Department of Primary Industries
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Primefact

Increasing native bees around berry farms

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The role of diverse pollinators in horticulture

Pollination is important to produce many crops, including berries. European honey bees are useful pollinators of blueberries, raspberries, and blackberries, but native bees and other pollinators also play a role. Now that varroa mite has been declared 'unable to eradicate', it is important to increase native bee populations as the collapse of honey bee populations (particularly wild colonies) is expected.

In an international study of more than 40 crops grown worldwide, wild pollinators, such as native bees, improved pollination efficiency by greatly increasing fruit set compared to crops pollinated only by European honey bees. The best pollination outcomes were achieved when both European honey bees and native pollinators, such as native bees, were present (Garibaldi et al. 2013; Figure 1). Therefore, to enhance crop yields, new practices must be considered for the integrated management of both honey bees and native bees.

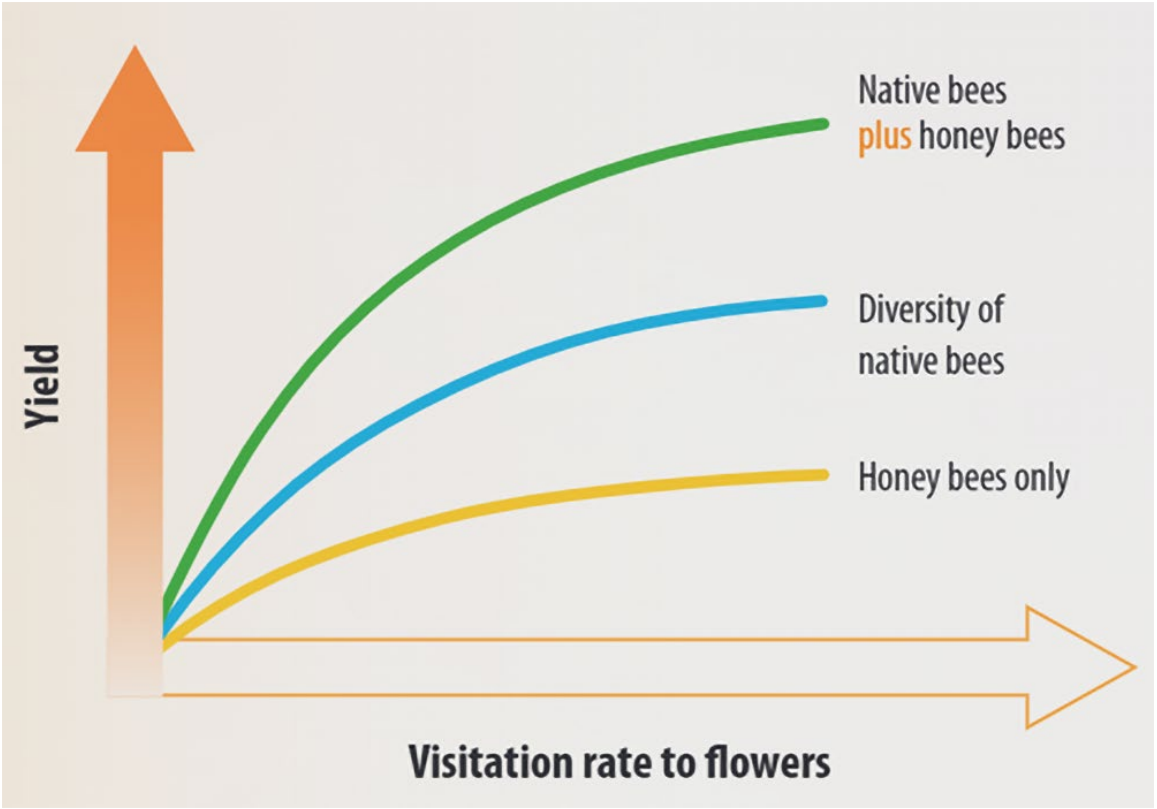


Figure 1. Having both honey bees and native bees provides the greatest increase in yields. Source: Australian Native Bees, adapted from Garibaldi et al. (2013).

Pollination in berries

Cross-pollination vs self-pollination

Cross-pollination involves the transfer of pollen from the flower of one plant to the flower of another plant of the same species (Figure 2, left).

Self-pollination occurs when pollen from a flower fertilises the same flower or another flower on the same plant (Figure 2, right). This means they can produce fruit without pollen from another plant, which is advantageous in areas with limited pollinator activity.

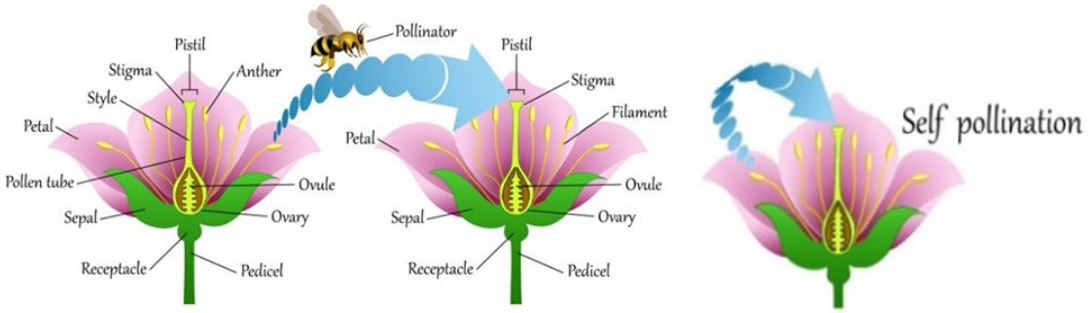


Figure 2. Cross-pollination (left) and self-pollination (right). Source: P Chaudhary, Pendulum Edu.

Blueberries: Highbush varieties are generally less dependent on cross-pollination, but most have improved fruit set and fruit size when cross-pollination occurs. Rabbiteye blueberries are mostly self-infertile and highly dependent on cross-pollination for adequate fruit set.

Raspberries and blackberries: commercial raspberry and blackberry cultivars are largely self-fertile and mostly self-pollinate. However, insects can move pollen within and between *Rubus* flowers, and this can increase fruit quality (e.g. number of drupelets), even in self-compatible varieties, by ensuring that more stigmas receive pollen.

Insect visitation is, therefore, essential to maximise production in blueberries, raspberries and blackberries.

Blueberry flower morphology

Blueberries have a bell-shaped flower that requires buzz pollination (rapid wing muscle vibrations) to release pollen from anthers (Buchmann 1983).

Honey bees have limited access to the anthers recessed within the bell-shaped blueberry corolla (flower), limiting the amount of pollen collected during each visit (Figure 3).

Many native bees that visit blueberry flowers, including carpenter bees, blue-banded bees, and teddy bear bees, can 'buzz' flowers. This vibration loosens the pollen from flower anthers, releasing large amounts of pollen. Some of these bees are more efficient (per individual) than honey bees.

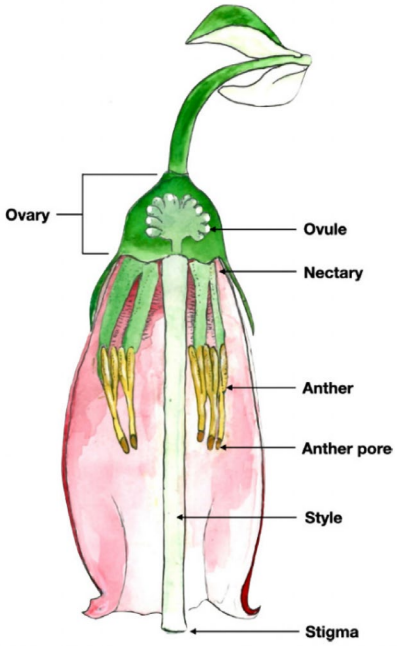


Figure 3. A transect of a blueberry flower. Source: S Delaplane, CABI.

Blackberry and raspberry flower morphology

Blackberries and raspberries form from a single flower (Figure 4) with numerous pistils (ovaries). These pistils must be individually pollinated to produce a drupelet (Andrikopoulos and Cane 2018). Poorly pollinated flowers are the most common cause of misshapen, crumbly fruit. Bees are highly attracted to raspberries and blackberries because of abundant nectar and pollen.

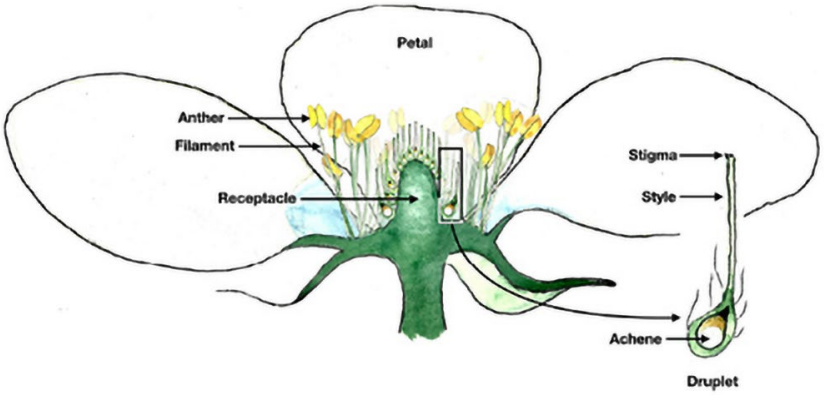


Figure 4. A *Rubus* (raspberry and blackberry) flower. Each pistil (style, stigma and ovary) will develop into a fruitlet that makes up part of an aggregate fruit. Source: K Delaplane, CABI.

Native bees are just as effective as honey bees at pollinating blackberries. A single visit by any bee species (honey bee or native) triples the number of drupelets, therefore increasing fruit size (Coates et al. 2021).

Types of native bees

Native Australian bees can be broadly grouped into 2 main categories: social bees and solitary bees, each playing a vital role in pollination and ecosystem health. Social native bees, such as the *Tetragonula* species (also known as stingless bees), live in colonies with a queen, workers, and drones, and cooperate in building nests, foraging, and raising young. These colonies can contain hundreds to thousands of individuals.

Solitary native bees, which make up the majority of Australia's over 1,700 native bee species – such as blue-banded bees and leafcutter bees – do not form colonies. Each female builds and provisions her own nest, often in the ground, hollow stems, or wood. While solitary bees might nest near one another, they work independently and do not share tasks like social bees. Solitary native bee species and their geographical distribution in Australia are listed in Table 1.

Social bees

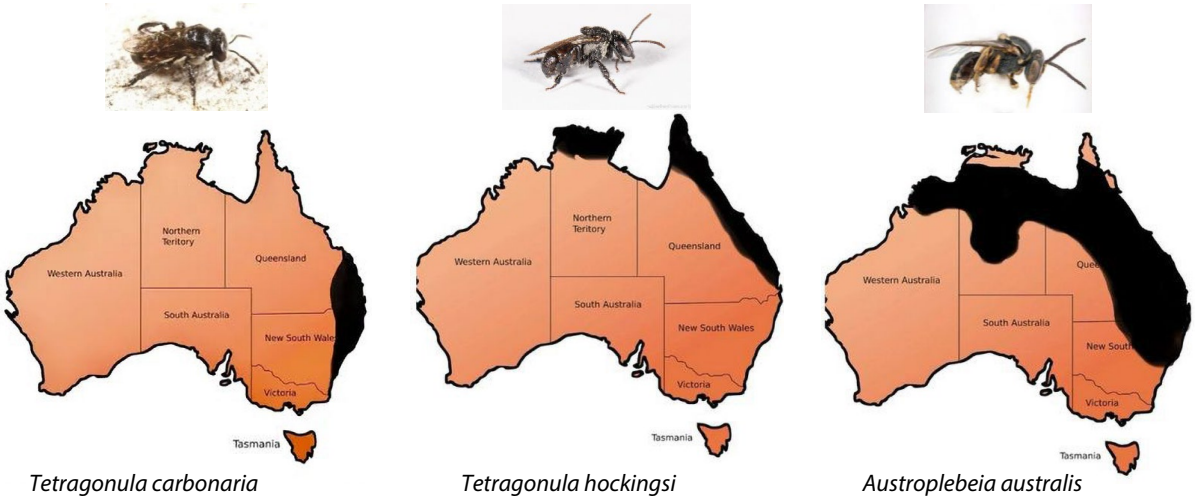
Stingless bees

Stingless social native bees in Australia belong to 2 genera: *Tetragonula* and *Austroplebeia*. They are both small and black (Figure 5), about 3–4 mm long.

Figure 5. A stingless bee on a blackberry flower on the mid-north coast, NSW.

Unfortunately, not all of the Australian continent is suitable for keeping stingless bees. These bees occur naturally in Australia's warmer and wetter parts, and it is recommended that species be kept in their natural range. Stingless bees are tropical, so they thrive in warm areas of Australia such as Queensland (Qld), Northern Territory (NT) and north-eastern areas of NSW (Figure 6).

- *Tetragonula carbonaria* are suited to sub-tropical conditions and are found in coastal areas from Qld to southern NSW.
- *Tetragonula hockingsi* are suited to tropical to sub-tropical areas and are found in coastal areas of Qld and the NT.
- *Austroplebeia australis* are found in southern and western Qld and are more common in inland areas.



Tetragonula carbonaria *Tetragonula hockingsi* *Austroplebeia australis*

Figure 6. *Tetragonula carbonaria*, *Tetragonula hockingsi* and *Austroplebeia australis* bee distribution. Source: Tetra native bees (https://tetranativebees.com/).

Using a combination of honey bees and stingless bees for pollinating blueberries can increase individual berry weight by 70% compared to using either type of bee alone (Kendall et al. 2022). Furthermore, stingless bees and honey bees exhibit marked differences in their foraging behaviour inside blueberry flowers. Stingless bees are small enough to forage inside blueberry flowers, directly contacting the anthers and the stigma, whereas honey bees can only insert their proboscis or forelegs into the flower.

The small bodies of stingless bees make good contact with stigmas while foraging, making them efficient blueberry pollinators.

Solitary bees

Blue-banded bees

The blue-banded bee is golden brown with a black abdomen and distinctive iridescent blue abdominal banding with dense hairs covering most of the body, including legs (Figure 7). They fly fast, darting from flower to flower, and are small, ranging from 10–12 mm long. The females build nests in shallow burrows in the ground, but they can also nest in mud brick houses or soft mortar. Blue-banded bees are buzz pollinators and are found in Qld, NSW, Vic, SA, WA, and the NT

Figure 7. A blue-banded bee. Source: Dianne Clarke, Australian Museum.

Great carpenter bees

Great carpenter bees are the largest native bees in Australia and are approximately 15–24 mm long. They are called carpenter bees because they cut nest burrows in soft timber. The females have a glossy black abdomen and bright yellow fur on the thorax (Figure 8). The males are covered uniformly with yellowy–brown or olive fur. These bees prefer a warm climate and are found in northern and eastern areas of WA, Qld, NT, and the northern areas of NSW.

Figure 8. A female great carpenter bee. Source: Jenny Thynne, Wildlife Preservation Society of Queensland.

Green carpenter bees

These bees are up to 17 mm long and are a glossy metallic green with tints of yellow or blue (Figure 9). They cut wide nest burrows in the dry flower stalks of grass trees (*Xanthorrhoea* spp.) or in soft pithy dead timber of Banksias. They are mostly found in eastern parts of Qld and NSW and some parts of SA.

Carpenter bees are buzz pollinators and play an important role in pollinating flowering plants, especially those that require buzz pollination like blueberries.

Figure 9. A green carpenter bee. Source: Wheen Bee Foundation.

Furrow bees

Furrow bees are members of the genus Lasioglossum, which contains around 20% of Australia's native bee species. Furrow bees are generally medium-sized, black or dark brown with broad white bands of hair across their abdomen (Figure 10). Furrow bees are found in forests, woodlands, heaths and urban areas, with most species nesting in the ground.

Lasioglossum spp. bees are important pollinators because females carry large amounts of pollen on their furry bodies and hind legs. When they nest in agricultural areas, they can contribute to crop pollination.

Figure 10. *Lagioglossum lanarium*, one of the largest species of furrow bee. Source: Dianne Clarke, Australian Museum.

Reed bees

Reed bees are slender, up to 8 mm long and often have a glossy black head and thorax. Their abdomen is either black or orange–red (Figure 11) and they often have a T-shaped cream mark on their face.

They nest inside dry, pithy twigs in plants such as raspberries and blackberries or in the dead fronds of tree ferns. Reed bees will nest in raspberry canes (Figure 12) they have entered at a damage point or an opening created by pruning. These bees prefer canes that are more upright and not too thick (stems less than 9 mm in diameter were preferred). Nests are in the orchard year-round and new nests are established in spring. As reed bees do not tunnel through live tissue, they do not harm the plant.

Figure 11. A reed bee. Source: Bruce Hulbert, Australian Museum.

Figure 12. A reed bee nesting. Source: Tobias Smith, Coffs Harbour Native Bees.

Reed bees have also been found nesting in stems of woody weed lantana, coral trees (*Erythrina* sp.), grass-tree spikes (Xanthorrhoea spp.), tree fern fronds and other hollow-stemmed plants. They are found in all states and territories in Australia.

Reed bees actively forage most of the year (less so in winter) and require floral resources outside crop flowering times.

Teddy bear bees

The teddy bear bee (*Amegilla bombiformis*) has golden brown colouring, ranges from 15–20 mm long and is typically a plumper-looking bee than European honey bees. They have dark hairless bands on their abdomen and are covered all over, including legs, in golden brown hairs (Figure 13). They have dark brown wing colour and medium-length antennae.

They live solitary or within close range to other teddy bear bees and they choose small burrows in soil or eroded banks to live. They are widely distributed across eastern Australia excluding Tasmania. Teddy bear bees are also buzz pollinators, playing an important role in pollination services to flowering plants to species that require buzz pollination.

Figure 13. Teddy bear bee. Source: Jessica Drake, Noosa News.

Table 1. Solitary native bee species and the states and territories where they can be found.

Species	NSW	QLD	VIC	SA	WA	TAS	NT
Blue-banded	✓	✓	✓	✓	✓	✗	✓
Great carpenter bees	✓	✓	✗	✗	✓	✗	✓
Green carpenter bees	✓	✓	✗	✓	✗	✗	✗
Furrow bees	✓	✓	✓	✓	✓	✓	✓
Reed bees	✓	✓	✓	✓	✓	✓	✓
Teddy bear bees	✓	✓	✓	✓	✗	✓	✓

Ways to increase native bees around farms

Placing stingless bee hives on farm

Stingless bee hives (Figure 14) can be placed permanently or temporarily on a farm. Permanent hives work particularly well in a diverse environment with year-round resources for them, such as a mix of multiple crop species, natural bushland, and ornamental garden plant species (Table 2).

Figure 14. Stingless bee hives on a blueberry farm for pollination in NSW.

Australian stingless bees have a flight range of approximately 500 m; 10 times less than honey bees. Therefore, when placing hives on farms, ensure all areas of the target crop are covered.

Artificial nesting sites

Artificial nests can be used around the farm to encourage several solitary bee species with diverse nesting strategies. Solitary bees have 2 types of nesting behaviour: above-ground cavity nesters and ground nesters. Artificial nesting sites can be provided to attract them around farms.

Above-ground cavity nesting

Nesting habitats for reed bees can be built by using cut pieces of Rubus canes or lantana stems cut in 200–250 mm lengths and tied together or placed into a PVC pipe and attached to poles around the orchard (Figure 15).

Drilling holes into timber blocks is another way to provide artificial nesting sites for tunnelling solitary bees. Drill various sized holes irregularly in the blocks, with spaces of not less than 20 mm between the centres of neighbouring holes (Figure 16). The holes should be between 120 and 150 mm deep and can have varying hole widths from 3–13 mm.

Figure 15. Raspberry canes used as artificial nesting sites for reed bees. Source: Australian Native Bee Association.

Figure 16. Nest blocks about the size of small loaves of bread. These can be stacked together or separately. Source: Milkwood Trading Pty Ltd.

Ground-nesting solitary bees

Blue-banded bees and teddy bear bees are commonly found nesting in the dry walls of mud brick houses. Mud bricks can be made (Figure 17) using clay soil from a local area or by using commercially available clay such as fine tennis court loam. PCV downpipe can be used as a mould. The nests should be placed in a dry, sheltered location that receives the morning sun. It is best to stack the blocks as blue-banded bees are attracted to the sight of multiple nest holes.

Figure 17. PVC down pipe used as a mould to create clay brick nests for blue-banded bees. Source: Aussie Bee.

Table 2. Types of artificial nest sites and bee target groups. Source: Australian Native Bees.

Species	Suitable nest types
Blue-banded and teddy bear bees	Mud bricks. Provide shallow starter holes.
Reed bees	Dead lantana stems and other pithy stems such as raspberries >200 m long.
Carpenter bees	Dead branches (approximately 40–80 mm diameter including mango, jacaranda, eucalyptus, and melaleuca.
Various ground-nesting bees (e.g. *Lasioglossum* spp. and *Homalictus* spp.)	Sandy loam areas, well drained sunny aspect, >600 deep.

Species diversity helps to ensure insects will visit in a wide range of conditions and increases the likelihood that pollen will be moved around the crop in different ways.

Hedgerows and flower strips

These include woody or herbaceous vegetation planted at the edge of a crop.

- Leaving older trees around blocks provides nesting hollows for feral honey bees and stingless bees (Figure 18).
- Vegetation corridors provide connectivity between different parts of the landscape. Plant species that will provide pollen and nectar around the time the berry crop starts and finishes flowering.

Figure 18. Older trees and vegetation around a blueberry block provide nesting hollows for bees.

Generally, wild pollinator visitation rates decline by half the maximum rate at 0.6 km from natural vegetation. This means that crops further than 0.5 km from natural vegetation might not receive adequate pollination (Carvalheiro et al. 2010).

In-field practices

- Insects will visit flowering weedy vegetation along field edges or crop headlands (Figure 19). For example, dandelions attract native bees and hoverflies.
- In orchards, maintain grassy ground cover or plant cover crops between rows and keep wildflower meadows in open uncropped areas (Figure 20).
- Reduce mowing frequency of unmanaged grassy areas so that plants flower and reseed for the next generation of plants.

Figure 19. Weedy vegetation and flowering plants planted around blueberry rows to increase insects for pollination.

Figure 20. Inter-row planting in orchards to increase native bees and other pollinators. Source: Irwin Hunter and Co.

Plant species for native bees

Species to plant outside and around the crop

Plants grow best when they are suited to local conditions. Choosing species that are native or proven in your area means they will need less water, grow more reliably, and support local ecosystems. Always check which plants are best for your region before planting. Some common species that can be planted to help to increase native bee populations are in Table 3.

Table 3. Plant species that help to increase native bee species and images to help identify them.

Plant species		
Banksia – such as *Banksia serrata* and *B. integrifolia*		
Grevillia – such as Grevillea 'Bronze Rambler' or Grevillea 'Honey Gem'		
Eucalyptus – flowering gums such as *Eucalyptus tereticornis* or *Corymbia ficifolia* syn. *Eucalyptus ficifolia*		
Melaleuca – such as *Melaleuca quinquenervia* and *M. linariifolia*		
Leptospernum – such as *Leptospermum rotundifolium* and *L. polygalifolium*		

Plant species		
Callistemon (bottlebrush) – such as *Callistemon viminalis* and Callistemon 'Little Caroline'		
Carex apressa (tall sedge) and *Ficinia nodosa* (Knobby club rush)		
Westringia fruticose – native rosemary		
Daisies – natives such as cut leaf daisy (*Brachyscome*) and the everlasting daisy *Bracteantha*, as well as exotic species such as *Osteospermum* and seaside daisy erigeron	 	 

Summary

Native bees are crucial for berry pollination, complementing European honey bees, to improve fruit set and yields. With the decline of wild honey bee populations due to the varroa mite, increasing numbers of native pollinators such as stingless bees, carpenter bees, blue-banded bees, and reed bees is essential. Research shows that native bees, particularly buzz pollinators, are highly effective in pollinating blueberries, leading to better fruit formation. Stingless bees, for example, make direct contact with flower stigmas, enhancing blueberry fruit weight, while native bees, such as carpenter bees and reed bees, contribute to increased drupelet numbers in blackberries and raspberries.

To encourage native pollinators on farms, growers can provide artificial nesting sites, plant hedgerows with diverse flowering plants, and maintain natural vegetation corridors. Nesting sites can include mud bricks for blue-banded bees, dead stems for reed bees, and drilled wood blocks for carpenter bees. Reducing mowing frequency and preserving wildflowers can also attract beneficial insects. By adopting these strategies, a more resilient pollination system can be created to increase berry yields while promoting biodiversity.

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