Maximise your blueberry crop with better pollination

THE BASICS OF BLUEBERRY POLLINATION 1

Blueberry plants form clusters of bell-shaped flowers, which contain a central style surrounded by shorter pollen-producing anthers (Figure 1).

While flower shape varies, the stigma that receives pollen is usually just at the opening of the flower. The pollen-producing anthers are further inside the flower and surround the stigma. Nectar is produced at the base of the flower.

For fruit to develop, pollen must be moved from the anthers to the stigma. Blueberry pollen does not readily travel by wind, so pollinators are needed for adequate fruit set to occur.

Top tip

Insects other than honey bees may play a major role in pollination on some farms

Monitor pollinator numbers and work with your beekeeper to make sure you have sufficient activity on flowers at all times.

Most blueberry cultivars grown in Australia are either 'highbush' (*Vaccinium corymbosum*) or 'rabbiteye' (*Vaccinium virgatum*) varieties.

Rabbiteye blueberries are mostly self-infertile, and highly dependent on cross-pollination for adequate fruit set: pollen moved to the stigma must be from plants of a different variety.

Highbush varieties are generally less dependent on cross-pollination, but most have improved fruit set with cross-pollination.

Some popular highbush varieties like 'Brigitta' require a high degree of cross-pollination. In addition to increasing fruit set, adequate cross-pollination can increase seed counts and fruit size, and the speed of berry development.

Figure 1 A blueberry flower with part of the corolla removed, showing the central style and stigma surrounded by pollen producing anthers.

What you need to know

- *Fruit set in all blueberry varieties is increased by insects moving pollen between cultivars.*
- *Rabbiteye varieties need to be cross-pollinated for fruit to set, so pollinators are vital.*
- *Improved pollination can add value by increasing fruit weight and shortening fruit development times.*
- *Honey bees are essential pollinators on many Australian blueberry farms.*
- *Pollination hives need to be of adequate strength and distributed through the farm to improve pollination.*
- *Unmanaged pollinators, such as native bees and bumble bees (in Tasmania) contribute to pollination.*
- *Bumble bees and carpenter bees may chew holes at the base of flowers to get to nectar, but these 'nectar-robbing' visits still contribute to pollination.*
- *Honey bee behaviour can be disrupted by protective covers (e.g. tunnel houses, hail netting) so ensure flower visiting insects are present if covers are used.*
- *The number of pollinator visits to flowers should be assessed and hives added if needed during flowering.*

BLUEBERRY POLLINATORS 2

A diversity of pollinators including bees, flies and moths visit blueberry flowers, many of which can contribute to crop pollination. Visits by unmanaged pollinators are likely to vary from farm to farm, and between growing regions.

Honey bees

European honey bees (*Apis mellifera*) are important pollinators of blueberry because their populations can be easily manipulated via the addition of managed hives (Figure 2). Current guidelines for hive stocking density for blueberry pollination vary widely, from 1.25 to 10 hives per hectare, and will depend on factors such as flower density and the number of feral honey bees or other pollinators.

Monitoring pollinator activity on your crop can help guide decisions about pollinator management. To assess honey bee activity, count bee numbers mid-morning on a fine day. When there are only a few other pollinators, you should see about two honey bees foraging per bush as you stroll down a row.

Figure 2 Honey bees are the most important pollinator of blueberries on many farms, and can be moved in large numbers to boost pollinator numbers.

Other bees

There are about 1500 species of bees in Australia. Research is ongoing to determine which of these are most important for blueberry pollination. Several species – like carpenter bees, blue-banded bees and teddy bear bees – are capable of 'buzz pollination' that vibrates pollen loose from flower anthers. Because this releases large amounts of pollen, some of these bees have been shown to be more efficient (per individual) than honey bees (Figure 3).

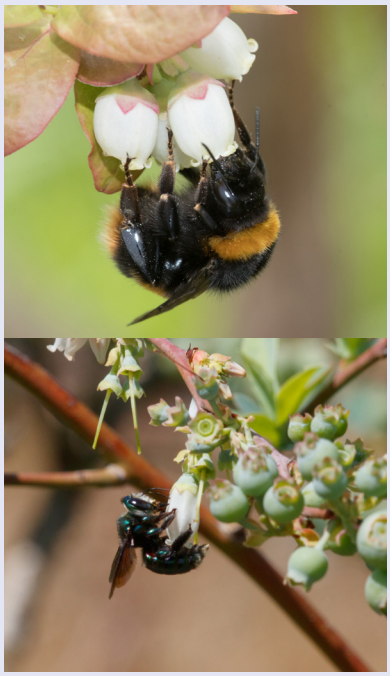

Figure 3 Many species of bees visit blueberry flowers, including bumble bees in Tasmania (top) and peacock carpenter bees in Queensland and NSW (bottom). Both are capable of 'buzz pollination' and 'nectar robbing'.

The bumble bee, *Bombus terrestris*, is an introduced species to Tasmania, and on some farms it can be the primary pollinator of blueberry flowers. While bumble bees are known to be good pollinators of blueberries, the environmental consequences of bumble bee introduction in Tasmania are not fully understood, and these bees are not present in other parts of Australia.

Stingless bees are frequent visitors to blueberry flowers in mainland Australia. These small bodied native bees make good contact with stigmas while foraging and are likely to be efficient pollinators for blueberries. Stingless bees are social and in warmer regions managed hives are available for hire.

Other pollinators

Various flies, butterflies, beetles and even birds may all contribute to blueberry pollination (Figure 4). Understanding the life histories of these species is key to preserving their populations on farms. Some unmanaged pollinators move between farms and surrounding natural or low-disturbance areas. Others take shelter in the crop and can be more susceptible to non-target effects of pest control measures.

Figure 4 Blueberry flowers are attractive to a wide variety of pollinators, including stingless bees (top) and the scarlet honey eater (bottom).

Nectar robbing

Large bees like bumble bees and carpenter bees can sometimes struggle to reach pollen at the base of blueberry flowers, but they can chew holes at the base of the flower to reach nectar. This is called 'nectar-robbing' or 'side-working' and you'll know it's happening if you see damage to the flower petals (Figure 5).

Once a hole is made, other visitors to the flower, including honey bees, may use this rather than the flower opening. Many growers worry that nectar-robbing will decrease pollination and fruit development, but research has shown that even robbing visits usually add to pollination and fruit set, although more visits are required for full pollination.

Figure 5 Bumble bees and carpenter bees may chew holes at the base of flowers to feed on nectar. Honey bees may then use these holes. 'Nectar robbing' visits still contribute to pollination, although they are not as efficient as other visits.

POLLINATION UNDER COVERS 3

Many farms use protective covers such as plastic poly-tunnels and woven hail or bird netting to enhance blueberry growing conditions and protect the crop from damage. These covers may disrupt normal pollinator behaviour. Honey bees forage less under netted covers, and can lose hive strength under such conditions (Figure 6).

Figure 6 Honey bee pollination may be less efficient in some covered environments.

Other pollinators may be less sensitive to the environmental changes faced under covers. Pollination in these conditions is still achievable, but you'll need to monitor pollinator activity to be sure it is sufficient. If you can, delay covering the crop completely until the pollination period is over. Since foraging bees may travel less under covers, hives may help to ensure pollination throughout the farm.

ENSURING POLLINATION OF YOUR CROP 4

On most farms, pollination occurs thanks to a mix of different pollinating species. Managed honey bees should be used to raise pollinator activity in places where other pollinators are not very active in the crop.

In colder regions, pollination of early flowering varieties may be a challenge, as populations of pollinators (including honey bees) may not have fully rebounded from winter, and some are less active in cooler conditions. Work with your beekeeper to ensure that colonies supplied for pollination are of adequate strength, and that these are distributed in a way to maximise pollination coverage across the farm.

Develop a pollination contract with your beekeeper to ensure that responsibility for pollination and hive management is clear. Consult your beekeeper prior to applying agrichemicals, as even non-insecticidal sprays can affect pollinators if applied at the wrong time. Also, provide water for bees and shelter for hives in exposed locations.

How to measure fruit set

You can easily monitor your pollination rates by tagging individual flowers, or clusters of flowers, with small 'jewellers' tags' or other robust markers. Count the number of tagged flower buds, and go back later to count the number of berries that develop. This will give you an estimate of fruit set rate. Doing this at several locations across the farm can tell you if pollination is occurring in a consistent way. By noting weather conditions and pollination management actions, you can work out which strategies are best for your farm from year to year.

5 CHECKLIST

FARM MANAGEMENT			
ACTION	YES	NO	COMMENT
Unless growing a known self-compatible cultivar, rows of compatible cultivars are planted next to each other to maximise cross-pollination.			
Peak flowering times of cultivars overlap in your region.			
Flowers (or flower clusters) are tagged each year and the fruit set rate is recorded to monitor changes in pollination from year to year, or in different parts of the farm.			
Shrubs are pruned annually to maintain a range of canes of different ages, including new fruiting canes.			
Options to mitigate the effects on honey bees of protective covers are discussed with your beekeepers.			

POLLINATOR MANAGEMENT			
ACTION	YES	NO	COMMENT
Staff can identify common insects visiting flowers.			
Checks are done for adequate pollinator activity on fine days – about two honey bees per large bush in mid-morning.			
When or where pollinator activity is lower than usual, managed honey bee hives are brought in to maintain pollination rates (at 5 per cent flowering).			
If hives are not usually brought in for pollination, the degree of reliance on local honey bees is known, and plans made to supplement this service when needed.			
Pollination agreements are drawn up with beekeepers, detailing respective responsibilities.			
Beekeeper has provided evidence of compliance with the Australian Honey Bee Industry Biosecurity Code of Practice.			
Honey bee hives are placed in small groups that are evenly spaced in the farm, at an overall stocking rate of between 1.25 and 10 hives per hectare.			
Where dependence on unmanaged pollinators is known to occur (i.e. more than half of flower visitors), management plans are developed to protect or enhance their numbers.			

Goodwin (2012) *Pollination of Crops in Australia and New Zealand* 121 p.
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