purposes. There is an online traceability interactive tool to help determine what traceability requirements apply to your food business. The Alberta Beekeepers Commission has Safe Honey Production Practices program templates to assist beekeepers with meeting the requirements of the SFCR.

Glossary

Abdomen – segmented posterior part of the bee following the thorax.

Alarm pheromone – a chemical substance released from the worker bee's sting that alerts other bees to danger.

Antennae – slender jointed feelers on the head of insects that are used to sense the environment

Apiary – a place where bees and beehives are kept.

Apiculturist – a farmer who keeps bees for their honey.

Bee blower – a blower that is used to remove bees from a full super of honey.

Bee brush – a brush that is used to remove bees from combs.

Bee escape – a device that lets bees pass in only one direction and is inserted between honey supers and brood chamber to remove bees from the supers over time.

Beeswax – wax secreted by the wax glands of the worker bee and used to build comb.

Biosecurity – measures taken to prevent the introduction and/or spread of harmful organisms (e.g. viruses, bacteria, etc.) to animals and plants to minimize the risk of disease transmission.

Bottom board – the floor of the hive.

Brood – the immature or developing stage of honey bees and includes eggs, larvae and pupae.

Brood chamber – the part of the hive where the brood is reared and food is stored. This is usually the bottom two hive boxes.

Brood frame – a frame in the brood chamber. Usually darker in colour.

Brood food – nutritious food produced by a gland in the nurse bees' head and fed to young larvae.

Brood nest – the area of the hive where bees are densely clustered and brood is reared.

Brood rearing – the raising of young bees from eggs to adults.

Burr comb – comb built out from the frame or comb that can be unattached on one end or connected to a neighbouring frame, hive box wall, or inner cover.

Candy – candy made from powdered sugar and water to form a stiff dough that is used in queen cages.

Capping – thin wax covering of full honey cells.

Capped brood – brood cells that have been sealed by the bees with a porous wax cover to contain the developing larva and pupa.

Capped honey – sealed honey cells.

Castes – groups of individuals within the same species of social insects that have different appearances and roles. Honey bees have three castes: worker, drone, and queen.

Cell – a hexagonal compartment in which brood can be raised or honey is stored.

Cleansing flight – flight bees take to void their feces outside of the hive.

Cluster – the arrangement of bees within a hive when the outside temperature drops below 14°C (57°F).

Colony – the aggregation of worker bees, drones, and a queen bee living together in a hive or other dwelling as one social unit.

Comb – comprises beeswax hexagonal cells constructed by bees on both sides of the foundation. Used to store pollen, honey and raise brood.

Division board – see frame feeder.

Drawn comb – comb in which the cells have been completely built out from the foundation.

Drifting – foraging bees returning to the apiary and entering a hive other than its own. It may be caused by prevailing winds and/or lack of landmarks to assist bees in finding their hive.

Drone – a male bee.

Drone brood - the immature or developing stage of drones and includes eggs, larvae and pupae.

Drone layer – a queen that lays only unfertilized eggs, resulting in only drones. A queen may do this because she has run out of sperm, was poorly mated, or has never mated.

Entrance reducer – a piece of wood that is used to regulate the size of the bottom entrance to the hive.

Extractor – a machine that rotates frames of honey at a sufficient speed to remove the honey from the cells by centrifugal force.

Feces – excrement

Fermentation – a chemical breakdown of sugar caused by yeasts.

Foundation – a sheet of beeswax impressed with the pattern of worker cells on which the bees build comb.

Frame – a man-made moveable frame of wood or plastic in which bees build comb.

Frame Feeder – a compartment or trough hung in the hive in place of a frame and used to feed sugar syrup to the bees.

Fume board – a board lined with absorbent material to add bee repellent to that covers the top of a honey super. Once placed on the super, the repellent drives the bees down and out of the honey supers.

Grafting – the process of removing a young female larva from its cell and transferring it to a queen cup to have it reared into a queen by bees.

Hive – the human-constructed dwelling of the bees.

Hive stand – a structure that supports the hive.

Hive tool – a metal device that is used to work in the hive.

Honey – food that is derived from the nectar of blossoms, or the secretions of or on living plants, that meets Canada's Food and Drug Regulations.

Honey flow – see nectar flow.

Honey house – any place used by a beekeeper for handling, storing, extracting, and packaging honey.

Honey super – hive boxes that are placed on top of the brood chamber for the storage of honey.

Husbandry – the care, cultivation, and breeding of crops and animals.

Inner cover – a cover placed between the hive box and the lid

Larva (plural. larvae) – the second immature stage of the honey bee life cycle immediately after the hatching of the egg.

Laying worker – a worker bee that lays eggs that develop into drones.

Mating flight – the flight taken by a virgin queen where she mates in the air with one or more drones.

Nectar – a sugary fluid produced by plants to attract pollinators. It is a source of water, carbohydrates, and a minute source of vitamins and minerals for the bees.

Nectar flow – the time of year when the production of nectar by various plant species is great enough that bees can gather and store the nectar and convert it to honey.

Nucleus colony (nuc) – a smaller version of a hive. Typically, nucs contain a small number of worker bees and a queen and have 3-5 frames.

Nurse bees – young worker bees that tend to the brood.

Package – a wooden or screened box that contains 8,000-12,000 bees with a single queen and sugar syrup for food.

Pheromone – a chemical secretion released externally by an individual that stimulates a response in another individual of the same species.

Pollen – a fine, usually powdery, substance produced by anthers of flowers and collected by bees and stored in the comb as bee bread. It is the protein source for the bees.

Pollen supplement – a mixture of ingredients used to supplement the protein supply of a colony during a scarcity of pollen.

Pollen trap – a device installed over the colony entrance that scrapes off the pollen from the hind legs of the returning bees and collects fallen pollen in a tray.

Pollination – the transfer of pollen from the anthers to the female parts of a flower. Cross-pollination is the transfer of pollen from one cultivar to another cultivar of the same plant species.

Propolis – a resin naturally created by honey bees from substances collected while foraging. The resin is used by worker bees to seal cracks and openings to protect the hive from the elements and from pests and predators.

Prepupal stage – the third stage of development between the larval and pupal stages.

Pupa (plural. pupae) – the fourth stage of the honey bee life-cycle before becoming an adult.

Queen – the reproductive female in a colony of honey bees.

Queen cage – a small cage in which the queen may be confined for shipping or introduction into a colony. There may be worker bee attendants in the cage as well.

Queen cell – an elongated cell resembling a peanut shell in which a queen is reared. The cell hangs down from the comb in a vertical position.

Queen cup – a cup-shaped cell that hangs vertically from the comb and is the beginning of a queen cell.

Queen excluder – a barrier placed between the brood chamber and the honey supers to prevent the queen from moving into the honey supers and laying eggs.

Queenless – a colony without a queen.

Rendering wax – the process of melting combs and cappings and the refining of wax.

Robbing – a behaviour where bees will steal honey from other hives, extracted comb, etc., to bring back to their hive. Usually occurs in the spring and fall.

Royal jelly – a honey bee secretion that is fed to young larvae. It is secreted from the glands in the nurse bees and fed to all larvae in the colony, regardless of sex or caste.

Splits – when bees and brood is taken from a very large colony to make a new colony.

Smoker – a device used to produce and blow smoke on bees to help in calming them.

Solar wax melter – a glass-covered box in which comb or cappings are melted by sunlight to recover the beeswax.

Super – see honey super.

Supersedure – replacement by the bees of an old or failing queen with a new young queen raised by the bees of the same colony.

Swarm – a group of worker bees, drones, and a queen that leaves the mother colony to establish a new colony.

Thorax – the middle part of the bee's body where the legs and wings attach.

Tracheae – the breathing tubes within the insect that open externally.

Uncapping – the process of removing the wax cappings from cells containing honey.

Unite – to combine one colony with another.

Veil – a screen or net worn over the head and neck for protection from bee stings.

Virgin queen – an unmated queen

Wax – see beeswax

Worker bee – a sterile female member of the colony that works in the hive, including caring for the young, cleaning the hive, guard duty and also forages for food and water outside the hive or nest.

References

Adamo, S.A. 2016. Do insects feel pain? A question at the intersection of animal behaviour, philosophy and robotics. Animal Behaviour, 118: 75–79. doi: 10.1016/j.anbehav.2016.05.005.

Alberta Beekeepers Commission. (n.d.). Available from www.albertabeekeepers.ca.

Alberta Farm Animal Care. (n.d.). The five freedoms. Available from https://www.afac.ab.ca/wp-content/uploads/2020/05/The-Five-Freedoms.pdf.

Alberta Farm Animal Care. (n.d.). Animal Welfare or Animal Rights: What's the Difference? Available from https://www.afac.ab.ca/wp-content/uploads/2020/05/welfare-or-rights-infographic.pdf.

Alberta Native Bee Council. (n.d.). Available from www.albertanativebeecouncil.ca.

Ammons, A.D., and Hunt, G.J. 2008. Characterization of honey bee sensitivity to ethanol vapor and its correlation with aggression. Alcohol, 42: 129–136. doi: 10.1016/j.alcohol.2007.12.005.

Aronstein, K.A., and Murray, K.D. 2010. Chalkbrood disease in honey bees. Journal of Invertebrate Pathology, 103: S20–S29. doi: 10.1016/j.jip.2009.06.018.

Avalos, A., Rodríguez-Cruz, Y., and Giray, T. 2014. Individual responsiveness to shock and colony-level aggression in honey bees: evidence for a genetic component. Behavioral Ecology and Sociobiology, 68: 761–771. doi: 10.1007/s00265-014-1689-8.

B.E.E. Consulting Services. 2019. Honey packing house design. Available from https://www.albertabeekeepers.ca/wp-content/uploads/2018/09/HoneyHousePosterReport.pdf.

Bees Matter. (n.d.). Available from https://www.beesmatter.ca/.

Bixby, M., Guarna, M., Hoover, S., and Pernal, S. 2018. Canadian honey bee queen bee breeders' reference guide. Available from http://honeycouncil.ca/wp-content/uploads/2018/12/FinalQueenBreederReferenceGuide2018.pdf.

British Columbia Ministry of Agriculture. 2015. Summer management. Available from https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/animal-and-crops/animal-production/bee-assets/api_fs406.pdf.

British Columbia Ministry of Agriculture. 2015. Swarming. Available from https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/animal-and-crops/animal-production/bee-assets/api_fs404.pdf.

British Columbia Ministry of Agriculture. 2015. Nutrition and its effect on bee management. Available from https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/animal-and-crops/animal-production/bee-assets/api_fs410.pdf.

British Columbia Ministry of Agriculture. 2015. Spring management. Available from https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/animal-and-crops/animal-production/bee-assets/api_fs401.pdf.

British Columbia Ministry of Agriculture Food and Fisheries. 2020. Apiculture factsheet: The small hive beetle (SHB). Available from https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/animal-and-crops/animal-production/bee-assets/api_fs218.pdf.

Calgary and District Beekeepers Association. (n.d.). Available from https://www.calgarybeekeepers.com/.

Canadian Association of Professional Apiculturists. 1995. A guide to: Managing bees for crop pollination. Available from https://capabees.com/shared/2012/10/CAPAcroppollination.pdf.

Canadian Honey Council. 2017. Canadian best management practices for honey bee health. Available from http://honeycouncil.ca/wp-content/uploads/2016/12/BMP-manual-for-honey-bee-health-Feb-2017-English.pdf.

City of Calgary. (n.d.). Responsible pet ownership bylaw. Available from https://publicaccess.calgary.ca/lldm01/exccpa?func=ccpa.general&msgID=ZTeTscAyKAB&msgAction=Download.

City of Edmonton. (n.d.). Animal licensing and control bylaw. Available from https://www.edmonton.ca/sites/default/files/public-files/assets/PDF/C13145.pdf?cb=1642888873.

City of Lacombe. (n.d.). Bylaw 469. Available from https://www.lacombe.ca/DocumentCenter/View/1764/By-law-469---Responsible-Animal-Ownership-Bylaw?bidId=.

City of St. Albert. (n.d.). Consolidated version of the urban beekeeping bylaw. Available from https://stalbert.ca/site/assets/files/1881/urban_beekeeping_consolidation_by_bl_51-2021.pdf.

Couto, A. V., and Averill, A.L. 2016. A review on bees: Northeast crops edition. Available from https://ag.umass.edu/sites/ag.umass.edu/files/pdf-doc-ppt/2-1-17_a_review_on_bees.pdf.

Currie, R.W., Pernal, S.F., and Guzmán-Novoa, E. 2010. Honey bee colony losses in Canada. Journal of Apicultural Research, 49: 104–106. doi: 10.3896/IBRA.1.49.1.18.

Currie, R.W., Spivak, M., and Reuter, G.S. 2015. Wintering management of honey bee colonies. *In* The hive and the honey bee. *Edited by* J.M. Graham. Dadant & Sons, Hamilton, Illinois. pp. 629–670.

DeBerry, S., Crowley, J., and Ellis, J.D. 2019. Swarm control for managed beehives. Available from https://edis.ifas.ufl.edu/publication/IN970.

Dukas, R., and Real, L.A. 1991. Learning foraging tasks by bees: a comparison between social and solitary species. Animal Behaviour, 42: 269–276. doi: 10.1016/S0003-3472(05)80558-5.

Edmonton District Beekeepers Association. (n.d.). Available from https://edmontonbeekeepers.ca/.

Evans, J.D., and Spivak, M. 2010. Socialized medicine: Individual and communal disease barriers in honey bees. Journal of Invertebrate Pathology, 103: S62–S72. doi: 10.1016/j.jip.2009.06.019.

Forsgren, E. 2010. European foulbrood in honey bees. Journal of Invertebrate Pathology, 103: S5–S9. doi: 10.1016/j.jip.2009.06.016.

Genersch, E. 2010. American Foulbrood in honeybees and its causative agent, Paenibacillus larvae. Journal of Invertebrate Pathology, 103: S10–S19. doi: 10.1016/j.jip.2009.06.015.

Goodman, R. 2014. Australian Beekeeping Guide. Rural Industries Research and Development Corporation, Barton, ACT. p. Available from https://www.agrifutures.com.au/wp-content/uploads/publications/14-098.pdf.

Goodwin, M. 2012. Pollination of crops in Australia and New Zealand. Rural Industries Research and Development Corporation, p. Available from https://www.agrifutures.com.au/product/pollination-of-crops-in-australia-and-new-zealand/.

Government of Alberta. (n.d.). Animal Health Act. Available from https://open.alberta.ca/publications/a40p2.

Government of Alberta. (n.d.). Bee Act. Available from https://open.alberta.ca/publications/b02.

Government of Alberta. (n.d.). Bee regulation. Available from https://open.alberta.ca/publications/2003_194.

Government of Alberta. (n.d.). Honey grading regulation. Available from https://open.alberta.ca/publications/1997_104.

Government of Alberta. (n.d.). Premise Identification Program. Available from https://www.alberta.ca/register-with-the-animal-premises-identification-program.aspx.

Government of Alberta. 2001. Commercial honey industry. Available from https://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex2743/$file/616_830-1.pdf.

Government of Alberta. 2002. Beekeeping for beginners. Available from https://open.alberta.ca/publications/2819821.

Government of Alberta. 2007. Honey bees and winterkill. Available from https://open.alberta.ca/publications/4007956.

Government of Alberta. 2017. Statistical overview of the Canadian honey and bee industry and the economic contribution of honey bee pollination 2016. Available from https://agriculture.canada.ca/sites/default/files/legacy/resources/prod/doc/pdf/honey_2016-eng.pdf.

Government of Alberta. 2019. American foulbrood. Available from https://open.alberta.ca/publications/american-foulbrood.

Government of Alberta. 2019. Purchasing honey bees or equipment in Alberta: questions to ask and things to consider. Available from https://open.alberta.ca/publications/purchasing-honey-bees-or-equipment-in-alberta.

Government of Alberta. 2019. Seed canola pollinators: A communication guide for agronomists and beekeepers. Available from https://open.alberta.ca/publications/seed-canola-pollinators-a-communication-guide-for-agronomists-and-beekeepers.

Government of Alberta. 2019. Seed canola pollinators: A communication guide for seed companies and growers. Available from https://open.alberta.ca/publications/seed-canola-pollinators-a-communication-guide-for-seed-companies-and-growers.

Government of Alberta. 2021. Alberta guide to hunting regulations. Available from https://open.alberta.ca/publications/1485-4287.

Government of Alberta. 2021. Alberta guide to trapping regulations. Available from https://albertaregulations.ca/2021-22-Alberta-Trapping-Regulations.pdf.

Government of Alberta. 2020. Bloom guide: hybrid seed canola. Available from https://open.alberta.ca/publications/bloom-guide-hybrid-seed-canola.

Government of Alberta. 2021. European foulbrood. Available from https://open.alberta.ca/publications/european-foulbrood.

Government of Alberta. 2021. Honey bee pests and diseases: Best management practices. Available from https://open.alberta.ca/publications/9781460147696.

Government of Canada. (n.d.). Extreme heat events. Available from https://www.canada.ca/en/health-canada/services/climate-change-health/extreme-heat.html.

Government of Canada. (n.d.). Food business activities that require a licence under the Safe Food for Canadians Regulations. Available from https://inspection.canada.ca/food-licences/food-business-activities/eng/1524074697160/1524074697425#a519.

Government of Canada. (n.d.). Food-specific requirements and guidance - honey. Available from https://inspection.canada.ca/food-guidance-by-commodity/honey/eng/1526655030663/1526655030943.

Government of Canada. (n.d.). Honey bee producer guide to the national bee farm-level biosecurity standard. Available from https://inspection.canada.ca/animal-health/terrestrial-animals/biosecurity/standards-and-principles/honey-bee-producer-guide/eng/1378390483360/1378390541968.

Government of Canada. (n.d.). Immediately notifiable diseases. Available from https://inspection.canada.ca/animal-health/terrestrial-animals/diseases/immediately-notifiable/eng/1305670991321/1305671848331.

Government of Canada. (n.d.). Labelling requirements for honey. Available from https://inspection.canada.ca/food-labels/labelling/industry/honey/eng/1625512297254/1625512297753?chap=0.

Government of Canada. (n.d.). Pesticides in Canada. Available from https://www.canada.ca/en/health-canada/services/consumer-product-safety/pesticides-pest-management/public.html.

Government of Canada. (n.d.). Regulatory requirements: Preventive controls. Available from https://inspection.canada.ca/preventive-controls/regulatory-requirements/eng/1616007201758/1616008092049?chap=0.

Government of Canada. (n.d.). Safe Food for Canadians Regulations. Available from https://laws-lois.justice.gc.ca/eng/regulations/SOR-2018-108/index.html.

Government of Canada. (n.d.). Traceability for food. Available from https://inspection.canada.ca/food-safety-for-industry/traceability/eng/1526651817880/1526651951357.

Government of Canada. (n.d.). Understanding the Safe Food for Canadians Regulations. Available from https://inspection.canada.ca/food-safety-for-industry/toolkit-for-food-businesses/understanding-the-sfcr/eng/1492029195746/1492029286734#a5c.

Groening, J., Venini, D., and Srinivasan, M. V. 2017. In search of evidence for the experience of pain in honeybees: A self-administration study. Scientific Reports, 7: 45825. doi: 10.1038/srep45825.

Gruszka, J., Currie, R., Dixon, D., Tuckey, K., and van Westendorp, P. 1998. Beekeeping in Western Canada. Alberta Agriculture and Rural Development, Edmonton, AB. p.

Honey Bee Health Coalition. 2019. Best management practices for hive health: A guide for beekeepers. Available from https://honeybeehealthcoalition.org/wp-content/uploads/2019/01/HBHC_Hive_BMPs_v1.0_reduced.pdf.

Honey Bee Research and Extension Laboratory. (n.d.). Time commitment of beekeeping by operation size. Available from https://sfyl.ifas.ufl.edu/media/sfylifasufledu/hernando/lawn-and-garden/Time-Commitment-of-Beekeeping-by-Operation-Size.pdf.

Laate, E.A. 2017. The economics of beekeeping in Alberta 2016. Edmonton, AB. p. Available from https://open.alberta.ca/publications/2291-6997.

Melathopoulos, A. (n.d.). The biology and management of colonies in winter. Available from https://capabees.com/shared/2013/02/winteringpdf.pdf.

Melathopoulos, A., Buckland, K., and Sagili, R.R. 2022. Bee protection protocol for Western specialty seed crops. Available from tps://extension.oregonstate.edu/pub/em-9353.

Melathopoulos, A., Rodia, R., Holt, J., and Sagili, R.R. 2018. Residential beekeeping: Best-practice guidelines for nuisance-free beekeeping in Oregon. Available from https://catalog.extension.oregonstate.edu/em9186.

Melhim, A., Weersink, A., Daly, Z., and Bennett, N. 2010. Beekeeping in Canada: Honey and pollination outlook. Available from https://www.uoguelph.ca/canpolin/Publications/Melhim et al 2010 Outlook-Beekeeping-in-Canada.pdf.

Mid-Atlantic Apiculture Research and Extension Consortium. (n.d.). The colony and its organization. Available from https://canr.udel.edu/maarec/honey-bee-biology/the-colony-and-its-organization/.

Mortensen, A.N., Smith, B., and Ellis, J.D. 2019. The social organization of honey bees. Available from https://edis.ifas.ufl.edu/pdf/IN/IN110200.pdf.

NC State University Extension. (n.d.). The different types of honey bees. Available from https://content.ces.ncsu.edu/the-different-types-of-honey-bees.

Oryan, A., Alemzadeh, E., and Moshiri, A. 2018. Potential role of propolis in wound healing: Biological properties and therapeutic activities. Biomedicine & Pharmacotherapy, 98: 469–483. doi: 10.1016/j.biopha.2017.12.069.

Parks, A.E. and. 2017. Bearsmart: Electric fences and bears. Available from https://open.alberta.ca/publications/9781460133101.

Pernal, S.F., Albright, R.L., and Melathopoulos, A.P. 2008. Evaluation of the shaking technique for the economic management of American foulbrood disease of honey bees (Hymenoptera: Apidae). Journal of Economic Entomology, 101: 1095–1104. doi: 10.1093/jee/101.4.1095.

Pernal, S.F., and Clay, H. (*Editors*). 2013. Honey bee diseases & pests. *In* Third Edit. Canadian Association of Professional Apiculturists, Beaverlodge, AB. p.

Pettis, J.S., Chen, Y.P., Ellis, J., Evans, J.D., Rennich, K.D., VanEngelsdorp, D., and Shimanuki, H. 2015. Diseases and pests of honey bees. *In* The hive and the honey bee. *Edited by* J.M. Graham. Dadant & Sons, Hamilton, Illinois. pp. 833–879.

Plant Health Australia. (n.d.). National bee biosecurity program. Available from https://www.planthealthaustralia.com.au/national-programs/national-bee-biosecurity-program/.

Plant Health Australia. 2016. Biosecurity manual for beekeepers: Reducing the risk of exotic and established pests affecting honey bees. Available from https://beeaware.org.au/wp-content/uploads/2019/05/Biosecurity-Manual-for-Beekeepers.pdf.

Pollinator Partnership Canada. 2017. Planting forage for honey bees in Canada: A guide for farmers, land managers, and gardeners. Available from https://pollinatorpartnership.ca/assets/generalFiles/Planting-Guide-FINAL-ISBN-June-2017-for-Web-English.pdf.

Pollinator Partnership Canada. 2018. Practices to reduce bee poisoning from agricultural pesticides in Canada. Available from https://pollinatorpartnership.ca/assets/generalFiles/Reduce.Bee_.Poisoning.CanadaGuide.FINAL_.noCrops2.pdf.

Punko, R.N., Currie, R.W., Nasr, M.E., and Hoover, S.E. 2021. Epidemiology of Nosema spp. and the effect of indoor and outdoor wintering on honey bee colony population and survival in the Canadian Prairies. PLOS ONE, 16: e0258801. doi: 10.1371/journal.pone.0258801.

Retschnig, G., Williams, G., Schneeberger, A., and Neumann, P. 2017. Cold ambient temperature promotes Nosema spp. intensity in honey bees (Apis mellifera). Insects, 8: 20. doi: 10.3390/insects8010020.

Rittschof, C.C., Coombs, C.B., Frazier, M., Grozinger, C.M., and Robinson, G.E. 2015. Early-life experience affects honey bee aggression and resilience to immune challenge. Scientific Reports, 5: 15572. doi: 10.1038/srep15572.

Rocky View County. (n.d.). Land use bylaw. Available from https://www.rockyview.ca/Portals/0/Files/Government/Bylaws/RVC-Land-Use-Bylaw.pdf.

Sagili, R.R., and Burgett, M. 2011. Evaluating honey bee colonies for pollination. Available from https://catalog.extension.oregonstate.edu/pnw623.

Seely, T.D. 1989. The honey bee colony as a superorganism. American Scientist, 77: 546–553.

Siefert, P., Buling, N., and Grünewald, B. 2021. Honey bee behaviours within the hive: Insights from long-term video analysis. PLOS ONE, 16: e0247323. doi: 10.1371/journal.pone.0247323.

Soklič, M., and Gregorc, A. 2016. Comparison of the two microsporidia that infect honey bees – a review. Agricultura, 13: 49–56. doi: 10.1515/agricultura-2017-0006.

Somerville, D., and Frost, E. 2018. Pollination using honey bees. NSW Department of Primary Industries, p.

Southwick, E.E., and Heldmaier, G. 1987. Temperature control in honey bee colonies. BioScience, 37: 395–399. doi: 10.2307/1310562.

Stevanovic, J., Stanimirovic, Z., Lakic, N., Djelic, N., and Radovic, I. 2012. Stimulating effect of sugar dusting on honey bee grooming behaviour. Entomologia Experimentalis et Applicata, 143: 23–30. doi: 10.1111/j.1570-7458.2012.01231.x.

Strathcona County. (n.d.). Bylaw 43-2011. Available from https://www.strathcona.ca/files/files/at-lls-by-laws-43-2011_apiculture-control-bylaw_-keeping-and-management-of-bees.pdf.

The Keystone Policy Center. 2020. Best management practices (BMP) to protect honey bees and other pollinators in soybean fields. Available from https://honeybeehealthcoalition.org/wp-content/uploads/2020/03/HBHC_Soybean_022020.pdf.

Town of Bon Accord. (n.d.). Animal control bylaw. Available from https://bonaccord.ca/Home/DownloadDocument?docId=3368df03-72b9-4023-a0c5-cd0c4957b8b1.

Town of Devon. (n.d.). Responsible animal ownership. Available from https://www.devon.ca/Portals/0/Documents/Bylaws/2020-10-15-Bylaw-949-2020 -Responsible-Animal-Ownership_v1.pdf.

Town of High Prairie. (n.d.). Bylaw no. 12-2020. Available from https://www.highprairie.ca/Home/DownloadDocument?docId=7e43ccb3-82aa-4832-aea6-bb0dd4c701c2.

Town of High River. (n.d.). Bylaw 4567/2019 – Animal bylaw. Available from https://highriver.civicweb.net/filepro/document/22854/Bylaw 4567_2019 - Animal Bylaw.pdf.

Town of Nanton. (n.d.). Beekeeping bylaw. Available from https://www.nanton.ca/DocumentCenter/View/2725/1342-Beekeeping-Bylaw.

U.S. Canola Association. 2020. Best management practices (BMPS) for pollinator protection in canola fields. Available from https://honeybeehealthcoalition.org/wp-content/uploads/2020/03/HBHC_Canola_022020.pdf.

Wagh, V.D. 2013. Propolis: A wonder bees product and its pharmacological potentials. Advances in Pharmacological Sciences, 2013: 1–11. doi: 10.1155/2013/308249.

Appendix A: Alberta Beekeeping Calendar

Disclaimer: The following calendar of beekeeping events is based on a typical year in Alberta. Some events may be affected due to weather conditions. For example, drought may result in the beekeeper needing to feed additional sugar syrup to their bees.

January

- Keep hive entrances clear of dead bees.
- Make or order hive parts, equipment and supplies required for the season.
- Last chance to order packages or nucs.

March

- In early March, gently tip the colony forward to gauge its weight. If light, supplemental sugar syrup may be given in hive-top or frame feeders. Do not disrupt the winter cluster or keep the hive open for long.
- Pollen patties may be added to stimulate brood rearing.

April

- Packaged bees start to arrive and installed into a hive.
  If the bee package is placed on foundation only, feed a minimum of 1 gallon of sugar syrup every week and pollen patties every two weeks.
- Feed syrup as required and replace queens if necessary.
- When weather permits, open the hive for inspection. Check for eggs and brood to confirm a laying queen. Examine colony for disease.
- When weather permits, test for Varroa mites. Check for Varroa mites at least once a month throughout the beekeeping season.

May

- New beekeepers must register with the Government of Alberta by June 29.
- Once night time temperatures are above 0°C, remove winter insulation.
- Remove deadouts from apiary for inspection, cleaning and sorting.
- Move colonies if needed for upcoming warmer weather.
- When weather permits, perform regular hive checks every 10-14 days for queen performance, stores, and disease.
- Add supers of combs or foundation as required to provide room for expanding bee population and for the storage of surplus honey. This will also prevent swarming.
- Continue feeding syrup as necessary.
- Install entrance reducer. Replace 2-4 brood chamber frames that are very dark or have more than 10% drone cells with drawn comb.
- Split colonies to replace dead colonies or increase number of colonies.
- Weak colonies may need to be combined. Confirm that the weak colony does not have pests or disease before combining.
- When weather permits, clean bottom boards. If there are no bees in the bottom brood chamber, remove, sort combs, clean, repair and paint where necessary.
- For colonies started from packages, add a second brood chamber as soon as bees have begun to occupy the outside frames of the first brood chamber.

June

- Supplemental feed may be needed during beginning of month. Feeding must be stopped at least 2 weeks before major nectar flow begins to prevent honey adulteration.
- In the beginning of June, beekeepers may create nucs.
- Continue regular hive checks every 10-14 days for queen performance, swarm cells, stores, disease, and sufficient space.
- Weak colonies may need to be combined or requeened during this time.
- Do not use antibiotics when honey supers are on.
- Split colonies to replace dead colonies or increase number of colonies.

July

- Nectar flows are at their maximum in most areas. Add honey supers as necessary.
- Supers should be removed and honey extracted as soon as combs are two-thirds capped.
- In areas of high production, extracted combs should be returned to the hives.
- Continue regular hive checks every 10-14 days for queen performance, swarm cells, stores, disease, and sufficient space.

August

- All supers containing honey in excess of what is required for wintering should be taken off and extracted in the second half of the month.
- When removing honey supers, and when the honey flow is over or temporarily ceased, remove supers in early morning or near sunset to prevent robbing.
- From the middle to the end of the month, install entrance reducers to prevent robbing.
- Colonies may be requeened with young laying queens following the removal of honey.
- Start feeding sugar syrup once supers are removed. A hive should weigh between 64 to 73 kg and have pollen stores equal to two combs filled on both sides with pollen.
- Do not spill syrup as this may initiate robbing. If weather remains warm, substitute solid entrance reducers with fine wire-mesh barriers (except for the 2-inch opening).
- Continue regular hive checks every 10-14 days for queen performance, swarm cells, stores, disease, and sufficient space.

September

- Finish extracting. Check all hives for wintering needs.
- Select hives suitable for wintering. Do not attempt to winter weak colonies, queenless colonies, colonies with a poor queen, or one that has little or no pollen.
- Continue feeding sugar syrup until hives have enough food stores.
- Continue regular hive checks every 10-14 days for queen performance, stores, and disease.
- When weather permits, test for Varroa mites.

October

- Finish feeding and wrap hives for winter if not wintering indoors.
- Complete cleanup of apiary.

November

- Equipment should be cleaned, repaired, sorted and stored properly to prevent rodent and wax moth damage.
- Make or order hive parts, equipment and supplies required for the season.
- Order bees or queens.

December

- Continue sorting and maintaining equipment. Order new equipment and supplies for the new year. Assemble new hive equipment.

Adapted from: British Columbia Ministry of Agriculture. 2015. Beekeeping calendar for British Columbia. Available from: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/animal-and-crops/animal-production/bee-assets/api_fs103.pdf

Appendix B: Draft Pollination Agreement

This agreement is made this _____ day of _____ 20_____, between

Grower Name:

Address:

Phone #: Emergency Phone #:

hereinafter called the "grower", and

Beekeeper Name:

Address:

Phone #: Emergency Phone #:

hereinafter called the "beekeeper".

Term of Agreement

The term of this agreement shall be for _____, 20____ until 48 hours after the grower requests hive removal, but not beyond _____ of that year.

Section A: Responsibilities of the Beekeeper

1. The beekeeper shall supply the grower with hives of honey bees as stipulated in the following table:

Crop Location	Number of Hectares	Colonies per Hectare

The beekeeper shall provide colonies with the following minimum standards:

a. ____ full standard frames of brood in all stages
b. ____ standard frames well-covered with bees
c. A laying queen
d. An adequate surplus of honey or equivalent feed
e. Sufficient room for colony expansion

2. The beekeeper agrees to maintain the bees in proper pollination conditions through an optimum management of the hives

Section B: The Grower's Responsibilities

The grower agrees to pay the following rental fees:

Colony Standard (i.e., number of frames of bees and brood)	Rental Fee per colony (+GST)

1. The total rental is $____ . Payments are to be made in _____ (e.g., cash or cheque) to the beekeeper at the rate of:

    a. ____ (e.g., one-third) of the agreed amount when the agreement is signed;

    b. ____ of the agreed amount when the bees are moved onto the crop;

    c. ____ of the agreed amount within ____ day(s) after the colonies are removed from the crop.

2. The grower shall give the beekeeper at least **48 hours** first notice and **24 hours** final notice that hives are required to be placed in the property.
3. The grower shall give the beekeeper at least **48 hours** notice to remove hives from the property.
4. The grower shall provide a suitable place to locate hives. This site must be readily accessible by truck and other vehicles used in handling and servicing the colonies, including access to locked property if hives are placed therein.
5. The grower shall allow the beekeeper entry onto the property at a reasonable time whenever necessary to service the bees.
6. The grower will not to shift, examine, or disrupt the hives without the beekeeper's approval.
7. The grower shall not apply and phytosanitary product on the crop while it is being pollinated by the bees nor immediately before the bee's arrival if product residues can endanger the colonies.

    In the case of emergency phytosanitary treatment, the grower agrees to bear all costs associated with the displacement of the hive and to respect the removal period recommended by the sanitary product's manufacturer as well as to inform the beekeeper **48 hours** before the projected removal period.
8. To advise the beekeeper within **12 hours** if a significant number (one cup or more) of dead bees are seen near the entrance of any hive.
9. The grower shall ensure the rented hives' protection and take full responsibility for any loss, colony deaths, thefts, damage or vandalism to the hives and the beekeeper's material. The grower shall indemnify the beekeeper on the basis of the full replacement value of $_____ per hive.

Arbitration

If the grower is dissatisfied with the quality of hives supplied his/her first recourse shall be to the beekeeper. Such complaints shall be lodged as soon as possible and in no case after the hives are removed from the property.

In the event of any unsettled dispute between the beekeeper and grower both parties agree to abide by the decision of a mutually agreed upon independent arbitrator.

By evidence of the signatures below, the beekeeper and grower agree to fulfill all portions of the contract as written.

Beekeeper		Grower	
Signature:	_____	Signature:	_____
Printed:	_____	Printed:	_____
Date:	_____	Date:	_____

Appendix C: Contamination Checklist

Establishment name: Date:

Honey Equipment	Construction material in contact with food					Is the material lead-free?	Is the material appropriate?	Corrective action(s)
	Galvanized steel	Lead solder	Brass	Bronze	Terne plate			
Extractors	☐	☐	☐	☐	☐	Yes ☐ No ☐	Yes ☐ No ☐	
Storage tanks	☐	☐	☐	☐	☐	Yes ☐ No ☐	Yes ☐ No ☐	
Heat treated equipment	☐	☐	☐	☐	☐	Yes ☐ No ☐	Yes ☐ No ☐	
Sump	☐	☐	☐	☐	☐	Yes ☐ No ☐	Yes ☐ No ☐	
Pumps, augers, piping, & valves	☐	☐	☐	☐	☐	Yes ☐ No ☐	Yes ☐ No ☐	
Filtering & filling equipment	☐	☐	☐	☐	☐	Yes ☐ No ☐	Yes ☐ No ☐	
Other equipment	☐	☐	☐	☐	☐	Yes ☐ No ☐	Yes ☐ No ☐	

Overall action items:

Signature:

Adapted from Government of Canda. 2018. Preventive controls for honey products.
Available from: https://inspection.canada.ca/preventive-controls/honey-products/eng/1511460446016/1511460473502

Appendix D: Biosecurity Checklist

Do you perform these biosecurity practices?	Yes	No
Do you source your bees from local, certified, and recognized suppliers?		
Are you aware of and follow all the acts and regulations that apply to beekeeping?		
Do you inspect new bees for the presence of pests and signs of disease?		
Do you regularly monitor all hives for signs of disease and pests?		
Do you place new bees into new or disinfected hives and handle with disinfected tools?		
Do you follow the label instructions on beekeeping products?		
Do you monitor the weather conditions at apiary sites and take measures to protect bees from adverse conditions?		
Do your bees have access to clean and good quality water and feed?		
Do you monitor your bees for signs of exposure to pesticides?		
Do you raise awareness of the dangers of pesticide exposure to growers in your area?		
Do you maintain your apiary and hive equipment to reduce the exposure to pests?		
Do you replace at least 20% of brood frames every year?		
Do you clean honey spills as soon as possible?		
Do you routinely remove dead bees from water sources and feeders?		
Do you use new or disinfected feeders and containers?		
Do you dispose of expired and excess products as directed on the label?		
When buying used equipment, do you ask the seller for disease and pest history?		
When buying used equipment, do you ask for an inspection certificate from the seller?		
Do you wash your hands after handling contaminated equipment or products?		
Do you wash your hands or change gloves between apiaries?		
Do you routinely wash your clothing after working in the apiary?		
Do you clean and sanitize tools after use in diseased or infested equipment?		
Do you clean and sanitize tools between apiaries?		
Do you remove debris from your tools before sanitizing them?		
When deciding to move to a new apiary site, do you assess the area for any risks?		
Do you know what to do if you identify the presence of disease or pests?		
Does your apiary staff know what to do if they identify the presence of disease or pests?		
Do you replace queens every two years?		

Adapted from Government of Canada. 2013. Honey bee producer guide to the national bee farm-level biosecurity standard. Available from: https://inspection.canada.ca/animal-health/terrestrial-animals/biosecurity/standards-and-principles/honey-bee-producer-guide/eng/1378390483360/1378390541968?chap=10

Appendix E: Biosecurity Sign example

Call using contact information below, in the event of an emergency

Beekeeper: _____

Phone number: _____

CANADIAN AGRICULTURAL PARTNERSHIP
Innovate. Grow. Prosper.

Alberta Government

Canada

Peavey Mart

Alberta Beekeepers Commission

Alberta Farm Animal Care

403 652 5111

afac@afac.ab.ca

www.afac.ab.ca