Evaluating the Strength of Honey Bee Hives for Wild Blueberry Pollination

Honey bee hives are commonly used to supplement pollination of wild blueberries. In New Brunswick, blueberry growers frequently rent honey bee hives from beekeepers. Hive strength is a critical component of effectively pollinating wild blueberries with honey bee colonies. Hive strength refers to the number of bees in a hive and the different life stages (e.g. nurse bees, forager bees, and brood). The strength of a hive is directly related to its ability to effectively visit flowers and provide pollination services. Evaluating hive strength for pollination begins with communication between the beekeeper and blueberry grower.

Hives should meet the following criteria to achieve pollination standard:

at least two boxes, a laying queen, brood, and 25,000 to 30,000 honeybees.

When hives that are sent to pollination meet the recommended pollination standard, both the hive and the field being pollinated have an increased chance of success. By sending hives at the proper strength, the colony functions at its optimal level during the pollination period. The hives also return from pollination in better shape. If weak l hives are sent to pollination, not only does it reduce the pollination efficacy, but the hives may return weak or stressed and may require the rest of the summer to rebuild its population. Hives are often placed in blueberry fields in different equipment configurations, depending on the preferences and management styles of the beekeeper (Figure 1 and 2). In most hive configurations, the bottom box is referred to as the 'brood box'- this is where the

Fig 1. Hives sent with one brood chamber and one honey super.

Fig 2. Hives sent with one brood chamber and two medium honey supers.

majority of the bees are expected to be. This brood box will house developing brood (young bees that have yet to hatch), nurse bees to care for the brood, and the queen. When a second box is placed on top, it may be a second brood box for the colony to expand into (double brood chamber or box), or it may be a honey super (another box designed to allow bees to store honey in frames, but the queen is excluded from laying there). It is unlikely and not recommended to have a colony with more than three deep boxes in total as there are likely not enough bees at this time to fill that much space. It is space the colony needs to keep warm, and more cumbersome to move for pollination. However, in certain situations, hives may be sent to pollination with three boxes to help reduce swarming if the colony undergoes a rapid expansion, or if the colony encounters a large honey flow. Another situation where a third box may be added is when hives are sent to remote locations to reduce the risk of swarming. Thus, hive strength cannot simply be judged by the number of boxes in a field but must be judged by its contents. Communication between growers and beekeepers is essential, as it doesn't matter what configuration the hives are in, but what is in the box!

What makes a hive strong?

Fig. 3. Close up view of hives: bottom box is brood chamber, with a queen excluder on top. Two medium honey supers are placed over the queen excluder and brood chamber.

A strong, healthy hive is comprised of a colony of bees with many different life stages: brood, nurse bees, forager bees, and a queen. When brood is present, nurse bees must feed nutritious bee bread, which is composed of fermented pollen. Within honey bee colonies, there are nectar foragers and pollen foragers. Pollen foragers are responsible for the majority of pollination, but nectar foragers still contribute to pollination in their quest for nectar. Nectar provides carbohydrates for the colony, while pollen provides protein. As forager bees collect pollen and nectar, they visit surrounding forage (blueberry flowers in the case of pollination). When a queen is present, eggs are being laid (brood production). When brood is produced, more nurse bees are hatched that will eventually become forager bees. It is a well-connected circle of tasks that drives a colony to be productive and strong. When any of these links are missing, hive strength, and subsequently pollination, are compromised.

Can a hive be too strong?

Yes, a hive can be too strong. If a colony is rapidly expanding and/or running out of room, the hive may swarm. In this instance, nearly half of the bees will be lost to swarming, and general production and pollination capacity will be severely compromised. When hives swarm in blueberry fields, both growers and beekeepers suffer. Hives tend to shut down production (egg laying, brood rearing, food storage, etc.) for one week to ten days prior to swarming. With no developing brood, worker bees are not motivated to collect pollen or nectar. Thus, managing hives to avoid swarming is imperative.

Can a hive be too weak?

Yes, a hive can be too weak for pollination. Each hive sent to pollination should meet the minimum pollination standard. If a hive is sent to pollination that is too weak, not only is pollination potential reduced, but so is the colony. If there are not enough foragers to bring back nectar and pollen, brood production can suffer, and the colony will not grow, or may even become weaker. Additionally, the colony can become stressed and potentially encounter stress-related and nutrition-related diseases, such as European Foulbrood (EFB) and chalkbrood.

How is a hive evaluated for strength?

A hive can be evaluated in many different ways. Without opening the hive, the hive entrance can be monitored from the side of the hive (do not disturb flight pattern of bees) for forager bees leaving and returning with pollen on their legs (worker bees carry pollen in their pollen basket, the corbicula, located on their back legs, Figure 4). Dozens of bees should be observed leaving and returning throughout the observation period. Remember to monitor hives in this way during ideal weather conditions (above 15°C, during sunny weather with low wind).

Fig. 4. Pollen foragers returning to the hive.

The University of Maine recommends observing the number of bees returning to the hive over a 15 second period and multiplying this number by 0.06. This calculated figure provides an estimate for the number of full frames in the hive that are covered with bees. If the figure you calculate (# bees returning * 0.06) is at least 7.5 (7.5 frames covered with bees), then you likely have a strong pollinating colony.

If the beekeeper is present to open the hive carefully, more robust evaluations can be taken (Figure 5). Gear such as a beekeeping veil or suit, hive tool, smoker, and gloves are recommended for hive inspections with the beekeeper for safety reasons. If hives are rented, ask the beekeeper to open and inspect the hives in your presence.

Fig. 5. Example of beekeeper conducting hive inspection.

What should you look for during an inspection?

Fig. 6. Looking down to count 'seams' of bees (bees visible between frames).

Fig. 7. Another example of counting 'seams' of bees between frames.

When the hive cover is first cracked with a hive tool, you should see bees visible in both the top of the bottom box, and bottom of the top box (if working with a two box system). When you reach the brood chamber (bottom box), you should expect to see bees visible between at least 7-8 frames (called 'seams' of bees, Figure 6 and 7)). As you begin gently working the colony, you should see more bees heading to the tops of the frames (bees appear to 'boil' over). To gain a better understanding of brood development, three brood frames should be inspected (usually in the centre of the box, and not usually the edge frames in the box). Brood frames should contain a mixture of capped and uncapped brood (Figure 8), as well as pollen and nectar stores (Figure 9). If eggs are visible or the queen is observed, the colony is said to be queenright.

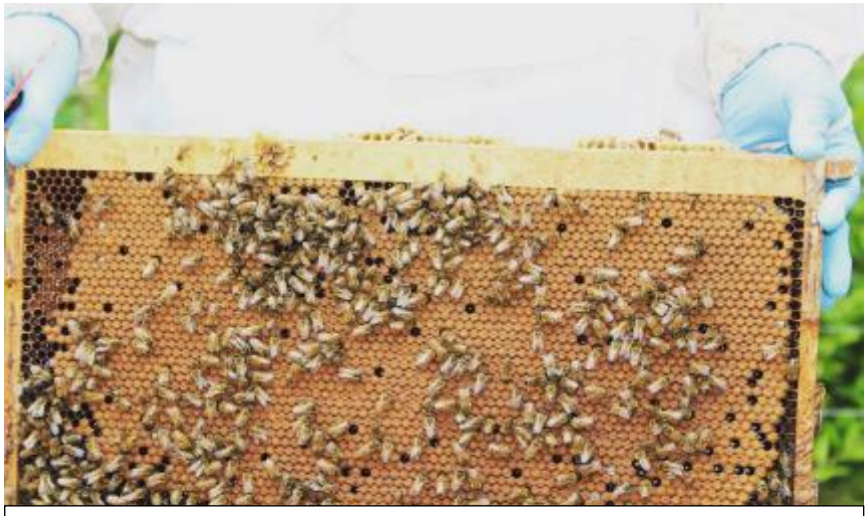

Fig. 8. A frame full of capped brood, as well as pollen stores in the top left-hand corner.

Honey bee colonies used for blueberry pollination should have six to ten frames with a variety of brood coverage present. There should also be plenty of nurse bees on these frames to be feeding developing larvae and cleaning out cells of freshly hatched bees.

Note: time of day can influence hive inspections to a certain extent. If evaluated early in the morning, bees are more likely to be clustered together and forager bees will be in the hive, allowing for a more accurate estimate of hive strength. If hives are inspected later in the day, remember many of the forager bees could be out foraging, and the cluster may have expanded as temperatures have warmed.

During inspections, you may observe a pollen patty placed on top of frames (Figure 10). Pollen patties can be used to provide a source of pollen to developing brood, and to mitigate stress-related and poor nutrition-associated diseases, such as European Foulbrood, during blueberry pollination. This is especially helpful if bees are confined to the hive for multiple days due to poor weather, such as rain.

Fig 9. Pollen stored in cells within a frame.

Fig. 10. Example of pollen patty placed on top of frames.

References:

Delaplane, K. S. and Mayer, D. F. 2000. Crop pollination by bees. CABI Publishing, New York, New York.

Drummond, F. 2002. 629: Honey bees and blueberry pollination. Available online: https://extension.umaine.edu/blueberries/factsheets/bees/629-honey-bees-and-blueberry-pollination/ [Accessed 11 March 2019].

Graham, J. M. (ed.) 2015. The hive and the honey bee. Dadant and Sons, Hamilton, Illinois.

Javorek, S. K., MacKenzie, K. E., and Vander Kloet, S. P. 2002. Comparative pollination effectiveness among bees (Hymenoptera: Apoidea) on lowbush blueberry (Ericaceae: Vaccinium angustifolium). Annals of the Entomological Society of America 95: 345-351.

Sammataro, D. and Avitabile, A. 2011. The beekeeper's handbook. Cornell University Press, Ithaca, New York.

Winston, M. L. 1987. The biology of the honey bee. Harvard University Press, Cambridge, Massachusetts.

For more information on honey bees and wild blueberry pollination, visit our website at https://www.perennia.ca/portfolio-items/honey-bees/

Robyn McCallum and Sawyer Olmstead, Atlantic Tech Transfer Team for Apiculture (ATTTA).
Photos by Robyn McCallum.