Fall Honey Bee Management Guide

Atlantic Tech Transfer Team

Fall is a busy and important time in beekeeping. It's time to get diseases and pests under control, ensure adequate nutrition and food stores for bees going into winter, prepare hives for the overwintering period and start thinking about equipment needed for next year. This management guide is designed to highlight all of these topics and provide practical tips for addressing them in our Atlantic Canada conditions.

A frame is carefully removed from the hive for inspection.

What's Happening in the Hive During the Winter?

In autumn as temperatures cool, days grow shorter and the amount of nectar and pollen coming into the hive begins to slow down, brood rearing is reduced and overall population begins to decrease. A decrease in food stores leads to the colony preventing drones from re-entering the hive, and along with changing photoperiod and cooler temperatures, shifts brood rearing from summer bees into winter bees. Winter bees have longer life spans that will get them through the winter, as opposed to summer bees that live for only 4-6 weeks. Physiologically, winter bees contain more fat bodies, higher fat and sugar levels in their blood, and lower levels of hormones compared to summer bees. Winter bees and the queen will survive the winter and summer bees will begin to die in the autumn. With cooler temperatures, the remaining bees form a tight cluster to keep warm for the winter and protect the queen. The cluster will move through the hive during the winter to access food stores. Bees on the inside of the cluster eat honey and generate heat, and also pass honey to bees on the outside of the

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cluster. Bees will rotate within the cluster so that bees on the outside do not become chilled.

Fall Feeding for Bees

There's a saying among beekeepers in our region that spring feeding happens in the fall. There is some truth to this - bees need to be monitored for fall feeding and benefit from 'fall groceries' in order to be healthy and strong the following spring. As fall approaches and after honey has been extracted (if applicable), feed hives a 2:1 sugar to water syrup solution for approximately one month; too few food stores and the supply will be inadequate for winter, but too many food stores will lead to the hive becoming honey bound (see below). Once the weather becomes too cool, bees will not break the cluster to take the sugar syrup solution; at this point, you can stop feeding the bees. Sugar syrup is a great way to feed medication in the fall (e.g. antibiotic fumagillin for nosema). Remember to always follow the label directions.

Why 2:1 solution instead of 1:1 in the fall? Cooler temperatures make it more difficult for bees to evaporate moisture from the solution to 'cure' it, so a thicker 2:1 solution reduces the water content and facilitates easier curing. To mix sugar syrup, dissolve white sugar in hot water and stir thoroughly. Do not use boiling water; boiled sugar syrup can lead to hydroxymethylfurfural (HMF) being formed, which is toxic to bees.

Capped honey stored in a frame.

To overwinter in our Atlantic Canada climate, each bee hive requires at least 60- 80 lbs (27-36 kgs) of honey, although nucleus colonies ('nucs') will require less food stores (approximately 50 lbs or 23 kgs). Honey is the carbohydrate source for the bees. Many beekeepers leave a honey super on top of the brood chamber to overwinter as the bee cluster will move upwards in search of food.

Nectar is being stored in this frame.

Without a scale, how can you tell what 60 lbs of honey feels like? You can conduct a lift test. Try to lift the hive with one hand using the handle on the box. If the hive is difficult to lift with one hand, the hive probably has enough food for the winter. If the hive is easy to lift, more food is likely required.

Pollen stored in a frame.

Pollen is also required for overwintering - this provides protein for developing larvae, particularly in the late winter and early spring. At least 3-6 frames of pollen are recommended for the hive to go into overwintering. If there is less, supplemental pollen patties may need to be fed in the fall or early in the spring to help with larval development. Brood rearing will start after the winter solstice, but the first natural pollen sources aren't generally available until April; thus, an adequate pollen store

A pollen patty placed on top of frames and frame feeder is found at the edge of the hive.

going into the winter addresses this spring shortage and provides protein for brood rearing.

Remember to prevent robbing (where bees 'rob' food sources like honey from other hives or honey remaining on equipment left in the apiary) during fall feeding by keeping strong hives, feeding all hives, and reducing hive entrances so it is easier for the guard bees to protect hives. Do not leave old honey frames or sugar syrup in the yard as this can promote robbing.

Feeders for Fall

When feeding large quantities of sugar syrup in the fall, tray feeders are recommended and are placed on the top of the hive. Frame feeders are also commonly used and are placed at one side of the hive as any other frame would be. Remember to leave a piece of wood or tree branch in the frame feeder for bees to land on while taking sugar syrup. Frame feeders take up the space of one frame, leaving less space for brood and food stores, but provide a close source of sugar syrup for bees. Frame feeders require the hive to be opened in order to refill them, however, which presents a challenge in cooler temperatures.

Although having enough food is critical for overwintering, ensuring there is enough empty space for the queen to continue to lay is also important. If there are excessive pollen and honey stores, the queen may be unable to lay eggs and there may be too few young bees in the spring. If you notice the hive is becoming 'honey bound' (as brood emerge, the cells are backfilled with nectar, rather than saving room for the queen to lay more eggs), you can remove two to four of the full honey and/or pollen frames (as long as there are still adequate food stores) and replace with drawn comb to facilitate enough empty space for more eggs.

Starvation

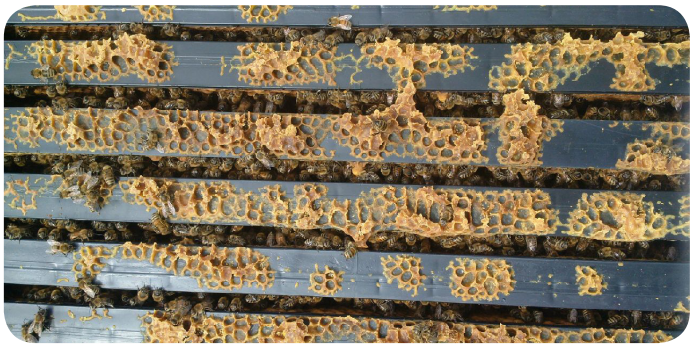
Starvation is a major concern for beekeepers over the winter. Even with adequate food stores, colonies can still starve to death by not being able to move over to the food frames. If signs of starvation (bees head-first into cells searching for food and a dwindling cluster) are noticed in early spring (when mild weather allows you to crack the hive), starvation can be prevented by rearranging some of the frames. Place a frame of honey next to the cluster and begin to feed sugar syrup (preferably in a frame feeder or hive-top tray feeder to provide a proximate food source) and a pollen patty on top of the frames with the bee cluster. Sometimes the cluster may not move even 2-3 frames away for food, so providing food in close proximity is critical to preventing starvation. Another option to ward off starvation is feeding fondant (bee candy) - it's a quick sugar source that can be placed on the top of the frames or on the inner cover and doesn't require you to disturb the cluster. There are various recipes for bee candy online (e.g. http://beehive-journal.blogspot.ca/2009/01/bee-fondant.html) or in *The Beekeeper's Handbook* by D. Sammataro and A. Avitabile.

Preventing starvation makes sense economically - by investing in sugar syrup and potentially pollen patties, you can save hives from starving to death. How can you tell if your hive died from starvation? Bees will be head-first into cells looking for food and will die in this position.

Bees that have died from starvation.

Amount of Bees Needed for Overwintering

At least seven to eight frames of bees are required to successfully overwinter - a quick way to look for this is to find seven 'seams' of bees between frames. Any less and there may not be enough bees to form an adequate cluster, access food stores and build up populations in the spring. Young queens tend to overwinter better as they are more productive (they will lay more eggs later in



'Seams' of bees visible between frames.

the fall), promoting young bees that will live throughout the winter.

Weak hives with low bee populations may be combined with other hives before winter. First, conduct a hive inspection to identify why the hive may be weak, and rule out disease or pest pressures that could spread to other hives if combined. If you are satisfied with the overall health of the weak hive, you can place it on top of another hive, separated by a couple of sheets of newspaper. The newspaper and some of the bees within each hive may be sprayed lightly with a sugar syrup solution; by the time the bees clean the syrup off one another and the newspaper, they begin to smell alike and will combine easier.

Tony Phillips, a Nova Scotia beekeeper, wrote a thorough article about overwintering bees in the Maritimes and it can be found at this link: http://www.nsbeekeepers.ca/cmsAdmin/uploads/Wintering-Bees-in-the-Maritimes.pdf

Fall Nutrition Concerns

Anecdotally, nectar from fall flowers such as goldenrod and other aster plants (at right) can hinder bee health through crystallization and poor nutritional content. Scientifically, aster honey is often thin and granulates quickly due to its high dextrose content. Sometimes the bees are unable to properly ripen the nectar into honey due to colder temperatures. This thin, unripe honey can contribute to bee dysentery. As aster honey crystallizes quickly, bees can starve to death over the winter even with seemingly adequate food stores in the hive, especially if there is no water source to use to moisten the honey. Canola flowers have the same impact on bees; due to a high dextrose content in the nectar, the honey can granulate very quickly, making honey extraction difficult.

How do we address this concern? A diversity of flowering sources in the fall provides different food options for bees and minimizes the risk of crystallized or unripe honey. Feeding syrup in the fall (after honey supers have been removed) can also help this situation.

Goldenrod is an important late summer and fall forage plant for bees.

Common fall forage plants for bees include goldenrod, sweet clovers, asters, coneflower, blanketflower, knapweed and St. John's Wort. Nutritious plants including sweet clover, red and white clover, phacelia and vetch provide good protein content in their pollen for bees.

Phacelia can be planted for bee forage.

Preparing Hives for Winter

There are several special considerations for wrapping and preparing hives for the winter.

Ventilation and Insulation

Install a metal or wooden entrance reducer to discourage robbing and restrict rodent entrance. An entrance reducer can be made using a piece of wood; recommended dimensions are 1.9 cm wide x 1.9 cm high and long enough to fill the bottom hive entrance. An opening is made in the piece of wood (approximately 5 cm wide) to allow access for bees, and is made on the top of the wooden entrance reducer rather than the bottom. A mouse guard may also need to be installed; different options can be found at bee supply stores or you can make your own using hardware cloth. Hardware cloth can be fastened over the 5 cm opening left in the wooden entrance reducer (see above). Create an upper entrance to improve ventilation and facilitate cleansing flights on good days. Beekeepers often put absorbent materials over the inner cover and under the lid to absorb moisture (common materials include wood shavings, straw, Styrofoam insulation, etc.).

Remove any queen excluders before winter.

Wrapping Material and Style

Tar paper/roofing paper - This black material promotes heat absorption from the sun and is commonly used. It is relatively inexpensive, and can be stapled or secured around the hive. Tar paper provides a wind break and keeps the hive dry from outside elements, but does not allow moisture to pass through very easily.

Typar - Typar is attracting more interest in recent years. It can be more costly to use on hives as a winter wrap compared to other materials, but it does allow for moisture movement out of the hive and provides a wind break. The downside is that Typar is not black and thus does not absorb heat from the sun very well. Little to no insulation is provided by Typar.

Black plastic wrap and bubble wrap - This is an increasingly common method of winterizing hives in the Maritimes. The plastic wrap is fairly cheap and provides a wind break and allows the hive to make use of heat from the sun. Although both chambers of a two-storey hive can be wrapped in bubble wrap followed by black plastic wrap, an increasingly popular method is to simply wrap the top chamber with bubble wrap, followed by black plastic. The reasoning behind this is that as the cluster moves upward throughout the winter, they will be in the top chamber when temperatures are particularly low and brood rearing has begun, requiring insulation from bubble wrap at that time. This could contribute to earlier spring build up within the hive. One of the downfalls of using black plastic is the inhibition of moisture movement outside of the hive.

The top chamber of this hive is wrapped in bubble wrap and the entire hive is then wrapped in black plastic.

Bee cozy - This commercial overwintering wrap is not typically used on a large scale due to the cost associated with purchasing them ($20-25 each), but they can be effective. They are ready to use as soon as they are purchased and consist of a polypropylene plastic sleeve filled with fibreglass to aid in solar heat collection and retention of heat as well. There are moisture retention issues that arise from the use of bee cozies and they are also big and bulky which can make handling an issue.

Most beekeepers in our region wrap their hives mid-November, depending upon the weather conditions at that time. If hives are wrapped earlier, the hive is stimulated to rear brood, using up important food stores. Beekeepers use various techniques for preparing their hives for winter; hives can be wrapped individually, in pairs, or four hives on a pallet. There are also differences in the industry between overwintering as singles or doubles. Chat with other beekeepers about what works best for them and why. Tip: Remember to secure the outer cover firmly.

Ratchet straps or heavy objects can be used to secure bee hive lids.

Overwintering Location

If wintering outdoors, choose a bee yard that is sheltered from northern winds or create a windbreak. Choose a south-facing location and ensure hives are not set into a hollow to facilitate good air flow.

Special Considerations for Overwintering Nucs

Nucs also need to be wrapped and fed for the winter. In our region, some beekeepers prefer to stack two nucs on top of one another, to help with generating heat. Alternatively, two nucs can be stored in a modified empty chamber that is divided in the middle (to separate the nucs) and the chamber is then set on top of another hive to help with heat.

Indoor Overwintering

Temperature control is key for indoor overwintering. 5°C is the recommended temperature to maintain indoors as below this temperature, bees will consume more food stores, and above this temperature, bees will become too active. In addition to temperature, ventilation must be considered. Hives will produce moisture, CO_2 and heat as they respire. A ventilation system can provide fresh air and remove damp air. Consider power generators in the event of power outages to maintain the correct temperature. To reduce bee activity during the

winter, the indoor storage facility should be kept dark as much as possible.

Indoor vs Outdoor Overwintering

One of the main advantages of overwintering bees outdoors is the opportunity for bees to take cleansing flights on warm days. Cleansing flights allow bees to fly outside and defecate, rather than excrete waste inside the hive. Another advantage is cost; overwintering bees in an indoor facility requires significant start-up costs. Wintering bees indoors can be helpful for weak hives, but these hives often take longer to build up in the spring, as they are not moved outdoors until April in many cases. In contrast, the queen can be stimulated to begin laying eggs earlier in the spring when overwintered outside, thus allowing a head start on brood rearing. This contributes to building up faster for blueberry pollination and making early splits, but hives must be strong and healthy enough to endure outdoor winters.

Nosema Fall Management

Monitoring and treating for nosema disease (i.e. nosemosis) is important in the fall. There are two strains of microsporidian that cause this disease: *Nosema apis* and *Nosema ceranae*. The latter was introduced to the European honey bee in the mid-2000's. *Nosema ceranae* is thought to cause higher mortality than its cousin N. apis, although there is ongoing research in this area.

Both strains of nosema infect and reproduce within the digestive cell layer of the bee midgut. Bees contract nosemosis via other bees, and food or water infected with spores. Nosema has the potential to seriously affect colonies by reducing worker longevity and honey yield, disrupting hormonal development and secretion of digestive enzymes, and even causing queen supersedure. It is not possible to diagnose nosemosis from its symptoms alone because they are associated with several other colony stressors, but signs to be looking for if nosema infection is suspected include:

- Forager bees crawling and unable to fly, even trembling
- Feces (aka dysentery) observed on top bars, bottom boards, and outsides of hives
- Swollen abdomens
- Bees not taking in syrup feed
- Bees abandoning the colony and their queen

There is a field test to check for nosema but this test can be unreliable unless the infection is fairly high. The field test involves pulling out a bee's stinger until the midgut is exposed. Nosema will cause the bee's midgut to swell and turn greyish-white (instead of the normal brownish-red or yellow colour). To effectively diagnose nosemosis, bees must be dissected and analyzed in an indoor laboratory-type setting. Separate species of nosema are difficult to differentiate by the untrained eye – even with the use of a microscope – but differ in their timing of affliction. *N. ceranae* tends to pose a risk to honey bee colonies year-round and in all climates whereas infections of N. apis tend to appear in the fall and spring, especially after a long winter of confinement.

When it comes to ridding colonies of nosema, beekeepers in Atlantic Canada are left with few treatment options. The active ingredient fumagillin remains a tried and true product for treating *N. apis* but there does not yet seem to be a consensus in terms of its efficacy in treating *N. ceranae*. Research has shown that applications of fumagillin at the label-recommended rate suppress *N. ceranae* as with *N. apis*, however, other research claims fumagillin only temporarily treats *N. ceranae* in the field and is therefore not an effective control method. Fumagillin is also expensive for beekeepers to continuously use to treat their bees. What then, are some alternative methods of dealing with nosema?

A smoker is lit for hive inspections.

IPM for Nosema

Integrated pest management can provide alternative treatment options for nosema. The growth of both strains of nosema is promoted by stressful conditions in the hive. Strong hive populations anchored by a young (i.e. one to two years old), healthy, and disease-resistant queen, plenty of food stores, and low disease and pest levels are the first lines of defense against nosemosis. Overwintered hives should have exits that double as a source of ventilation and escape accesses for bees performing cleansing flights on warm winter/early spring days. Old comb should be regularly replaced (or disinfected with acetic acid fumigation or irradiation) because it can act as a source of infection. If nosema levels are still high in the hive despite taking these steps, it may be

time to consider chemical treatment.

Note: if possible, it is best to confirm that chemical treatment is warranted by determining if a nosema infection has reached the economic threshold (ET) in the hive (i.e. 1 million spores per individual bee). A useful nosema assessment protocol produced by the Ontario Beekeepers' Association Technology Transfer Team can be found at http://www.ontariobee.com/outreach/fact-sheets-and-publications.

Alternatives to Fumagillin

Alternative commercially available chemical products to treat and/or help prevent nosemosis available on the market (mostly in Europe) are derived from essential oils, vegetable extracts, and polyphenols. The evidence is mixed in terms of their efficacy, but it appears no alternative treatments work as effectively as fumagillin. The product names of various alternative chemical treatments can be found online. Randy Oliver at scientificbeekeeping.com does a good job of comparing some of the products available: http://scientificbeekeeping.com/nosema-ceranae/treatment-for-nosema/. Alternative treatments require further experimental testing in the field; in the meantime, beekeepers should take the time to alleviate their colonies from any other stressors that could promote nosema infection. If colonies of honey bees are confirmed to be seriously infected with nosema to the point where good management alone is futile (i.e. well above the economic threshold), it will be worth the investment to treat with fumagillin.

In coming years, ATTTA will be working with beekeepers to develop regional management and treatment guidelines for nosema in addition to other pests and diseases. There is no fix-all management tactic for beekeepers across the world or Canada, and individual cases of pest and disease infection must be considered separately for our region.

Varroa Mites Fall Management

Varroa mites (*Varroa spp.*) are destructive ectoparasites that weaken adult bees and their brood by feeding off their hemolymph, reducing bee size, weakening their immune system, and shortening their life span. Furthermore, they vector several viruses including deformed wing virus (DWV) and Israeli acute paralysis virus, which can cause susceptibility to other bee diseases. Though we focus here on varroa mite management tactics for the fall, varroa management should be a priority year-round.

Honey bees infested with mites in their pupal stage will have reduced physiological characteristics necessary to ensure proper overwinter survival; relying on treatment for varroa in the fall, when the population of winter bees has already been affected by mites in their pupal stage, will therefore not prevent overwinter loss. Varroa can thus be devastating to hives during overwintering if left untreated. Chemical treatment and drone trapping in the spring followed by monitoring in the summer should precede the following possible fall treatment options.

Before fall treatments can begin, honey supers should be removed (unless doing so would conflict with the pre-harvest interval of a treatment) and bees should be sampled to determine whether the mite level in a colony has reached the economic threshold to warrant chemical treatment. The Ontario Ministry of Agriculture, Food, and Rural Affairs recommends 3 mites per 100 bees with an alcohol wash, 2 mites per 100 bees with an ether roll, and 12 mites in a 24 hour drop using a sticky board as economic thresholds for mite treatment in August. More information on sampling methods and economic thresholds can be found in the ATTTA factsheet *Summer Disease and Pest Monitoring in Honey Bees*. Two organic acids are commonly used in the fall to treat for varroa: formic acid and oxalic acid.

Using an alcohol wash to monitor for varroa mite levels.

Early Fall Formic Acid

The best time to treat for varroa with formic acid is early fall (i.e. mid-September). This time is suitable because of the aforementioned risk of treating for varroa too late in the season and the practicality of the seasonal temperature. Treatment with formic acid is most effective when applied between 10 and 26°C (application when external air temperatures exceed 30°C can cause excessive volatilization of the acid and damage to the colony). There are three ways of applying this product: multiple small applications with 65% formic acid pads, one large slow-release application with 65% formic acid pads, or 46.7% formic acid with Mite Away Quick Strips™ (MAQS™).

For both the multiple and single applications of 65% formic acid, the hive entrances must be open and unobstructed for ventilation. If using a single application, a 250 ml pad in a pin-pricked 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/ontar-

iobee.com/files/document/250ml-pamphlet-op.pdf. If treating with multiple applications, one 30 to 40 ml pad for a double brood chambered hive or 15 to 20 ml pad for a single brood chambered hive once every three to five days (up to six times in total) can be used. Multiple applications require several trips to the apiary which can be time consuming but offer a more uniform treatment than a single application.

Mite Away Quick Strips™ (MAQS™) can be an effective fall varroa treatment. The advantages to using MAQS™ are that the strips kill varroa mites in the reproductive stage in capped honey bee brood, they do not have a long-term impact on queen performance, and do not seem to cause the development of resistance in varroa populations. Unfortunately, this treatment option is not recommended for small or weak colonies. MAQS™ should only be used if the bee cluster in a hive covers at least six brood frames.

Late Fall Oxalic Acid

Unlike formic acid, oxalic acid does not treat for mites in their reproductive stage in the capped bee brood and should be applied to a colony of honey bees after brood rearing has ceased in the late fall. Oxalic acid can be applied to a colony either by trickling or vaporizing. A protocol for the trickle method can be found at http://www.ontariobee.com/sites/ontariobee.com/files/document/OA%20Protocol%202015.pdf. This method is arguably the best because it is the least expensive and safest for the beekeeper. If integrated into a regime of pest management that includes cultural and physical methods of control, oxalic acid has been shown to be an effective chemical treatment against varroa mites Regardless of your treatment choice, remember to always follow label directions and proper safety precautions.

Things to Think About in Autumn

What materials will you need for spring? Think about equipment needs such as additional hive boxes, screened bottom boards, foundation frames and drawn frames, medication and beekeeping gear (suits, gloves, hive tool, etc.). Also consider if you will build equipment yourself or purchase it pre-built.

Will you require new bee packages or new queens? Consider where and when you will need to order additional bees, the cost and availability, and pick up details. Contact your provincial beekeeper associations for more details about ordering bees and queens, deadlines and costs. Contact info for associations is found below.

Atlantic Canada Bee Associations

- Nova Scotia Beekeepers Association: www. nsbeekeepers.ca/index.php
- New Brunswick Beekeepers Association: www. nbba.ca/
- PEI Federation of Agriculture: JoAnn Pineau, Program Manager, Phone: (902) 368-7289 Email: joann@peifa.ca
- Newfoundland and Labrador Beekeeping Associa-tion: www.nlbeekeeping.ca

Pollination Preparation

If you are involved in blueberry pollination, it's never too early to be thinking about pollination contracts. The autumn is a busy time for blueberry association meetings and they are a great opportunity to network with blueberry growers and establish new contacts for pollination work (see association websites listed below to look for meeting dates). Knowing how many hives are required for pollination the following spring will help you plan for overwintering as well as spring preparation.

Blueberry bloom

Blueberry Associations

- Wild Blueberry Association of North America (WBANA) Symposium http://www.wildblueberries.com/
- Wild Blueberry Producers Association of Nova Scotia (WBPANS) http://nswildblueberries.com/
- Bleuets New Brunswick Blueberry (BNBB) http://nbwildblue.ca/
- Prince Edward Island Blueberry Growers http://peiwildblueberries.com/

Pollination Contracts

Sample pollination contracts are available from various organizations:

- Nova Scotia Beekeepers Association (NSBA) and Wild Blueberry Producers of Nova Scotia (WBPANS: http://www.nsbeekeepers.ca/cmsAdmin/uploads/PollinationContract.pdf
- Canadian Honey Council (CHC): http://www.honeycouncil.ca/images2/pdfs/Pollination_Contract_revised_Feb2015.pdf

Resources

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