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ATTTA
Atlantic Tech Transfer Team
for Apiculture

Spring Honey Bee Management Guide

In this Guide:

Purchasing Bees

Purchasing bees is an exciting time for any beekeeper, but it is important to be on the lookout for pests and diseases, as well as keeping biosecurity and bee health in mind.

Five Tips to Ensure Purchased Bees are Healthy and Disease Free

1. Be familiar with brood diseases. Know how to identify American Foulbrood (AFB), European Foulbrood (EFB), chalkbrood, and sacbrood. Know what a healthy larvae is supposed to look like, and be on the lookout for anything that looks unhealthy. Check the brood pattern and cappings; are there unusual holes? Is there a good brood pattern? Have a toothpick handy and good lighting to check any suspicious cells. Check out the Atlantic Tech Transfer Team for Apiculture's (ATTTA's) *Summer Disease and Pest Monitoring* fact sheet (http://www.perennia.ca/wp-content/uploads/2016/04/Summer-Disease-and-Pest-Monitoring.pdf) to learn how to check for brood diseases. Other resources are listed at the end of this section.

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Funders and Contributors:
Bleuets NB Blueberries
New Brunswick Beekeepers Association Inc.
Nova Scotia Beekeepers' Association
Wild Blueberry Producers' Association of Nova Scotia
Prince Edward Island Wild Blueberry Growers Association
PEI Beekeepers' Association
Oxford Frozen Foods
Jasper Wyman and Son

2. Ask for the inspection report. To sell bees, beekeepers must have their hives inspected. Ask for the report to know what diseases may be present in the bee yard and how they can be addressed. Some diseases are more serious than others, so it is a good idea to know the risks in order to give the bees the best possible start.

3. Set up a suitable bee yard and consider supplemental feeding. When introducing bees to the operation, set up an isolated bee yard, away from other healthy hives. If a brood disease is found, this will reduce the risk of spreading it to other hives. Ensure there is good forage nearby, and feed if necessary. Many beekeepers provide pollen patties and feed medicated sugar syrup to nucs and packages to address nosema concerns and encourage build up before winter. This may not be necessary for full hives unless they are being prepared for winter and need to be fed sugar syrup. Be aware of surrounding beekeepers and ensure there is a 5 km radius distance from other bee yards.

4. Shadow a beekeeper. When beginning beekeeping and purchasing bees for the first time, it is important to be prepared. Ask to shadow a beekeeper and learn how they monitor for diseases and pests, how they feed their bees, how often they open hives, and what kind of yard they set them up in. There are good resources available on the *ATTTA* website (http://www.perennia.ca/fieldservices/honey-bees-and-pollination/).

5. Keep good records. By tracking colony health, how much hives are being fed, and when the honey flows are, issues and successes can be tracked. Other information that can be recorded includes age of the equipment, when frames may need to be replaced, and information on the queen (e.g. age, laying pattern, productivity, colony temperament). If an unmated queen has been installed in the hive, do not open the hive for at least 28 days, but begin monitoring for new eggs after this time. This allows the queen to go on her mating flight and begin to lay undisturbed. If the queen that has been installed is already mated, you should notice new eggs within a week or two weeks at the very most. If there are no eggs after two weeks, consider installing another queen.

For information on feeding, overwintering, bee yards and more, visit the Atlantic Tech Transfer Team for Apiculture's *website* (http://www.perennia.ca/fieldservices/honey-bees-and-pollination/).

Purchasing Options

There are three main ways for beekeepers to purchase bees: as nucleus colonies from other beekeepers ('nucs'), as packages (most often in the spring), and as full colonies from beekeepers throughout the season. The advantages and disadvantages of each method of purchasing bees are outlined below in Table 1.

Table 1. Pros and Cons of Purchasing Nucs vs Packages vs Full Hives

	Nucs		Packages		Full Hives	
	Pros	**Cons**	**Pros**	**Cons**	**Pros**	**Cons**
Strength and Pollination	Contain 4-5 frames of bees in different developmental stages; brood present	Requires the season to build up - if purchased in spring, usually not ready for blueberry pollination	Will cover 2-3 frames of bees; if fed early and heavily in the season, may meet blueberry pollination standard that same year	Contain fewer bees than full hive or nucs; no brood present; build up can be slow from New Zealand (NZ) packages as bees would be going into winter there	Strongest option - probably ready for blueberry pollination; brood present	May need to watch for swarms or need to split if too strong
Availability	Available from beekeepers from May to July	Usually not available before blueberry pollination	Available before blueberry pollination	Only available in early spring in Atl. Canada (usually from NZ); arrive in early April, so typically need to be fed and installed in cool weather; need to coordinate pick up time	Available throughout the year from beekeepers; opportunity to meet with beekeeper and learn about their management practices	Speak with beekeepers earlier in the season to reserve

	Nucs		Packages		Full Hives	
	Pros	**Cons**	**Pros**	**Cons**	**Pros**	**Cons**
Honey Production		Unlikely the first year	Possible the first year		Expect production the first year	
Diseases and Pests	New equipment (especially frames) common, so less risk of transferring diseases	Nosema is common due to stress of splitting hives	Packages may be sourced from disease-free regions	May contain brood diseases; chalk-brood is common	Apiary must be inspected in order to sell - can ask for report	Should perform thorough disease inspection upon purchase
Overwintering	Can move to full hive or overwinter as a nuc; requires less food than full hive	Smaller population than full hive to enter overwintering	Available early spring if over-wintering did not go as planned	Requires more food stores than nuc to overwinter	Larger population to enter overwin-tering	Requires more food stores than nuc to overwinter
Biosecurity	Low incidence of pests and diseases since beekeeper must be inspected to sell	Need to isolate new hives from other hives (separate yards)	Bees often installed in new hive equipment (minimizes risk)	Monitor for diseas-es and pests; need to isolate new hives from other hives (separate yards); packages typically not treated before arrival	Low incidence of pests and diseases since beekeeper must be inspected to sell	Should isolate new hives from other hives (separate yards)
Equipment	Comes with nuc box	Will eventually require more foundation and drawn comb, more equipment; risk of disease transmis-sion from original equipment	No equipment comes with a package, reducing the risk of disease transmission	Requires equip-ment: frames, hive bodies, inner covers, etc.	Requires less start up equip-ment than nuc or package	Equipment may be old and/ or need to be replaced
Queens	Contains new (productive) queen	Queen may or may not be mated	Contains mated queen	Will need to release queen after a few days if not included with rest of bees; many need to be requeened due to non-hygienic queens; queen may not be well-adapted to our climate	Contains mated queen	Consider age and productivity of queen
Feeding	May grow to full strength the same year without feed-ing if purchased early in the season	Likely need to feed sugar syrup and pollen patties (although less than packages); may need to medicate feed to address stress concerns and prevent nosema		Bees should be fed to stimulate wax production; feeding medicated sugar syrup may be recommended if nosema is present	Probably don't need to feed until the fall	
Estimated Cost	$150-$200		$200-$230		$300-$400	
Other Costs	Equipment to transfer the nuc into a full colony.		Will need to purchase new equipment for initial package, as well as splits (and queens).		Largest initial investment, but potential to split the hive the first season (doubling number of hives). Will need to purchase or make a queen for new split, as well as new equipment.	

Differences Among Bee Races (Table 2)

The similarities and differences among European races of honey bees are described below in Table 2. The information is gathered from Winston (1987) and Vickery (1991).

Bee Race	Disposition	Resistance	Overwintering	Spring Build Up	Swarming Tendency	Robbing Tendency	Honey Production
German dark bees	Nervous, aggressive		Overwinter well in harsh climates	Slow	Moderate - High		Low - Moderate
Italian	Gentle	Resistance to European Foulbrood; good hygienic behaviour	Overwinter well with strong populations and plentiful food stores	Slow - Moderate	Low - Moderate	Moderate - High	High
Carniolan	Gentle		Overwinter well with limited food stores	Moderate - Rapid	Moderate - High	Low	Moderate - High
Caucausian	Gentle	Susceptible to nosema	Moderate overwintering success	Moderate	Low	Low - Moderate	High
Buckfast	Calm, gentle	Resistant to tracheal mite; good hygienic behaviour	Overwinter well with limited food stores	Rapid	Low	Moderate - High	High
Russian	Can be aggressive	Good hygienic behaviour	Overwinter well with limited food stores	Moderate	Low - Moderate		Low - Moderate

Packages

Unlike nucleus colonies, packages of honey bees do not come with conveniently pre-drawn frames containing food and brood. Packages come in two forms: either small wooden screened boxes or cardboard tubes (Arataki tube package). Packages should contain:

1. Three lbs of adult bees (>10,500 bees) if in a wooden box
   - 1 kg or 2.2 lbs of adult bees (>7,700 bees) if in an Arataki tube
2. A mated queen in a queen cage, ideally with two or three worker bee attendants
3. An inverted can of 1:1 sugar water with small holes punctured in the bottom for the package bees to access feed.
   - Not present in Arataki tube packages

Boxed packages typically arrive by mail in April or early May and tube packages arrive to Atlantic Canada from New Zealand around the first week of April. As a result, there may not be enough time to build up colonies from packages in time to meet the pollination standard of wild blueberries. When packages are picked up, inspect the interior for dead bees if possible; if there is an excessive amount of dead bees inside, the packages may have overheated during transport. Before installing the packages, place them in a quiet, dark, and cool (not below 13 °C to avoid killing stored sperm in the queen) room for a few hours. After this chilling period, packages may be treated for varroa mites they may be harbouring before installing them.

A typical boxed package of honey bees with the queen cage and inverted can of sugar syrup removed.

Treating Packages

The population of honey bees in packages come from pre-existing colonies and potentially bear pests and diseases. There are likely phoretic varroa mites in the packages, so oxalic acid can be employed to treat for mites at this opportune brood-less period. Arataki packages may come with a small strip of amitraz (Apivar®, Vetó-pharma) or another synthetic miticide, so treatment for varroa mites prior to installation with this type of package may not be necessary.

It has been found that 3.0 ml of oxalic acid at a concentration of 2.8% per 1,000 bees is effective at treating populations of varroa in packages (Aliano and Ellis, 2009). This treatment of oxalic acid can be combined with spraying of the boxed package with sugar water before installing them. To make a solution of oxalic acid at 2.8%, first make a 1 L solution of sugar water at a 1:1 ratio by weight using warm (not boiling) water. Then, dissolve 35 g of commercially available oxalic acid dihydrate into the warm sugar water.

Note: It is critically important to take safety precautions while handling oxalic acid. Although it is a natural treatment option, oxalic acid is still toxic to humans. Safety gloves, goggles, a long-sleeved shirt, and a mask should be worn in a well-ventilated area while preparing the oxalic acid solution.

One pound of honey bees is roughly comprised of 3,500 individuals. A three pound package of bees will contain at least 10,500 bees. Therefore, about 31.5 ml of 2.8% oxalic acid/sugar water solution should be evenly sprayed through the mesh screen of a package to treat its varroa load. A volumetric spray bottle can be used to measure how much solution is sprayed onto the package or a pressurized air brush for a more accurate application.

Installing the Package

Installing packages should be done in the early morning or in the evening when the temperature is cool to avoid bees being too active, unless the spring day is cool enough. Do not risk exposing the bees and the mated queen to lethal cold temperatures (e.g. < 5 °C) during installation; only install the bees in weather that is appropriate for opening and manipulating a hive in.

To install a package of bees, an empty hive needs to be prepared to receive them, which includes a hive box, bottom board, 10 empty frames, an inner cover, and lid. Wear a bee suit and veil and have a lit smoker and hive tool on hand. Give the package another light spray with sugar water. Remove three or four empty frames in the centre of the hive and set them aside. It is also a good idea to place an entrance reducer at the front of the hive. Some beekeepers will also lightly spray each empty frame with sugar water – not the oxalic acid solution – to attract the bees to the frames when the package is installed.

Boxed Package

With a hive tool, gently pry off the wooden panel (which should have the queen cage stapled to it) covering the circular hole on the top of the package of bees. Lightly pull out the can of sugar and the queen cage from the hole. Remove the queen cage from the wooden panel and quickly place the panel back over the hole to prevent bees from escaping from the package. Set the can of sugar water aside for a moment. Inspect the queen cage to ensure the queen is not damaged or lethargic and still has two or three living attendants with her if applicable. Once satisfied, place the queen cage aside out of direct sunlight.

Before shaking the bees into the hive, gently tap the package on the ground a few times so that the mass of bees collect into the bottom corner of the package and do not readily fly out of the top hole. Remove the wooden panel covering the hole and invert the package overtop of the hive – directly above the space created from removing some frames. Shake the bees into that space as quickly as possible. It will likely require a few rounds of tapping the corner of the package on the ground to collect the bees into a mass and shake them into the hive. It will not be possible to shake all the bees from the package into the hive. The remaining bees should crawl out and into the hive to join their sisters and their queen if you lean the package up against the front of the hive (after the queen has been installed). Gently return the empty frames to the centre of the hive, making sure not to crush any bees, and replace the hive-top feeder (if applicable), the inner cover, and the lid. Please see Figure 1 for an illustration of this process.

Oxalic acid dihyrate is available from local beekeeping supply stores. (www.countryfields.ca).

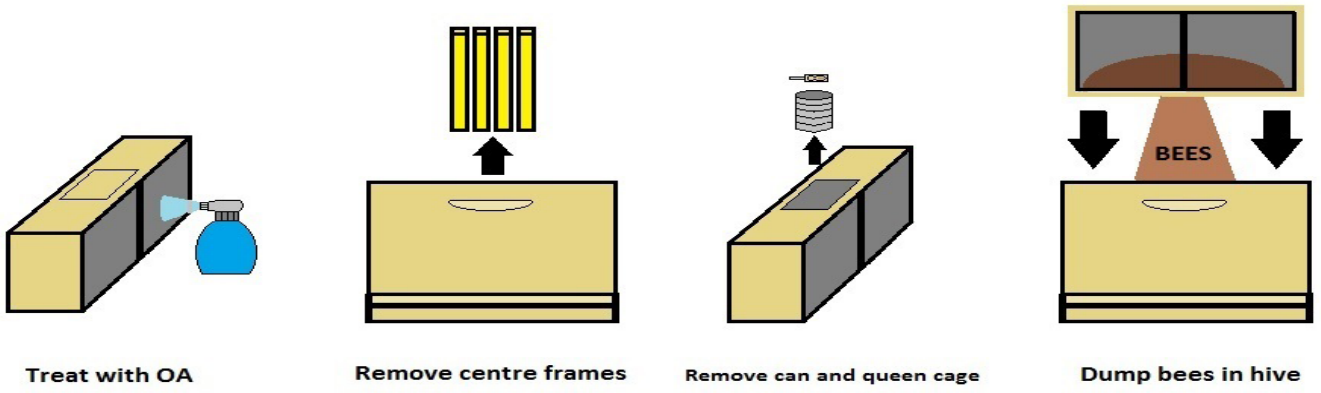


Figure 1. Simplified diagram illustrating the main steps to installing a boxed package of honey bees (drawn by Cameron Menzies)

Arataki Package

Many of the steps of installing an Arataki package are similar to those of the boxed packages, with a few key differences. First, orient the tube in a vertical position, making sure the end that has the tab of a green strip sticking out is oriented upwards and not resting on the ground.

Remove the staples attaching the (white plastic cone-shaped) top to the package, with the hive tool. Twist off the top and set it aside. Tap the package lightly a few times on the ground to force the adult bees to the bottom of the tube.

Grab the end of the green strip and remove it from the tube. This strip should have the miticide strip and the queen cage attached to it. Gently remove the queen cage and set it aside out of the sun. Discard the green strip with the miticide strip still attached to it, making sure not to touch the miticide strip with your bare skin.

Next, invert the tube of bees and shake them into the hive, towards the back, so that the bees do not immediately escape out of the front entrance. Gently replace the missing frames, the hive-top feeder (if applicable), the inner cover, and the lid. Please see Figure 2 for an illustration of this process.

Bartel Honey Farms Inc. in Manitoba has good instructions on handling Arataki packages and videos on installing them on their website *http://bartelhoneyfarms.ca/index/Hiving_a_Tube_Package.html*.

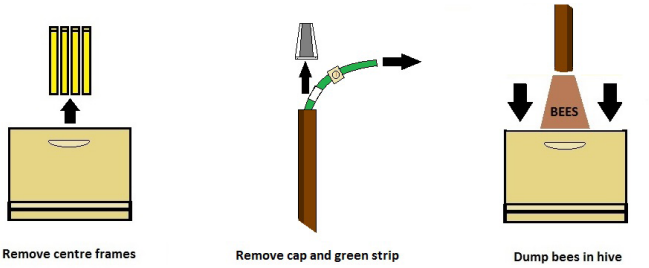


Figure 2. Simplified diagram illustrating the main steps to installing an Arataki tube package of honey bees (drawn by Cameron Menzies)

Installing a Queen from a Package

Installing a new queen to a new colony is challenging and there is no guarantee the colony will accept her. To maximize the chance of a successful queen installation, caution must be exercised to ensure she is not damaged in the process and that the worker bees have time to get accustomed to her scent (i.e. the set of pheromones she emits).

Boxed package

Observe the two holes on either side of the queen cage, each plugged with a small cork. One corked hole will lead directly to a wad of white candy and the other will lead directly into the small chamber containing the queen and her attendants. Once installed in the hive, the attendants and other worker bees from the package will slowly chew through the candy separating them and their new queen. This will take place over the course of a day or two, allowing enough time for the queen and her workers to become accustomed to each other.

Using needle nose pliers, remove the cork on the end that leads to the candy (do not remove the other cork). Using a small tack, puncture a hole through the queen candy to assist the bees to chew through it. Place the queen cage between two of the centre frames at the top of the hive with the hole leading to the candy facing upwards

and press the frames together to hold the queen cage in place. If there is a plastic tab stapled to the queen cage, it can be stapled to the edge of the top of the wooden brood box to hold the queen cage in place. It is best to prevent the queen cage from sliding down to the bottom of the hive for ease of access when checking to see if the queen has been released properly. If the plastic tab is attached to the top of the brood box, the empty cage can be easily pulled out without disturbing the new colony. Before closing the new hive, make sure there is a feeder on top or a frame feeder in the hive which can be filled with the remaining sugar water from the package. Puncture the top of the can with the hive tool, invert it to allow the syrup to drip into the feeder, and puncture the bottom of the can again to allow the syrup to flow more smoothly.

A caged queen from a boxed package ready to be introduced to a hive. Note: absent in this cage are two or three worker attendants that may be accompanying the queen.

Arataki Package

The queen cages that come with Arataki tube packages may only have one corked hole and likely no queen candy blocking the hole. The cork in these cages will need to be removed before installing the queen and it is a good idea to have some crystallized honey or solid fondant sugar on hand to block the hole after the cork is removed. Regardless of the style of the queen cage, if the queen exits the cage and immediately is among the worker bees there is a chance she will not be accepted. Place the queen cage between two centre frames as with the installation of a queen from a boxed package.

Hive Care After Installation

Once the package of bees is installed in the hive, it is important to monitor the development of the new colony and make sure it establishes itself successfully. About five days after installing the package, return to the new hive to see if the workers have begun drawing out any comb in the centre of the hive and if the queen has begun laying eggs there. If there is newly drawn comb but no eggs or young larvae in them, it could be that the queen was not established properly. At this point, remove the wooden cage, which should be empty, from the hive. If it is empty and there is no evidence of a laying queen, it is possible the queen emerged from the cage too quickly and was not accepted by the worker bees. If the queen is still in the cage and is still alive, clear away any remaining queen candy in the cage and allow her to escape into the hive. The workers around her should be used to her scent at this point, but being trapped in the cage for a prolonged period of time likely weakened her. If there is comb available in the hive and the queen doesn't immediately begin laying after emergence from her cage, it may be a good idea to attempt to replace her. Often, beekeepers purchase extra queens in the spring for this purpose.

Sometimes the queen successfully emerges from her cage and can be observed walking around the frames' foundation in search of drawn out comb to lay in, which the workers have not yet produced. A good strategy for coaxing the worker bees into drawing out comb is to simulate a nectar flow by heavily feeding the colony 1:1 sugar syrup. Fumagillin can be added to the syrup at this time to create medicated feed, if desired. See the 'Feeding' topic in the 'Splitting Hives and Making Nucs' section below for more information.

Splitting Hives and Making Nucs

Dividing or 'splitting' honey bees colonies is a useful management technique in any beekeeping operation. Splits can be made to increase the overall number of colonies (expansion), make up for overwintering losses, and discourage swarming. They can also be used to form nucleus colonies to sell.

What is a split?

A split is a division of a parent honey bee colony into a smaller parent colony and a newly-formed smaller colony. The new colony can be put into a full standard box or placed in a nucleus colony ('nuc'). Nucs are comprised of three to five frames of bees in various stages, as well as food stores in a smaller hive box, called a nuc box. A nuc can be overwintered in a nuc box or moved to a larger standard box, depending on when in the season it is formed and how it develops.

The original queen typically remains with the parent colony and a new queen can be installed to the split hive using a variety of methods (discussed below).

Unproductive colonies can also be split and added to other colonies (provided they are inspected for diseases and pests first).

What is a Nuc Box?

A nuc box is a small box commonly containing enough space for three to five frames of bees. It is designed for making small (two to three) frame splits, for giving a four or five-frame split a small space to keep warm in the early spring before being transferred into a hive body, or for the split to make its own queen or hatch and mate a queen.

In the summer, a four or five-frame split is commonly put directly into a deep hive body so the bees have room to grow. Beekeepers may put a piece of cardboard in a deep super to limit the space for the bees to work so they don't get discouraged with too much space, but this is personal preference.

The entrances of nucs are typically reduced to limit robbing and heat loss. Entrances can be reduced to two to three inches until the colony fills one deep super and is ready for a new super. By then, the colony is typically large enough to defend the entire opening of the entrance. If robbing or hornets and wasps are becoming a problem, keep the entrance reduced for longer. As the colony grows, the entrance can be gradually opened.

Newly split hives will have 10 frames of new foundation. Remove the center four to place the two food and two brood frames from the parent colony. The four foundation frames can be checkerboarded into the parent colony (i.e. the placement order of brood and food frames is alternated).

Timing

Timing of splits will depend on the availability of queens or the presence of drones to mate a queen produced within the hive. In Atlantic Canada, there is limited opportunity to make splits; splits made after late July may not have sufficient time to build up before winter. Beekeepers in the region have been able to make early August splits and overwinter them as a single deep, but they must be fed quite heavily and honey frames should be saved for them. These are sometimes called 'summer nucs', and with the right care and conditions (e.g. nice warm fall with plenty of forage), can grow to become good-sized hives before the winter. If hives are strong enough in the spring, splits may be made before lowbush blueberry bloom. Hives may also be split at various times in the season to reduce swarming.

Sunny, warm conditions are best for splitting hives as the forager bees will be busy and away from the hive.

Most importantly, hives must be strong enough to be split. There should be six to ten brood frames in the parent colony before it can be split, as there needs to be lots of brood and honey left in both hives.

Although it comes down to adequate food and brood, and beekeeper preference, nuc boxes should contain approximately one to two frames of a mixture of honey and pollen, two frames of brood, and an empty, drawn frame for room for the queen to lay.

Feeding

Splits are typically made before a honey flow, and since it will take time for the colony to develop and brood to become forager bees, feeding the splits is important. Beekeepers in the region often install a frame feeder in splits to feed sugar syrup (1:1 solution). Fumagillin can also be fed in the sugar syrup to address nosema concerns; as splitting hives can be a stressful time, feeding medicated sugar syrup could help control the risk of nosema. Pollen supplements may also need to be fed if pollen stores are low in the newly split hive and if there are a lack of forager bees.

A pollen patty provides supplemental pollen

Methods for Splitting Hives

Method 1: Finding the Queen

1. Determine if parent colony is strong enough to split
2. Prepare nuc or hive boxes- include drawn comb and foundation
3. Prepare feeders and medication if desired
4. Open parent colony and find queen- set the frame she is on aside or temporarily place her in a queen cage as she will remain in the parent colony
5. Locate two to three frames of brood in a range of stages
6. Locate two frames of food (pollen and nectar)
7. Place frames in new hive box keeping natural structure (brood on inside, food on outside)
8. Fill frame feeder in the nuc box, add pollen patty if desired
9. Shake some nurse bees from parent colony into new hive to keep brood warm (nurse bees will be loyal to brood rather than the queen in parent colony)
10. Reduce or close new hive entrance and move to new yard (at least three km away) unless doing a 50:50 split, whereby the new split is then placed beside the parent colony
11. Replace missing frames in parent colony with drawn frame and/or foundation; try to keep brood frames together and close to food frames
12. Place new, mated queen or queen cell in the split hive, usually after waiting 24 hours.

The queen on a frame

Advantages of this method include minimal lost brood rearing time; with a queen cell or a new queen placed in the hive, eggs can be viewed within one to ten days.

The disadvantage of this method is that the queen must be found, which takes time. If a mated queen is installed in the new split, there will be minimal brood break, meaning there is less of a brood break (that can potentially decrease varroa populations).

Method 2: Walkaway Split

1. Determine if parent colony is strong enough
2. Prepare nuc or hive boxes: include drawn comb and foundation (or if a double-chamber parent hive, just split the chambers, as long as there is adequate brood in each chamber)
3. Prepare feeders and medication, if desired.
4. Place two to three frames of young brood in new hive; include eggs, larvae and some capped brood in new hive.
5. Place two to three frames of food (pollen and nectar) in new hive.
6. Place frames in new hive box keeping natural structure (brood on inside, food on outside)
7. Fill frame feeder in the nuc box, add pollen patty if desired.
8. Shake some nurse bees from parent colony into new hive to keep brood warm (nurse bees will be loyal to brood rather than queen in parent colony).
9. Reduce or close new hive entrance and move to new yard (at least three km away) or alternatively, set next to parent colony (foragers will return to parent colony, nurse bees will remain with split hive).
10. Replace missing frames in parent colony with drawn frame and/or foundation; try to keep the brood together and close to food frames
11. The split hive will begin to raise its own queen from the young larvae. Do not open hive for at least 28 days; the queen will need to be raised from a very young stage, develop, get out for mating flights and then begin laying eggs. You should notice eggs after 28 days. Disturbing the colony before this time risks harming the developing queen and setting the hive back significantly. Drones will need to be in the area for mating flights.
12. Forager bees will return to the hive with the original queen, and eggs will continue to be produced.

Honey stored in frame

If available, a swarm cell (or another type of queen cell) could be installed in the walkaway split to speed up the process of requeening and eventual brood production. The simplest way to do this is to place the frame containing the queen cell directly into the nuc.

An advantage to walkaway splits is that the queen does not need to be found (saving time). Another benefit of walkaway splits is the break in the brood rearing; this break can halt the varroa mite cycle as there are no new brood cells for the varroa to reproduce in.

The disadvantage of walkway splits is the longer time required for the hive to raise a queen. This is likely not the best splitting option for late in the season as the hive may not have time to build up adequately for foraging and overwintering.

Method 3: Delaplane's Version

Select four to five frames of honey, brood and clinging bees (ensuring the queen is not present) and move these frames to the middle of a new, empty hive. Surround the four to five transferred frames with a mixture of empty drawn comb and foundation. Ideally, move the split to another yard, but if this is not possible, shake additional bees from the original hive (parent hive) onto the newly-made split.

Installing a Queen into a Nuc

There are several commonly used techniques to install a queen in a nuc. Certain beekeepers prefer to leave hives queenless for approximately 24 hours before introducing a new queen to the split.

Installing a Mated Queen

A mated queen can be purchased from a reputable queen breeder and installed in the hive. Usually the cage containing the queen is placed between the top bars of the hive or pushed into wax to hold the queen cage up. The mesh part of the cage has to be accessible for bees in the hive to help feed the caged queen. A small tack should be driven all of the way through the queen candy to aid in mixing of pheromones and to give the bees a place to start releasing the queen. The queen candy entrance should be level with the top bars of the frames and should be in the upwards position. That way, if some of the attendants die and fall to the bottom of the cage, they will not plug the queen's exit point. If the queen has not emerged after three to four days, and the bees are not clustered around the queen, she can be manually released from the cage. If the bees are clustered around the cage, make sure the original queen wasn't placed in the split before the queen is manually released.

Installing a Queen Cell

A queen cell can be installed in a colony by putting a frame containing a queen cell into the colony. A queen cell cup containing a queen cell can be put into the colony by gently pushing the cup into the wax of a frame.

Spring Housekeeping

There are a number of spring housekeeping practices to ensure hives are clean and colonies can build up.

1. Unwrap hives (typically April in Atlantic Canada).
2. Remove entrance reducers (unless colonies are weak).
3. Check bottom boards for dead bees, observe any abnormalities and remove residue (can be scraped with a hive tool). Reverse the bottom board if reversible and/or torch the bottom board after scraping to help destroy diseases that may be present.
4. Reverse the hive bodies/chambers (if overwintering in doubles). As the cluster moves through the hive over the winter, it will end up in the top box in the spring. Take the top box and reverse it with the bottom box. Place some honey frames in the top box to encourage bees to move throughout hive, but leave some honey in the bottom to provide a close food source during cool weather.
5. Inspect and replace old comb; try to rotate comb out every three to five years. Inspect for signs of American Foulbrood (AFB).
6. Feed hives. A 1:1 solution of sugar syrup can be fed to stimulate brood rearing. Be careful to not feed too much in case the hives become 'honey bound' too early, causing the queen to run out of room to lay eggs and potentially stimulating swarming. If the hive contains too many honey frames and there is limited room to lay, remove some of the honey frames and replace with drawn empty frames to encourage brood rearing. Pollen patties can also be fed.
7. Monitor for diseases and pests. Sample for varroa mites (see *Integrated Pest Management* section further on for more information) and send off bee samples for nosema spore counts (or count on your own with a microscope). If nosema spores exceed threshold, feed fumagillin in sugar syrup. Beekeepers may add thymol or other products to sugar syrup to lower the nosema spore count if the threshold has not yet been exceeded. If mites exceed threshold, select a treatment method not used in previous 12 months.

Spring Buildup

Pollination Standard

The first warm days of the year for commercial Atlantic Canadian beekeepers signal the time to prepare for the pollination of wild blueberries. Hives to be used for pollination must meet specific standards of strength, and many hives will require some manipulation to meet this standard. The following passage is the minimum standard of strength required to rent out a hive for pollination according to the Nova Scotia Beekeepers' Association (NSBA) and the Wild Blueberry Producers Association of Nova Scotia (WBPANS):

4 frames of brood (100% coverage of equivalent of 4 frames)
8 frames of bees (100% coverage of equivalent of 8 frames)
2 frames of honey
1 laying queen
(*www.nsbeekeepers.ca*)

Note: these frame requirements can be contained in one brood chamber or spread out over two brood chambers.

New Brunswick has less specific requirements, but states, "A hive should have at least two supers and contain a laying queen, brood, and 25,000 to 30,000 honeybees." (*www.gnb.ca*). A similar standard of strength is required for Prince Edward Island.

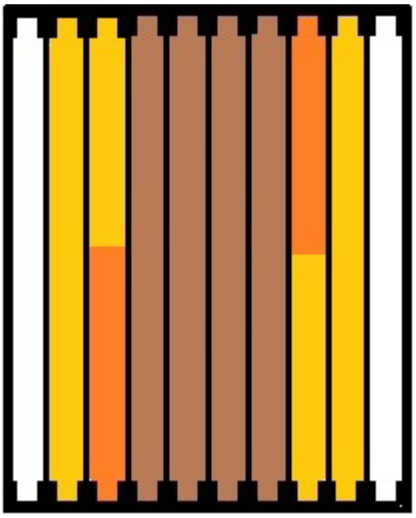


Figure 3. Bird's-eye-view example diagram of a single brood chamber hive meeting NS minimum pollination standard. Beige frames are 100% covered in brood, yellow frames are honey, orange frames are pollen, and white frames are empty. Each coloured frame in this diagram is also 100% covered in bees and the frames may not necessarily be in this order (drawn by Cameron Menzies).

Meeting Pollination Standard

Ensuring honey bee colonies meet pollination standard requires thoughtful year-round management and begins well before the onset of spring. Hives should be managed in the summer and fall to foster strong populations of winter bees to maximize overwintering success. See *ATTTA's Fall Management Guide* for more information (*www.perennia.ca/wp-content/uploads/2016/04/Fall-Management-Guide.pdf*). After a temporary hiatus, colonies continue rearing brood in the winter as the queen continues laying eggs in empty cells at the centre of the cluster recently cleared of honey stores. Colonies that do not begin brood rearing during the overwinter period will have a greatly reduced rate of spring population build up (Seeley and Visscher, 1985).

There are several factors that influence whether a colony will overwinter successfully and become sufficiently populous for pollination. Colonies that are not monitored regularly risk harbouring high levels of varroa mites and pathogens which, if left untreated, can cause a colony to collapse, or fail to build up to the pollination standard. Hives should be insulated and must be provided proper ventilation or else risk succumbing to the lethal elements of an Atlantic Canadian winter.

Hives must also contain a sufficient quantity of stored honey and pollen to sustain the overwintering population. Adult bees close to the perimeter of the overwintering cluster activate their flight muscles to generate heat – an activity that is costly in terms of energy expenditure. Winter bees will constantly consume honey to keep energy stored for insulation. Once brood rearing starts again, readily available pollen must be present to nourish the brood's development.

Immediately following the winter season, hives should be inspected to determine if overwintering was successful. If one or several hives did not overwinter successfully, possible causes of colony mortality can be identified with the help of ATTTA's interactive winter colony dead-out *Bee Diagnostic Tool* (*http://perennia.ca/beediagnostic/*). Weak colonies that made it through the winter can begin to be manipulated at this time to ensure they are up to standard in time for pollination.

Identifying a Weak Hive in Late Winter/Early Spring

Lift Test

Exercise caution while inspecting hives in the early spring months. Overwintering clusters of bees should not be disturbed and exposure of brood to lethal cold tempera-

tures should be avoided. One trick to roughly assess the strength of a hive without inspecting its interior is to perform a 'lift test' wherein a strapped hive is manually tilted back by lifting one side of the hive slightly off the ground (front or back). A hive comprised of two wooden Langstroth boxes, 20 drawn frames, a bottom board, an inner cover, a lid, and a healthy overwintering population of bees will weigh approximately 70 lbs (32 kg). On top of that weight are the stores of honey and pollen remaining in the hive. A healthy double boxed hive going into an Atlantic Canada winter should have approximately 80 lbs (36 kg) of honey stored; the colony will consume its honey stores over the winter but will become threatened when stores are depleted below roughly 20 lbs (9 kg). If a hive feels to be well below 100 lbs in weight, emergency spring feeding may be necessary to prevent colony death.

Objectively estimating a hive's weight with a manual lift test requires experience and a sturdy back. Equipment may be used to assess the hives' weight (without having to slide a platform scale underneath). Luggage scales can be used to weigh one half of a strapped hive at a time by hooking the scale underneath the strap at one edge of the lid and lifting that side of the hive off the ground (as in the 'lift test' method). After obtaining a reading on both sides of the hive, the two values can be added together for a rough but useful hive weight estimate.

Luggage scale

Inspecting a Colony

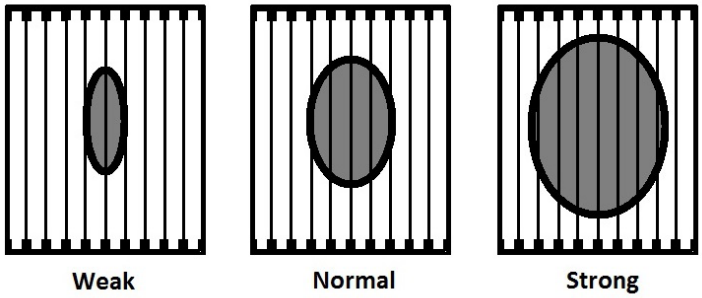
If weather permits, hives can be opened to inspect colony strength. Hives should not be opened if the weather is below 5 °C. A mild, windless, sunny afternoon in late winter or early spring would be an appropriate time to open hives. When opening a hive, be careful not to disrupt the winter cluster, which at this point will likely have moved up into the top chamber (if the hive has two brood boxes). Frames should not be removed for inspection if the outdoor temperature is below 13 °C. Later in the spring when it is warm enough outside, hives can be more thoroughly assessed for adequate food storage, presence of brood, and population strength.

Strengthening Weak Hives

The strength of a queenright colony (i.e. laying queen present) can be quantified by categorizing the size of the winter bee cluster in terms of how many frames it occupies: strong = six or more frames, normal = three to five frames, and weak = one to two frames (Ontario Beekeepers' Association). Weak colonies will likely not build up to pollination standard on their own and will require some manipulation. There are a couple of options to boost a weak colony. The first option is to reduce the hive to a single brood chamber if it is a double. This can be done by removing the bottom brood chamber altogether (as long as the cluster is entirely situated in the top brood chamber). Note: if removing equipment, make sure to inspect it for diseases and pests and store it somewhere sealed where wax moth and other pests cannot easily access it.

Excess nurse bees (i.e. young adult bees that have hatched from cells this season – not winter bees from the previous fall) from strong colonies can be shaken into the weak hive. Eventually, frames of brood from strong hives can be donated to weak hives when the population of nurse bees of the weak colony is great enough to take care of the brood.

The second option is to unite a weak colony with a strong or normal colony (see *Two-Queen Colonies* section further on for more information).



Bird's-eye-view diagram of a "weak", "normal", and "strong" colony; the grey circles in the centre of the hives represent example sizes of bee clusters (drawn by Cameron Menzies).

Spring Management for Normal and Strong Colonies

Equalization

Queenright colonies whose winter clusters of bees are sufficiently large to not be considered weak often still require some manipulation in the spring. If the cluster has moved entirely up into the top brood chamber and there is an ample supply of brood on the frames among the cluster, the positions of the top and bottom brood chambers should be switched. Extra frames of honey left near the edges of the (now) bottom chamber should be moved inward and closer to the cluster but one or two can be placed in the top chamber to encourage the bees to move upwards as the spring progresses. Ideally, hives coming out of the overwinter period are relatively strong and have ample food stores. However, it is important to ensure colonies have room to expand in their hives. The queen needs empty comb to lay eggs and the workers need empty comb to store nectar and pollen to feed the growing colony.

Pay attention to the balance of adult bees, brood, honey, and pollen in the hives. If a hive has a healthy population but low food stores, consider providing it supplemental 1:1 sugar water feed until the onset of the first nectar flow in spring. If a strong hive has ample food stores and plenty of brood frames but nowhere for the queen to lay, consider trading one or two brood frames from the strong hive with one or two empty drawn out frames from a weaker hive. Colonies that are too weak will not build up strength in time for pollination season and colonies that are too strong (i.e. are outgrowing their hives) risk swarming. See ATTTA's *A Comparison of Honey Bee Swarm Prevention Techniques* factsheet for more information (*http://www.perennia.ca/wp-content/uploads/2016/04/Swarm-Prevention.pdf*).

Dead Colonies

It is quite likely that not all colonies survived the winter. It is also possible that some of the hives that survived the winter will collapse in the spring before pollination season. To help diagnose the cause of winter mortality, check out ATTTA's interactive winter colony dead-out *Bee Diagnostic Tool* (*http://perennia.ca/beediagnostic/*). Dead colonies can become problematic if left out in the field. They become magnets for storage pests like wax moth that healthy honey bee colonies can typically control. It is best to clean out dead colonies by brushing the dead bees off the frames and bottom board and scraping the bottom board of debris. Frames that have been inspected for residual signs of disease can be used to supplement other hives in the apiary. Empty drawn comb can be given to hives in need of more laying space for the queen and unused frames of honey can be given to hives in need of supplemental feeding. Stored honey is a better option than sugar water for feeding hives in the late winter/early spring while the winter bees are still huddled in a cluster because bees are less able to process sugar water in the colder months by inverting sucrose into glucose and fructose. The remaining equipment should be stored in a cold, dark, sealed area.

Integrated Pest Management of Diseases and Pests

Managing diseases and pest populations in honey bee hives is a year-long process. Although this aspect of beekeeping is expensive in terms of both money and time, it is not sufficient to treat hives once a year and then forget about them. A thorough integrated pest management (IPM) approach to controlling diseases and pests is necessary for sustaining healthy colonies while reducing reliance on synthetic chemical treatment. The warm weather brought on by spring offers beekeepers an opportunity to do their first colony health check-ups. These check-ups involve assessing colony strength/ food stores, as previously mentioned, along with taking a snapshot of disease and pest loads.

Monitoring

Varroa

Monitoring events for varroa mites (*Varroa destructor*, Anderson and Trueman) should take place at least three times per year: once each in spring, summer, and fall. The idea of monitoring is to determine whether the disease or pest levels in the hives have reached a specific population level (i.e. economic threshold) at which treatment is warranted. There are several techniques for monitoring varroa; the instructions, pros and cons, and economic thresholds associated with each technique are outlined in ATTTA's *Summer Disease and Pest Monitoring* factsheet (*http://www.perennia.ca/wp-content/uploads/2016/04/Summer-Disease-and-Pest-Monitoring.pdf*). The same techniques used for monitoring in the summer can be used in the spring as well. These techniques include the ether roll, alcohol wash, and sticky IPM board (slid underneath a screened bottom board).

Nosema

Warm days in the late winter and early spring allow bees that have been cooped up in their hives all winter a chance to perform cleansing flights. During these flights, bees will defecate and cleanse their digestive tract of

potentially harmful microbes, like spores of nosema (*Nosema apis* and/or *Nosema cerenae*). Beekeepers should keep an eye out for excessive dysentery on the exterior of their hives. Messy dark streaks on the exterior hive walls may be associated with nosema but are not necessarily diagnostic of nosema infection in a colony; dysentery can signify nutritional issues and other ailments. To determine the presence of nosema infection, adult bees from suspected hives should be sampled and dissected so that the contents of their midgut can be visually analyzed under a microscope. The Nosema Assessment Protocol, as outlined by the Ontario Beekeepers' Association Technology Transfer Program, can be found at http://www.ontariobee.com/outreach/fact-sheets-and-publications.

Hive with dysentery on exterior (James Tew).

Brood Diseases

While removing comb in the spring to assess hive strength, beekeepers should also be checking for any signs of diseases or pests. This includes looking for the dark scale and discoloured larvae characteristic of American foulbrood and European foulbrood, signs of chalkbrood, and signs of vectored diseases from varroa mites like deformed wing virus. See ATTTA's *Summer Disease and Pest Monitoring in Honey Bees* factsheet (*http://www.perennia.ca/wp-content/uploads/2016/04/Summer-Disease-and-Pest-Monitoring.pdf*) for more information.

Cells containing chalkbrood (Rob Snyder www.beeinformed.org).

Adult honey bee worker displaying symptoms of deformed wing virus, a virus vectored by varroa mites.

Chemical treatment

Varroa

Spring is arguably the most important time to treat for varroa. Varroa mites reproduce exponentially as a colony of honey bees grows throughout the season, so cutting down the number of mites in a hive early in the year makes a big difference. It is often too late to wait until the fall to treat; emergency corrective treatment of high varroa infestations late in the season is a futile endeavor. Several chemical treatment options are available to Atlantic Canadian beekeepers, both synthetic and natural (i.e. organic/non-synthetic), for spring varroa treatment.

Note: All chemical treatments should be handled with care whether natural or synthetic. It is against the law in Canada to use "… a pest control product in a way that is inconsistent with… the directions on the label" (Pest Control Products Act of Canada, 2016).

Amitraz (Apivar®, Vetó-pharma), tau-fluvalinate (Apistan®, Wellmark International), and coumaphos (Checkmite+®, Bayer) are all synthetic-miticide strips commercially available in Canada, and the newly registered flumethrin (Bayvarol®, Bayer) will soon join this list in Canada (as of spring 2017). The active ingredient on each strip kills varroa mites on contact. The strips must therefore be placed in the hive between frames of the broodnest so that they are in close proximity to the bee hosts the ectoparasitic mites are feeding on. Unfortunately, miticide resistance in populations of varroa has been reported with both tau-fluvalinate and coumaphos in Canada (Currie et al, 2010). The possibility of cross-resistance developing between flumethrin and tau-fluvalinate exists because both miticides are in the same class of insecticide (i.e. group 3A pyrethroids). Cross-resistance between these two miticides has been previously reported in Italy (Milani, 1995). To avoid miticide resistance developing in Atlantic Canadian apiaries,

chemical treatments should be rotated both within and over the course of multiple seasons. Applying the same miticide more than once in a year and continuously for multiple successive years should be avoided.

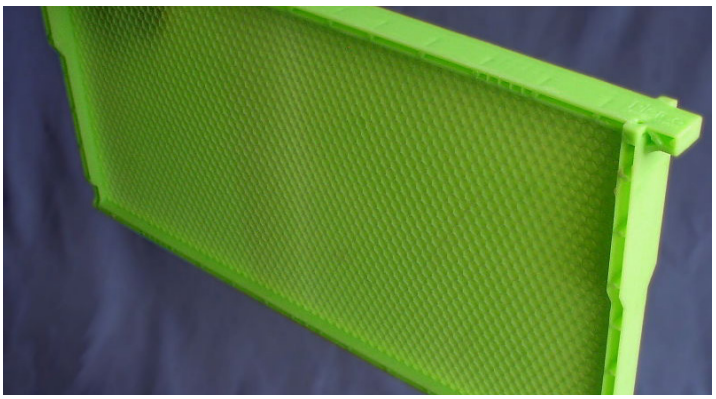
Formic acid, a natural treatment chemical, is commercially available in strip form as well: Mite Away Quick Strips® (NOD Apiary Products). This product works the same as the aforementioned synthetic-miticide strips and can be applied to hives in the spring according to label. Formic acid can also be purchased in bulk form and applied to pads for either single or multiple application directly on top of the frames in a hive. For both the multiple and single applications, the hive entrances must be open and unobstructed for ventilation. If using a single application, a 250 ml pad in a perforated bag should be applied to the hive and left for three to four weeks. Detailed preparation and application guidelines for this method can be found at *http://www.ontariobee.com/sites/ontariobee.com/files/document/250ml-pamphlet-op.pdf*. Although this product is natural, it is still dangerous to humans at commercially available concentrations and so proper safety precautions, including personal protective equipment, should be followed. Another natural treatment product, oxalic acid, is best suited for treatment in the late-fall when there is no brood left in the hive.

Varroa Cultural and Physical Control

Controlling levels of diseases and pests in honey bee hives need not solely be done with chemical treatment; beekeepers have the option to manipulate colonies by physical means or utilize specialized equipment to keep disease and pest levels under control. Reducing the frequency of chemical treatment in an apiary in turn reduces the risk of resistance developing in populations of disease and pests. Residues from lipophilic miticides accumulate in the wax comb and chronic exposure to these residues may have negative implications for honey bee health (Johnson et al, 2009). Synthetic miticides can be expensive, so it is worth considering the costs and benefits associated with the time and labour that goes into implementing cultural and physical methods versus applying miticides. Physical and cultural control methods may not necessarily control varroa infestations on their own and are not designed to outright replace chemical treatment, but can instead be integrated into a thoughtful pest management approach.

Drone Brood Removal

Spring offers an opportune period of time for beekeepers to get a head start on reducing varroa loads. Queens will often lay strips of unfertilized eggs at the edges of frames in the late spring to boost a colony's population of drones. Due to the larger size of drones, varroa mites prefer reproducing in drone cells rather than worker cells. Capped drone cells therefore become "traps" for varroa mites in the spring and should be removed before the drones hatch. Commercially available drone brood frames with large hexagonal foundations can be purchased for this purpose. In May when a colony starts building up its drone population, a drone brood frame can be placed in a hive (in the place of a typical empty frame) beside the broodnest near the centre of the hive. The worker bees should then draw out this frame and the queen will lay unfertilized eggs in it. It is important to note when the queen starts laying on the frame because in 24 to 25 days, the drones will begin hatching. Drone brood frames should be removed and scraped away or frozen before the drone bees hatch but not before the brood is capped over, or else risk increasing the varroa population in a hive even further. After having been frozen for several hours, the drone pupae will die along with the reproducing mites feeding off them. The frame can be placed back into the hive to repeat the cycle if desired and the housekeeping bees will uncap and clean out the dead drone pupae. Alternatively, the drone frames can be scraped off before being placed in the hive. Note: this method is recommended for colonies that are strong enough to rear a large population of drones and can afford to have an entire frame's worth of drone brood and not female worker brood. This method has limited efficacy for colonies with excessively high varroa infestations.



Specialized drone comb foundation frame (www.countryfields.ca).

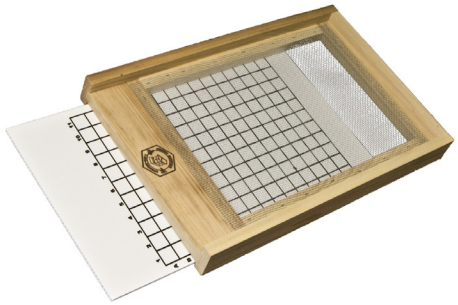
Splitting

Splitting hives in the spring is another method of varroa cultural control. When a colony is split, its varroa population is effectively cut in half. The daughter colony without a queen will have a break in its brood cycle during the process of re-queening (so long as the colony is not manually re-queened with a mated queen). During the break in the daughter colony's brood cycle post-split, the

majority of mites in the hive will be in their phoretic (i.e. adult) stage attached to adult worker bees. Oxalic acid can then be used to treat the adult mites by vaporization or the trickle application of liquid oxalic acid. A protocol for the trickle method can be found at *http://www.ontariobee.com/sites/ontariobee.com/files/document/OA*%20Protocol%202015.pdf.

Screened bottom board

Screened bottom boards not only act as a monitoring tool for varroa mite levels, but can also offer some physical control. Mites that fall down naturally through the screen to the bottom board are preventing from returning back up into the hive.



Screened bottom with sticky IPM board (www.countryfields.ca).

Spring Dwindling

What is Spring Dwindling?

Spring dwindling is when older, winter bees die at a rate faster than new bees are produced and emerge. Spring dwindling can be caused by a number of problems including varroa mites, weak queens, insufficient colony strength entering the winter, insufficient food stores for the winter, and poor weather, typical of Atlantic Canada springs.

How Should Spring Dwindling be Managed?

There are various management techniques to avoid spring dwindling including:

- monitoring and controlling varroa mites
- requeening every year with strong, young, productive queens
- overwintering strong colonies
- ensuring adequate food stores in the fall, monitoring food stores during the winter
- overwintering hives in sheltered locations
- monitoring hive strength in the spring- inspect weak hives and combine with stronger hives if possible
- monitoring nosema spore levels

Other Options

Avoiding spring dwindling and ensuring colonies are strong in the spring is a major issue in Atlantic Canada as many beekeepers prepare their hives for lowbush blueberry pollination early in the season. Other techniques to prevent spring dwindling include:

- running a two-queen colony system
- hardy genetics
- spring feeding

Spring Foraging Resources and Feeding

Spring Foraging Resources

Natural spring foraging resources are an important source of protein (pollen) and carbohydrates (nectar) for building colonies. Depending on the apiary location, several early-flowering plants and trees provide pollen and/ or nectar, including willow, maple, birch, speckled alder, dandelion, and coltsfoot.

Spring Feeding

Sugar syrup can be fed to colonies beginning early in the spring (April). A 1:1 sugar syrup solution should be used during this time to stimulate brood production, and can be fed using various methods including division board feeders, pail feeders, inverted mason jars, baggie feeders, hive top feeders, bottom board feeders, and Boardman feeders.

If there are limited natural foraging resources or if strong colonies are being built for blueberry pollination, pollen patties can be fed in the spring.

Honey bee foraging on crocus in early spring. (Sawyer Olmstead)

Two-Queen Colonies

What is a Two-Queen Colony?

A two-queen colony is a colony containing two queens. The brood chambers of each queen are separated (e.g. by a queen excluder). A vertical two-queen colony is comprised of a brood chamber of the Queen A on the bottom, with honey supers placed on top. A queen excluder is placed on the top of the honey supers, and the brood chamber of Queen B is placed on top of the excluder. Honey supers for Queen B are placed on top of that brood chamber. Two-queen colonies are able to build up faster in the spring which is advantageous in Atlantic Canada to meet requirements for spring pollination of lowbush blueberries. Two-queen colonies are also known to collect more nectar for larger honey crops.

What are Some Disadvantages?

- Larger colonies to transport for pollination
- More intensive management/ hive
- Need for early mated queens

How do you Construct a Two-Queen Colony?

Two-queen colonies should be established early in the season, by mid-May in Atlantic Canada. A strong and weak colony can be used for this procedure, after the cause of the weaker colony is determined (rule out diseases and pests, etc.). Steps (adapted from Vickery et al, 1991):

1. Locate a strong and weak colony on which to perform the two-queen colony.
2. The weaker colony is placed on the top of the stronger colony.
3. Locate the older queen of the strong colony and place her in the bottom chamber.
4. Add another chamber to the top of the bottom chamber with 10 drawn frames.
5. Place a queen excluder on top of the second chamber and add a honey super as the third chamber.
6. Place a division screen board (aka double screen board).
7. Take the original top chamber containing a mixture of brood and set it on top of the division screen board. Ensure there are a mixture of adult bees in this chamber to care for the brood.
8. Install a new queen into this chamber.
9. Close the entrance of the uppermost chamber containing the new queen (can plug with grass, etc.). This will prevent adult bees from moving back to the bottom chamber.
10. Install the inner cover and outer cover.
11. Check the top chamber for queen release and acceptance after a few days.
12. As the bottom colony builds up, another honey super may be necessary and can be installed. If the top colony also needs more room, place a queen excluder on top of the brood chamber and add a honey super on top.
13. Once the honey flow begins, the two-queen colony will be rearranged to form one super colony.
14. Locate and remove the older queen in the bottom brood chamber.
15. Unite the bottom and top colonies via the newspaper method. Take the brood chamber from the bottom and place it on top of the brood chamber at the top, with a few sheets of newspaper between them. By the time the bees chew through the newspaper, the odors of the two colonies will have mixed and fighting will be avoided. A queen excluder or Snelgrove board can be added on top of the two brood chambers and honey supers added above that.

Resources

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Ontario Beekeepers' Association nosema identification protocol: http://www.ontariobee.com/outreach/fact-sheets-and-publications

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Special thanks to Julia Baak for bee photos.