5.2 Pollination Requirements for Blueberries

PURPOSE

These notes provide information on blueberry flowering and are designed for growers and managers as a practical guide on how to optimise pollination and fruit set.

KEY POINTS

- Pollination is an essential component of growing blueberries. To achieve high percentage of fruit set with large, evenly-ripening berries, bees are required to transfer and deposit enough pollen onto stigmas during bloom.
- Bees are introduced when 5% of the flowers are open and they need to keep working in the crop until most of the petals have fallen. This may occur over a period of 6- 8 weeks or longer depending on the cultivar mix.
- Cross pollination between blueberry varieties generally results in better fruit set and larger fruit.
- A good relationship between grower and beekeeper is needed to ensure healthy bees and optimum chance of success with pollination
- Combinations of introduced Honey Bees and Bumble bees provides the best solution for pollination in blueberries

BACKGROUND

Blueberry flowers require pollination to ensure that flowers turn into fruit. Bees are the main pollinator. Their role is to transfer pollen from the anthers and deposit it onto the stigma of a recipient flower. This enable the process of fertilization and fruit-set to take place (figure 1).

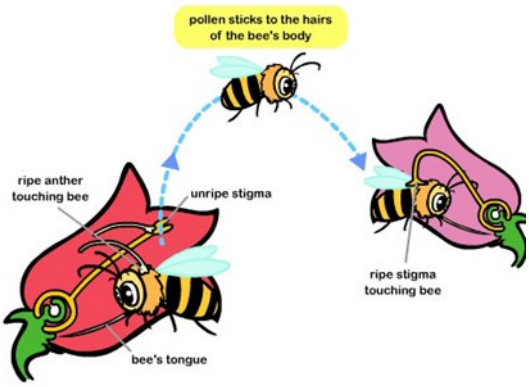

Figure 1
Source: www.sciencewithme.com

Value of Bees

- Improved fruit set
- Increased numbers of fruit
- Larger fruit
- Earlier fruit maturation by 4 – 12 days

POLLINATION/FRUIT SET

Blueberry flowers open in the morning and are most receptive to pollination for the first 24 – 48 hours. Flowers are viable for about 5 – 6 days although there are varietal differences. Once petal fall occurs, the stigma is no longer receptive, and the bees have no interest in visiting the flower.

Fruit set in blueberry needs to be at least 65 – 70% successful for an economic crop.
Check fruit set on your own farm by labelling flowers as they open, revisit after 3-4 weeks and make a record if a fruit has been formed. For every 100 flowers, you should get at least 65 berries.

POLLEN GERMINATION AND GROWTH

Growth of pollen tubes is favoured by warm temperatures, and once germinated a pollen tube will reach the style about 48hrs after pollination. At day 6 after pollination the pollen will reach the ovule, and fertilization may occur.

Cold temperatures inhibit pollen tube germination and growth. Studies have shown that just 1hour at -1°C will substantially reduce fruit set in Rabbiteye blueberries, even when there is no visible damage to the petals or other flower parts.
Although an individual flower is open for only a few days, more and more flowers open each day. This means that flowering in a blueberry crop can take many weeks to complete from start to finish.

Fruit drop in blueberries can occur about 3 – 4 weeks after flowering. There are numerous causes of fruit drop, including in-compatibility between varieties, poor pollination, poor fertilization, and low seed set. Drought stress and cold temperatures will also cause fruitlets to abscise and fall from the bush.

POLLINATION MANAGEMENT FOR BLUEBERRIES IN NEW ZEALAND

Effective pollination is a critical factor in determining fruit set, berry weight and rate of ripening.

Growers commonly place hives of honey bees (*Apis mellifera*) into a blueberry plantation at the start of flowering and leave them on the farm until petal fall; this can take several weeks. Bumble bee colonies (*Bombus spp*) are also used by many growers and are complimentary to other pollinators. Using a variety of pollinators will ensure adequate pollen transfer between flowers.

There are numerous factors to consider on a blueberry farm which will have a direct bearing on the pollination efficiency of bees.

PLANTING DESIGNS

For cultivars that benefit from cross pollination, it is recommended that two different varieties with similar flowering dates are planted closely in proximity to each other.

All Southern Highbush types (e.g. Eureka, First Blush, Twilight) and Rabbiteye types (e.g. Centra Blue, Velluto Blue, Rahi) benefit from cross pollination.

Northern Highbush are generally self-fertile but will also benefit from cross pollination resulting in improved fruit set and larger fruit.

Planting plans will vary for different varieties, depending on plant vigour, flowering overlap and compatibility. A ratio of 2:1 with two rows of the main variety separated by one row of polliniser works well in High Tunnels. In our experience with outdoor blueberry crops, no more than 8 rows of any one variety should be planted before planting an adjacent polliniser variety.

BEE DENSITY

Different densities of bee hives are recommended depending on the farm lay-out, also attractiveness of the variety to the bees. Recommendations for outdoor growers vary from 2.5 - 8.0 beehives per ha.
Hives should contain at least 30,000 - 45,000 honey bees

Tunnels need special consideration
Heading down tunnels that all look the same can be a disincentive for bees. Therefore, a higher density of hives is recommended. A total of 10 honey beehives and 10 Bumble bee hives per hectare should provide adequate pollination.

If possible place hives at either end of the tunnels. As the MBO varieties flower through winter it is most important that the hives get the morning sun early to get bees active, so it may not be possible to do this. It is common for growers to place different shapes at the start of each tunnel to help bees navigate.

NECTAR ROBBERY

Look out for slits or holes cut into the sides of blueberry blossoms by other insects which allow bees access to nectar without passing the pollen sacs (figure 2). Nectar is taken ("robbed") from the flower without any pollen deposition onto the stigma and poor pollination can result.
Hungry bees will eat blueberry flowers, this will also result in low fruit numbers (figure 3).

Figure 2

Figure 3

Wax eyes also are very hungry in winter and do similar damage going in the side of the flowers for the nectar. Some pollination seems to still occur, but this situation is not ideal. Thus, the reason to have bird netting in place as well.

TIMING

Place bees in the tunnels or field at the beginning of bloom (~ 5-10% of all flowers open) and keep in-situ until the petals begin to drop. This is likely to be late June/early July with Eureka. With First Blush plantings and especially those growers with Masena they may need to go in earlier.

ENSURE OPTIMAL POLLINATION BY:

- Install bees at 5% bloom
- Spread hives evenly throughout the field
- Face hives to the East to get morning sun at earliest
- Avoid pesticides while bees are in the field

Ask your beekeeper to monitor honey bee health on a regular basis, feed the bees with supplementary sugar syrup through the coldest months and replace any light hives as needed.

Best case for ideal pollination is to replace the bee hives every three weeks but beekeeper may not agree to this.

Provide all-weather truck access for the beekeeper. Limited access to the farm may lead to uneven distribution of hives and thus inefficient pollination.

PREPARATION OF BEES

Blueberry flowering begins in mid-late winter.
Timing is temperature dependent, and flowers will start to open much earlier in warmer climates.
Hives are required at a time of year when bees are coming out of winter and generally have low populations. For adequate pollination, hives with four frames containing brood on both sides and eight frames covered with bees are the minimum strength required for blueberry pollination.
The number of honey bees and other insects working the flowers is the most important consideration.

Rule of Thumb
Aim for four – eight bees working each blueberry plant during the hottest part of the day

ARRANGEMENT OF HIVES

Most seed set occurs within a 100m radius of hives. For tunnel production, hives should ideally be positioned at both ends of a 100m tunnel.

Bees have quite distinct behavioural traits. Rows of identical tunnels and the presence of netting sides or canopies can upset their normal foraging rituals. It is conventional bee keeping wisdom to place hives OUTSIDE any such enclosure but provide plenty of places to enter and exit marked with navigable shapes. Such points of ingress should be birdproof but bee friendly. The 'wider weave' bird netting is ideal, and bees freely enter and exit when there is sufficient flowering to ignite their interest. Windbreak or 'hail net' does not have enough space in the weave for bee ingress.

Bumble bees are happy being placed within the tunnels. So best placement of the combination is honey bees at one or both ends of the tunnel in a sunny location and bumble bees in the middle of the tunnels, or towards the end less easily serviced by honey bees.

BUMBLE BEES VS HONEY BEES

In general, bumble bees are more efficient pollinators of blueberries than honey bees.
Bumblebees harvest pollen by moving their flight muscles very rapidly, causing the flower and anthers to vibrate dislodging pollen (Buzz pollination)

The bumblebee positions itself to catch the pollen on its belly, and invariably makes good contact with the stigma, transferring pollen from flower to flower. Honeybees do not buzz pollinate, so are much less efficient at pollen harvesting and are generally more focused on nectar collection.

Advantages of Bumble bees
Can work under cooler, wetter and windier conditions than honey bees
Carry more pollen
Can be placed within the tunnels
Deposit 43 pollen grains per visit compared with 11.5 grains for honey bees
Make more flower visits per minute
Longer flight times
If insecticides are sprayed the bumble bee hives can be shut until the leaves are dry and safe for foraging.

Bumblebees in conjunction with honeybees are known to increase the working speed of honeybees and improve their overall efficiency.

However, caution should be taken to monitor that the honeybees are not raiding the bumblebee hive (or vice versa) for its sugar syrup. If honeybees begin raiding the hives, the health and longevity of the hives can be jeopardized. When using both honeybees and bumblebees we recommend that they be kept at least 50 meters from each other. It is advised to introduce the bumble bees first, and honeybees somewhat later, after at least 5% of the flowers start blossoming.

Tip: Combinations of Honey Bees and Bumble bees provides the best solution for pollination in blueberries.

- A blueberry flower needs one visit from a bumble bee OR 3-4 visits from a honey bee for fruit-set
- Order Bees early – at least eight to ten weeks in advance of your requirements

Ask for bees in their growth phase of their development, these should develop into larger colonies within the crop. Standard hives regularly last for 8 weeks. It is good practise to stagger the introduction of bumble bees to ensure even populations over the full length of flowering.

ATTRACTIVENESS, NUTRITIONAL VALUE OF POLLEN AND NECTAR

Blueberries varieties vary in their ability to attract bees. Morphological differences between flowers, easier access to nectar through a wider opening to the corolla and higher odour volatiles have all been suggested as reasons for why bees seem to prefer some varieties over others. Attractive varieties may produce more nectar or nectar with a higher sugar content.
Blueberry nectar typically contains between 12 – 21% sugar.

Pollen is also important to bees, and some varieties produce more pollen than others. This increases their effectiveness when used for cross pollination as they attract more pollen-gathering bees.

Blueberry pollen is rich in protein and may be a complete food source for honey bees. Supplementary pollen from other species e.g. *Salix* are sometimes used by beekeepers and growers are encouraged to plant a variety of different flowering plants around their farm to increase the diversity of food sources for the bees and to enhance hive health.

Flying Doctors Hives
Bio-Bees can provide a specially designed “dispensing” hive, which uses the bumblebees as little “flying doctors” to protect the crop from disease, while at the same time providing the same elevated level of pollination. When the bumblebees leave the hive, they pick up beneficial microbes or compounds (the prescription) and distribute it directly out to the flowers. The bees deposit the beneficial microbe at each flower visit and the beneficial then grows and occupies the flower, protecting it from infection. The results are reported to be better than with more conventional methods, i.e. spraying, as the bees visit each new flower as it opens, providing continuous coverage.

Growers seeking more information on bumble bees should visit:
https://www.biobees.co.nz/
http://www.zonda.net.nz/

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