



## Managing Honey Bee Hives for the Pollination of Wild Blueberries

The pollination of wild blueberry flowers is the last, but most important step before fruit formation. Pollination is often cited as the most limiting factor in wild blueberry production and the most difficult for producers to control. For successful pollination to occur, pollen must be transferred to the female part of the flower (stigma) by a pollinating insect, such as wild (native) or commercial pollinators (honey bees, bumble bees or alfalfa leafcutter bees). The contribution of wild pollinators is important but may not always be sufficient to produce a consistent yield. This is especially true in larger fields and in areas with limited wild bee abundance. As a result, the use of standard strength honey bee hives is an excellent insurance policy to supply pollination services when wild pollinators are not sufficient. To achieve the most favorable results, it is essential to manage and place the honey bee hives in an optimal fashion in the field. There are several factors that must be considered when placing honey bees in blueberry fields.

### *Hive numbers:*

The number of hives necessary for good pollination and respectable yields depends on the number of flowers in the field, the strength of the hives, the size of the field, and the "background" pollination provided by wild bees. Every field is different, however as a general rule of thumb, 2-3 hives per acre is recommended under most field conditions. Stocking at 2-3 hives per acre is beneficial for the blueberry grower and the beekeeper.

Although 2-3 hives per acre seems like the most appropriate stocking density in terms of bee health, blueberry growers may choose to increase stocking density above 3 hives per acre for all or part of the bloom period (Figure 1). In the state of Maine, some of the growers in large fields with few wild pollinators will stock as high as 5 hives per acre.



**Fig. 1.** Certain honey bee hives remain in wild blueberry fields for the entire pollination season, but additional "mobile" hives are also moved in during peak bloom to maximize pollination.

In these cases, there are two hives per acre present on the fields during the whole bloom period. At mid-bloom, a set of "mobile" hives are introduced at the rate of three hives per acre and removed by the tail end of bloom. This concept of "brute force pollination" has been found to be

effective, and research trials are underway by ATTTA to determine if this is an economically viable solution for blueberry growers, without sacrificing the health or integrity of honey bee colonies.

Researchers at the University of Maine have conducted research to determine which bee density is needed to achieve adequate pollination and have developed some useful rules of thumb for blueberry growers (Drummond 1994). On a nice sunny day, ten or more quadrats of 1 square meter ( $m^2$ ) of the field should be inspected for the bees visiting blossoms. Wild bee counts (primarily bumble bees and solitary bees) should be made for five minutes, and the average of the areas should be calculated. At an average of more than 2.4 bees/  $m^2$ , the grower might decide that additional honey bees may not be necessary; at this density, the wild pollinators alone may be sufficient to supply adequate pollination services. At 2 bees/  $m^2$ , stocking density of 1 hive per acre is recommended. At 1.3 bees/  $m^2$ , 2 hives per acre is recommended. At 0.6 bees/  $m^2$ , 4 hives per acre are recommended. Finally, 5 hives per acre are recommended if no bees are observed.

Although these rules of thumb are useful to help blueberry growers make informed decisions with respect to stocking density, wild bee populations vary from year to year. Just because there are enough wild bees to provide pollination services one year, does not necessarily mean that the same will be true the following year, or subsequent years. Furthermore, by the time the blueberry grower determines that there may not be sufficient wild pollinators to supply pollination services, it is often too late to rent honey bees for that season. Therefore, it is recommended that honey bees, or other commercially available managed bees, should be added to blueberry fields for pollination, regardless of wild bee populations to ensure optimal pollination potential.

In fields with relatively low flower densities, a stocking rate greater than 2 hives per acre does not appear to saturate the field. With a rate of one hive per acre, a University of Québec research team demonstrated up to five-fold increases in yield with the use of honey bee hives (de Oliveira, 1995). These increases were associated with increases in fruit set (%), and particularly an increase in fruit size, due to a greater number of seeds setting in each fruit. These researchers reported potential revenue increases representing \$6 to \$ 28 for every dollar invested in honey bee hives (revenue and profit increases would of course depend on the price of berries and the additional harvest cost). One of the most significant observations of this study was the importance of hive strength, with one strong hive being more beneficial than as many as four hives of low strength. For more information on pollination and evaluating hive strength, please consult fact sheets B.1.0 and B.4.0, respectively.

### ***Timing the introduction of hives:***

The introduction of hives should be done between 10 and 20% bloom, which occurs towards the end of the first week of flowering (Figure 2). The goal of placing hives at this time is to encourage the bees to forage on the flowers of wild blueberry plants, rather than on the other types of flowers which are present. For wild blueberry fields surrounded by forest and not adjacent to other fields, the hives can be put out early, and reports from these types of areas in Québec recommend placement as early as 5% flowering (de Oliveira, personal communication). In situations where there are other wild blueberry fields or other sources of flowers, it is best to wait until 20% flowering before introducing the hives. This situation is often more comfortable for the beekeeper as well, since later introductions will benefit from the likelihood of good weather.



**Fig. 2.** To accurately determine percent bloom, count the number of open flowers on blueberry stems divided by the total number of flowers on the stem. These calculations should be conducted on many stems to determine a field average.

### ***Hive placement:***

Ideally, honey bee hives should be placed equidistantly throughout the field in order to obtain uniform pollination. For reasons of practicality, hives are often grouped together, either because they are on pallets, or to facilitate the work of the beekeeper and/or the grower and to make it easier to provide protective fencing. Alternatively, some beekeepers or growers may choose to leave hives on a trailer parked in the blueberry field for the duration of bloom. This is especially true if the fields are in relatively isolated areas. When hives are assembled together, they are usually in groups of 30 to 40 hives, with 2.5 m between the hives and 3 m between the rows. Additionally, it is necessary to alternate the orientation of the hive openings in order to avoid drift.

Hives should be placed slightly above the ground, and growers may wish to supply pallets if the hives are not already on pallets. This is important to limit the dew collecting on the bottom board which the bees have to fan dry before they leave for pollination. By elevating hives, they are kept out of weeds and tall grass to allow bees to freely come and go from the hives without any obstruction. Hives should also be placed in dry areas.

The choice of a location for the hives should be given some thought. The goal is to guide the pollinating force toward the interior of the desired field. It is therefore important to consider what surrounds the field, such as other wild blueberry fields or other flowering crops. If this is the case, the distance between the hives and the competing crop should be increased. The following is a list of recommendations for different situations.

- **Wild blueberry field surrounded by forest.**

In small fields surrounded by forest, without any other source of flowers, place the hives near the forest. For larger fields, direct the hives toward the centre of the field. In both

cases, space the groups of hives equidistantly in order to encourage the honey bees to work over the whole area.

- **Wild blueberry fields with strong and constant, predominant winds.**

Honey bees cease to be active in a field if wind speeds reach or exceed 30 km/hour. In wild blueberry fields with constant winds, honey bee hives should be placed such that the bees are flying against the wind as they make their way to the crop, and with the wind on their way back to the hive. This will result in a congregation of the hives to one end of the field, but will favor the return of the bees to the hives. Provide shelter where possible, either with trees or an artificial windbreak, and/or locate the hives in a low, protected area.

- **Wild blueberry field surrounded by other flower sources (blueberry or other).**

In this case, hives should be placed at the end of the field which is furthest from the competing flowers, such that the bees need to travel the whole distance of the field to reach them. If competing flower sources are present in every direction, the hives should be grouped more closely and in the centre of the field. In this instance, hive replacement and/or rotation can be useful in reducing the movement of bees to neighboring fields.

### ***Hive replacement or rotation:***

Honey bees that have recently been moved into a field will tend to forage on the closest source but will gradually increase their foraging distance to 1 km or more within a few days. To ensure that the bees do not drift too far away, blueberry growers and beekeepers can collaborate to rotate the hives between fields in order to maximize pollination. The hives are exchanged from one field to another one which must be more than 4 to 5 km away, after 4 or 5 days of flight. This will eliminate the established flight pattern of the bees and cause a new flight pattern, which will therefore include greater proportions of the target fields. Hive replacement or rotation incurs labor and transportation costs but may be rewarding in fields where the competition from other flowers is high. If the competing vegetation is negligible, hive replacement or rotation may be neither necessary nor

economical. Some blueberry growers have come up with innovative solutions for moving and rotating hives during bloom (Figure 3).



Bee hives should be moved only with the cooperation of the beekeeper. Rough handling can damage brood and can even result in loss of the queen. Movement should occur after dark only, when all field bees have returned to the hive. This prevents weakening of the colony from the loss of forager bees. There is often additional rental fees that are applied for hives that are rotated during pollination or used for double pollination. The

**Fig 3.** An example of a specialized trailer used to move bees from field to field during pollination.

rental price per hive and whether the hives will be moved during bloom should be outlined and agreed upon in a pollination contract.

### ***The effect of wind on honeybee hives:***

A site protected by predominant winds, like a wooded area or a natural windbreak, is desirable. This type of site facilitates entry and exit to the hive under unfavorable conditions. In the case in which winds are a problem and the wild blueberry field has no suitable, protected areas, an artificial windbreak can be installed. A snow fence can be very useful to reduce wind speed near the hives. The fence should be sufficiently long to ensure protection of the group of hives and should be 2 to 3 m high. The hives should be located about 1 meter behind the fence. Refer to factsheet A.4.0 for more information on windbreaks.

### ***The effect of sun on honeybee hives:***

When hives are located near a wooded area, they should not be shaded in the morning. If this is the case, locate the hives such that the first rays of the morning sun reach the hive. Heat and light warm up the hive and activate foraging by bees. Hives with morning sun are active earlier in the day than hives that are fully or partly shaded. Hives are most appropriately placed south or southeast facing. The earlier the bees start the day, the more flowers they can visit during the pollination period.

### ***Water sources near the hive:***

Water is essential for survival of honey bees. If there is no source of natural water like a spring or a pond, water should be provided near the hive. This is especially true in large blueberry fields. A barrel, cut in half lengthwise, or even a blueberry harvest box can act as a water reservoir. Pieces of wood or another material which floats should be placed on the surface as a landing pad for the bees, or else they will drown. It is very important to establish water sources before bringing hives to a field.

### ***Hive protection:***

Wild blueberry fields are most often located very far from residential areas, where large numbers of wild animals live. Many of these can cause damage to honey bee hives. Skunks, raccoons and bears can damage or kill a hive. Bears are the most damaging predators and therefore proper precautions should be in place before the hives arrive in the blueberry fields. A beekeeper should be advised if you see or suspect the presence of these animals with any regularity. Beekeepers cannot be expected to maintain an interest in bringing bees to fields in which hives have been destroyed. It is in the grower's best interest to provide and maintain electric fencing, to visit the fields regularly, and to warn the beekeeper of any potential or actual destruction. For more information on protection methods, please consult factsheet number B.5.0.

## ***Insecticides:***

The use of insecticides should be avoided during blueberry flowering and should never be used in the presence of hives. Certain insecticides are very toxic to bees and can be damaging to the forager population in any impacted hives (Figure 4). Applying insecticides while bees are placed in blueberry fields contravenes the Apiary Act to spray insecticides when bees are in the field. Delay introducing hives if an insecticide spraying is expected and follow label direction for the introduction of honey bees. The beekeeper must always be notified if an insecticide is to be applied. It is important that appropriate precautions can be taken.



**Fig. 4.** Example dead bees in front of the hive from of a suspected pesticide kill.

## ***Contracts:***

A contract between growers and beekeepers is recommended to determine the responsibility of each party.

## ***Conclusion:***

The use of honey bee hives is not a guarantee of high yields, but rather a form of insurance. Uncontrollable factors may influence the performance of bees during pollination. Under these circumstances, it is important to keep an open dialogue and good communication, and continue to recognize the value of honey bees in the pollination of wild blueberries.

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***Revised: Sawyer Olmstead and Robyn McCallum, Atlantic Tech Transfer Team for Apiculture.***