How to make the most of your pollination service

Helen Newman, Berry Industry Development Officer, Agricultural Produce Commission, WA

European honeybees are an important part of berry production. They busily work away transferring pollen grains within flowers improving yields and fruit quality.

While feral honeybees can provide pollination, in cold wet weather they may not fly the required distance to pollinate your crop effectively. They may also find other more attractive food sources (flowers) nearby so might not visit your crop as much.

One way to ensure consistent pollination in your crop is to employ professional paid pollination services. If you decide to do this, you want to make sure you get the most out of your new 'employbees'.

This article aims to provide information to help you when working with your pollination service provider.

> **A professional working relationship with your beekeeper based on a mutual understanding of each other's needs is essential to success.**

Getting the timing right

Generally, bees should be bought into the crop at 5-10% flowering so they can start working immediately. If bees arrive too early, they will find other nectar and pollen sources, and may not move into your crop when it starts flowering.

This is particularly important for blueberry and strawberry crops which are less attractive to bees due to their relatively low nectar content.

Rubus on the other hand produces large volumes of nectar and has no problem attracting bees and other pollinators.

Hive placement

Temperature, rain, and wind dictate the distance that bees will fly and pollinate. In calm, mild conditions, bees can provide good pollination within a 1.5km radius of their colonies.

Bees fly shorter distances in cold weather (13-16°C), limiting the area of pollination. Bee activity is very limited in temperatures below 13°C. As temperatures rise the distance bees travel from the hive to gather pollen and nectar increases, expanding the pollinated area.

Wind limits the area of pollination by slowing bees down and wearing them out. Bees may travel shorter distances or make fewer foraging trips during windy conditions.

They are also less likely to leave the hive in high winds.

Your beekeeper will consider the prevailing environmental conditions, and your site and crop characteristics when determining the optimum hive placement and may:

- monitor the flying patterns of the bees to see how far they fly during critical pollination periods and in different weather conditions (mid-morning is the best time to do this)
- keep hives close to the planted area, particularly during cold and/or windy seasons, distributing them according to observed flying distances
- place hives in sunny north/northeast-facing sites in cooler weather
- keep hives cool in summer by placing them in the shade
- provide shelter from the prevailing wind

Hives must also be located away from:

- light sources that will attract them away from the hive at nighttime
- high-traffic areas where they may be bumped by people and machinery
- incompatible neighbouring crops and more attractive nectar sources

In the less bee-attractive berry crops (blueberry and strawberry), beekeepers may place hives in the middle of the planting so that the bees must travel through the crop to get to more attractive nectar sources in the surrounding area. If there is a more attractive nectar source on one side of the crop but not the other, hives may be placed so that bees must travel through the crop to reach that nectar source (Figure 1).

Food and water

Bees need unlimited access to clean fresh water. Water is used to dilute the honey the bees feed on and to regulate temperature and humidity in the hive. A healthy colony (one hive) will go through up to two litres (2L) of water every day during summer. On hot days, bees may become stressed if they are temporarily without water, which impacts their health and capacity to pollinate.

Water points should be located within 50 to 100 metres of the hive and must be free from chemical and fungicide contamination (spray drift).

If natural water sources aren't located nearby, your beekeeper will set up watering stations like the one shown in Figure 2. Beekeepers may install and maintain these water stations as part of their pollination service (Figure 2).

1

2

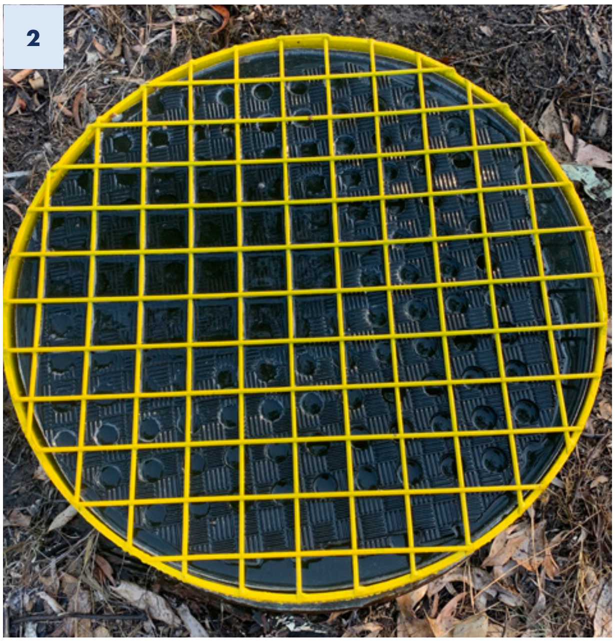


Figure 1. Strategically placed hives make bees travel through this blueberry crop before they reach
Figure 2. Example water station made from a 44-gallon drum cut in half. A rubber mat trimmed to size floats on the water to prevent bees from drowning. The yellow mesh top prevents other animals from falling into the reservoir.
Photo credit: Steve Fuller

Supplementary feeding with sugar water and pollen is not generally recommended when bees are on a pollination job as it will decrease pollination. Instead, beekeepers will rotate hives to maintain the optimum hive health for the target crop (different crops require different colony structures). Hives may be rotated every 3 to 4 weeks, resting bees between pollination jobs in a more pollen and nectar-rich area like forests and parklands. Supplementary food may be provided in this resting stage.

Site access

From a beekeeper's point of view, all-weather vehicle access is highly desirable. Limited access may lead to an increased workload for the beekeeper and uneven placement of hives, damage to equipment, unnecessary damage to farms, and possible personal injuries. Ensuring the beekeeper has good access will aid in the optimal placement of hives (Figure 3).

Site access tips

- have all-weather access for medium to large trucks
- be large enough to unload the truck with a bobcat, forklift, or Hiab
- locate away from gateways or high-traffic areas

Chemicals and poisons

Pesticides should be kept to a minimum while hives remain on the property. Even non-insecticidal sprays can affect pollinators if applied at the wrong time.

Consult your beekeeper before applying any agrichemicals

Most poisoning occurs when pesticides are applied to flowering crops, pastures, and weeds and when instructions for spray use from the beekeeper are not followed. Bees can also be killed by poisonous flowering plants, such as the African tulip tree and Sturt Desert pea, and where environmental conditions render normally safe nectar sources toxic.

Nectar of the native grey box and black butt trees are an example of this, where fermentation during wet weather makes the nectar of these species' toxic to bees.

To reduce bee losses:

- check all chemical labels for any effects on bees
- if a spray is necessary, apply it late in the afternoon after bees have finished flying (only for sprays with a bee withholding period of 12 hours or less)
- if a chemical has a bee withholding period of more than 12 hours, inform the beekeeper and discuss the options. Removing the bees from the farm may be the only option
- consider surrounding plants that may be toxic to bees

Be mindful of spray drift and do not spray in conditions where spray might drift onto adjacent fields supporting foraging bees. Dispose of waste chemicals or used containers correctly.

Moving bees off-site to accommodate chemical applications is not a quick and simple task. Bees are like cats and dogs, they will return 'home' if they can. Hives must be moved at least 3km away from the sprayed area for 3 to 7 days or they will return to the site and die (Figure 4).

Did you know that bees have two stomachs? Foraging worker bees can bring poison back to the hive in their non-feeding stomach where it is deposited in the honey and bee bread that larvae and other bees feed on.

Protected cropping

Bees tend to forage less under protective covers so hives can quickly lose health. Bees also dislike flying into areas under netting or into tunnels.

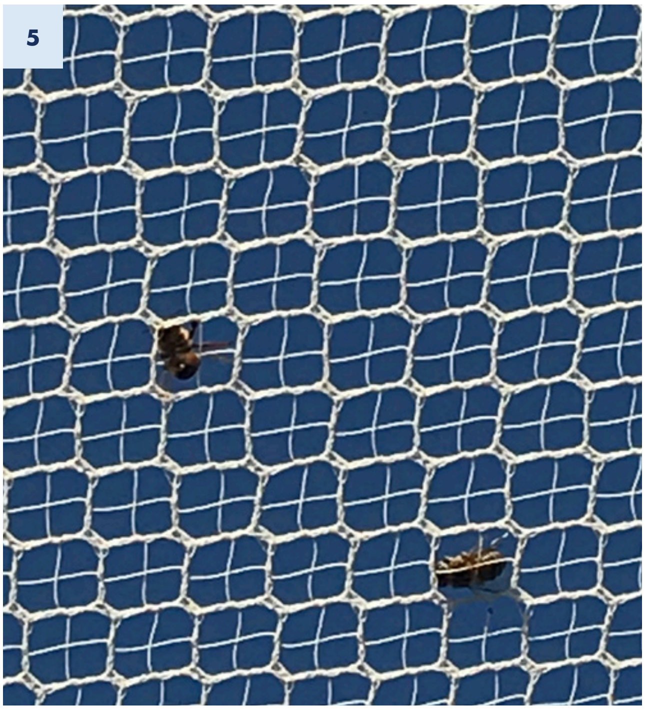
The colour of the protective covering can have an impact on bee navigation. Bees forage better under white surfaces in preference to dark colours or black. Bees may benefit from large colourful objects placed in the enclosure to enhance navigation.

Netting type is also important, bees get stuck in hail netting (Figure 5) but can pass safely through bird netting (Figure 6).

Hives are normally best moved at night, but in protected cropping situations, daytime may be preferred. The daytime movement of hives into a protected cropping area leaves behind old field bees, which would quickly become disoriented and die in the new environment.

Figure 3. Hives are mainly moved at night so a clear area to unload and safe access to locations where hives are to be placed is essential. Photo credit: Steve Fuller

Figure 4. Bees poisoned with a systemic chemical or toxic nectar die with their tongues sticking out. These poisons can also be fed to larvae in the brood by returning worker bees. Photo credit: Steve Fuller


5


6

Figure 5. Hail netting kills bees, they can fit their head and thorax through the net, but their abdomen gets stuck and they die. Figure 6. Bird netting allows bees to pass through safely. Photo credit: Steve Fullerr

Figure 7. Hives placed on leg rows at the end of polytunnels allow bees to be drawn into this Rubus crop
Photo credit: Steve Fuller

Field bees are the oldest bees in the hive and are programmed to travel long distances.

To manage pollination under protected cropping your beekeeper may:

- place hives within netted areas instead of on the outside. While bees will enter through holes or gaps in bird netting this takes time and energy, reducing their capacity to pollinate.
- place hives in the middle of the crop on leg rows, particularly in less attractive blueberry and strawberry crops
- place hives at the end of tunnels to funnel bees through more attractive Rubus crops

Colony strength

Colony strength refers to the number of bees in the hive and the population structure of the colony.

A beekeeper must understand the characteristics of the crop and will match colony strength to that crop.

In very nectar and pollen-rich crops like canola and clover, bees breed rapidly and can swarm if not managed correctly. Swarming reduces hive strength.

In less attractive crops like strawberries and blueberries, additional honey and pollen stores are needed in the hive to maintain colony health. These stores only last 3 to 4 weeks, hence the need to rotate colonies in and out of these crops.

Colonies suitable for pollinating blueberries or strawberries generally contain at least 30,000 to 40,000 bees and have 6 to 10 full frames of brood in all stages of development.

It takes 12 months for a beekeeper to establish a strong colony. Having one strong colony is equal to 4 to 6 weak colonies. Stronger colonies work at lower temperatures!

Stocking rates

Guidelines for hive stocking density for berry pollination vary widely, even within berry types and varieties. Because of the diverse factors at play, the exact number of bees a berry grower will need cannot be given.

Your beekeeper will consider the following points when determining the appropriate stocking rate for your crop:

- number of native pollinators and feral bee colonies already in the area
- other plants in the area that flower at the same as the berry crop and thus compete for bees
- weather conditions during the flowering period
- the density of flowering in the target crop (influenced by planting density, variety, season, etc.)
- the attractiveness of the crop to bees – higher stocking rates may be needed under protected cropping conditions and in less attractive crops like strawberry and blueberry, or in the case of Rubus, where individual bees make fewer visits to flowers because they get their fill of nectar quickly from fewer flowers
- yield expectations

Hot weather makes flowers open quickly. This increases the chance that flowers will not get visited before they lose viability. Higher bee stocking densities can counteract this potential limiting factor.

Blueberries

Good pollination in blueberries can result in a higher percentage of fruit set, larger fruit, and earlier ripening.

Researchers at Michigan State University suggest that for highbush varieties, bees must visit each flower up to three times for the berry to grow to its maximum size. Blueberry flowers are most viable for the first three days after opening, so it is important to have enough bees to allow those visits in that 3-day window.

Pollination success should be monitored in each crop so that stocking rates can be adjusted. Flowers turning brown and discoloured on the bush is an indication that pollination was not sufficient. The petals (corollas) fall off the flowers in well-pollinated fields when they are still bright white.

Estimating pollination success on blueberries

Select and tag 30 flowering stems throughout each block at random just before flowering starts. Count the number of flower buds above the tag before they open. Revisit the tagged stems one week after flowering and count the number of fruitlets – this will give you the initial percentage of fruit set. Return to the tagged stems again after the natural fruit drop to count the number of berries remaining on the plant. These should mature and will give you the final fruit set relative to the initial number of flowers. Remember to take note of any external factors, such as weather events and pest and disease, that may have impacted fruit set and the estimation of pollination success.

Strawberries

Good pollination in strawberries improves fruit set and increases fruit size. Poor pollination can result in misshapen fruit.

10 to 16 bee visits are needed to effectively pollinate a strawberry, and flowers are most viable in the first one to four days after opening.

Because strawberry flowers are less attractive to bees some growers use what's known as 'saturation pollination' where a larger number of bees per unit of space are used. Overstocking helps ensure enough bees visit the crop, accepting that they will also forage on more attractive (non-strawberry) pollen and nectar sources nearby.

Rubus

Good pollination in Rubus crops enhances fruit size, quality, and yield. There is also a strong correlation between the number of bee visits to each flower and drupelet numbers.

Nectar is secreted in large amounts from blackberries and raspberry flowers and both nectars have a high sugar content that attracts an abundance of pollinating insects, especially the honeybee. Raspberries are even more attractive than blackberries.

Because the flowers produce relatively large amounts of nectar, bees may need to visit fewer flowers to collect nectar and may not spread evenly through a field. If an uneven distribution of bees is noted, more hives should be introduced and spread around the crop.

Acknowledgments

Thank you to Steve Fuller, President of the Crop Pollination Association of Australia, for providing technical input and images for this article.

These sources were also consulted in creating this article:

BeeAware: beeaware.org.au

Crop Pollination Association Inc: aussiepollination.com.au

www.canr.msu.edu/news/invest_in_pollination_for_success_with_highbush_blueberries

Cooperative Extension – Maine (USA) Wild Berries: extension.umaine.edu/blueberries/629-honey-bees-and-blueberry-pollination

Engaging a beekeeper

When you engage a beekeeper you are not just hiring hives, you are purchasing a professional service.

Bees have a 3-week breeding cycle, so your beekeeper will visit the hives every 3 to 4 weeks to check colony strength. While on-site, they may also adjust hive locations (if needed), maintain water stations, conduct biosecurity checks, and monitor bee behaviour. Hives may also be rotated depending on food stores and colony strength.

Maintaining a pollination contract with your beekeeper is essential to ensure that your responsibilities and the responsibilities of the beekeeper are clear. You can also use this contract to ensure that your beekeeper has the necessary qualifications, registrations, licenses, and insurance.

The most important tool that beekeepers and berry growers can use to ensure a long-term, hassle free and mutually beneficial business relationship is communication.

The Pollination Guide for the Australian Berry Industry 2024 is a best management practices guide for growers and pollination stakeholders in the berry industry. It provides guidance on how to establish and maintain clear communication between parts of your business and your beekeeper. It includes a detailed list of key conversations to have, roles and responsibilities. It also includes templates for pollination agreements and letters to neighbours.

Thank you to the Australian Honey Bee Industry Council (AHBIC) for their assistance in the preparation of this guide.

The guide is available now in the RESOURCE LIBRARY at www.berries.net.au/resource-library by typing 'pollination guide' into the Search box