

Maximise your avocado crop with better *pollination*

THE BASICS OF AVOCADO POLLINATION

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Avocado flowers open first as females that are receptive to pollen, then close before reopening the next day as male pollen donors. Fertilisation only occurs when pollen is transferred to a female flower from a male flower.

Avocado plant cultivars are grouped into two types based on when the flowers are in the male or female phases. Type B (eg Bacon, Edranol, Ettinger, Fuerte) will generally be in the male phase and release pollen when Type A (eg Hass) is in the receptive female phase. Inter-planting cultivars of the different types is therefore not only good for promoting cross-pollination, it also increases the chances that enough pollen will be available when the female flowers are ready to be fertilised and produce fruit.



Male Hass avocado flower releasing pollen

It's typical for about three fruit to be produced from one thousand flowers. This very low fruit set rate means that even slight increases in pollination can significantly increase fruit set and yield.



Female Hass avocado flower ready to be pollinated

Although avocado flowers are self-fertile, the entire breeding system has evolved to reduce the amount of self-pollination that occurs. Growing a mix of cultivars increases the chances of successful pollination and improves final yields because cross-pollinated fruit are less likely to be dropped early during periods of stress.

Planting in the ratio of at least one pollen donor tree for eight main cultivar trees will reduce the negative effect of distance from pollen donor trees on fruit set in low flowering years.

Self-pollination within a single cultivar can occur when there is overlap between male and female phases. When it's warm, the overlap is usually for a few hours in the middle of the day. If it's colder, the overlap may be in the late afternoon or evening, or even overnight.

The time at which female Hass flowers open changes with temperature. As overnight temperatures drop, flowering is delayed until later in the day. When overnight temperatures drop below about 7°C, most female flowers open in the late afternoon, stay open overnight, and close the next morning. It's not known how much night active insects like moths contribute to pollination.



What you need to know

- Pollination of avocados is less predictable than for other crops
- Flowers open first as females, then open again as males
- Flowers open once as females, usually for only 4-6 hours
- Plants grown as pollen providers need to have their male flowers open when the main crop has female flowers open to make sure you have a good supply of pollen
- While self-pollination is possible, cross pollinated fruit are more likely to stay on the tree until harvest
- When overnight temperatures are low, female flowers don't open until the afternoon or evening
- Having a wide range of insects visiting flowers will ensure you get good levels of pollination no matter when the flowers open
- Honey bees often prefer other flowers over avocado
- High numbers of flies might be all you need to pollinate your crop, depending on where you are
- The number of pollinators can differ from year to year depending on land management and the health of local honey bees

2

OVERNIGHT TEMPERATURES AND FEMALE FLOWER OPENING TIMES



Avocado flowers only open in the female stage once for less than a day (green bars). As overnight minimum temperatures decrease, female Hass flowers open later in the day, and can remain open overnight. Supporting a range of pollinators in your orchard, including those active in the evening, will improve the chances of pollination occurring.



EFFICIENCY OF DIFFERENT POLLINATORS

	BRISTLE FLIES	BLOW FLIES	HOVER FLIES	LADY BEETLES
Number of insects equivalent to 1 honey bee	1	2	3	3



High numbers of flies might be all you need to pollinate your crop. Get to know which pollinators are working in your orchard.

3

INSECT POLLINATORS

A wide variety of insects like flies, beetles and bees pollinate avocado flowers. The main pollinators can vary greatly between regions. Flies can be essential in some regions, honey bees in others.

In large numbers, honey bees will be the most effective pollinators. But honey bees often prefer other flowers over avocado flowers, so it can be difficult to get them to visit the crop. When flies and beetles are more abundant, they will be more important for pollination than honey bees.

The table (left) shows the relative efficiency of different pollinators, based on how much pollen they deposit on stigmas.



How to boost pollination

- Plant a mix of type A (eg Hass) and type B (eg Bacon, Edranol, Ettinger) cultivars in a ratio no less than 8:1
- Check when your female flowers are open and whether pollen is available on other trees or flowers at the same time
- Identify and count insects that visit flowers in your orchard. At five hives per hectare, you should have a minimum of three foraging bees per tree on a fine sunny day
- Investigate other options for pollination if honey bees are not visiting your flowers
- Protect unmanaged pollinators if they are the main insects foraging on your flowers
- Agree to a pollination contract with your beekeeper
- Have a plan so you know what to do if pollinator numbers change suddenly

Honey bees

Honey bees might only pollinate one flower per minute, so generally the more you have on flowers the better. Counting bees and other insects on trees will help you to work out the amount and evenness of pollination in your orchard.

Even if you do not currently bring in hives, it is important to know how reliant you are on local honey bees to pollinate your crop.

Recommended hive stocking rate for avocados is 5-8 per hectare, but you should check bee activity in your orchard after hive placement. If you see few bees, and few other insect pollinators, then you need more hives.

The presence of other crops that are flowering at the same time can greatly reduce the numbers of bees foraging on your avocado. For this reason, new avocado orchards should not be sited next to other crops such as citrus that flower at the same time.

Honey bees that are gathering nectar can visit both female and male flowers while foraging.

It is important to order hives early enough in the season to ensure an adequate supply when trees are flowering, as beekeepers need time to prepare colonies suitable for pollination. To be sure of what you are getting, and there are no misunderstandings about what is being supplied, develop a pollination agreement with your beekeeper.

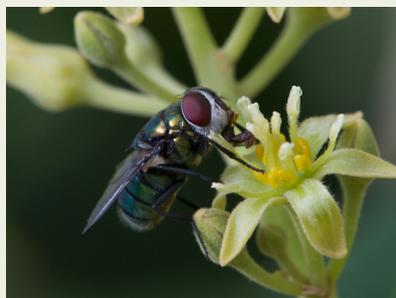
The placement of hives is important. Colonies should be spread evenly throughout the orchard in groups of 2-4 hives, to ensure bees visit flowers across the entire orchard.

Honey bees need water, so growers and beekeepers should agree on how this will be provided.

Flies

Flies can be better at cross-pollinating avocado than honey bees because they move randomly through an orchard between different cultivars, visiting male and female flowers.

The effectiveness of flies as pollinators varies between species, but there can often be more than 20 types in an orchard. This means it's likely that some good pollinators will be present, and that pollination can occur whenever the female flowers are open.

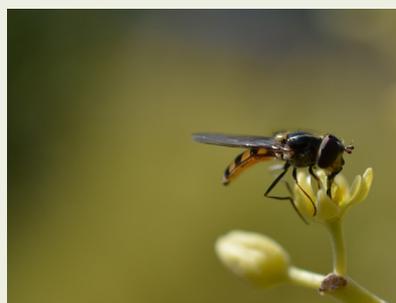


Green blow fly pollinating an avocado flower

When they are visiting in large numbers, flies can be the most important pollinators.

If you think flies are important pollinators in your orchard, they might be breeding in damp leaf litter (eg some hoverflies) or on other organic matter (eg blow flies, flesh flies). Although it's easy to encourage flies to breed in your orchard, you should consider their potential negative impacts on you and your neighbours. Breeding sites may pose a biosecurity risk because they can attract disease carrying insects (eg mosquitoes), vermin and feral or wild animals.

Other types of flies can be beneficial because they are predators of plant pests. Aphids for example are preyed upon by the larvae of hoverflies, which may be breeding on long grass.



Orange hover fly pollinating an avocado flower



Lady beetle pollinating an avocado flower

It is particularly important to avoid the use of pesticides during flowering. Non-bee pollinators are likely to be present in orchards both day and night and strategically applying pesticides to minimise honey bee losses is still likely to cause large losses of non-bee pollinators.



Top Tip

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Having a wide range of abundant pollinators in your orchard is the key to good avocado yield.

Other pollinators

Beetles, moths and other small insects can also boost pollination in avocado orchards. Just like the benefits of fly diversity, having a range of other insects in your orchard can improve pollination and crop yields.

4 CHECKLIST

DEVELOP A POLLINATION PLAN FOR YOUR ORCHARD			
ACTION	YES	NO	COMMENT
New orchards or blocks are established with an appropriate mix and spacing of type A and B cultivars			
Pollen donor ratios are optimised by replacing unproductive trees with pollen donors			
Crop loads (eg no fruit, light, average and heavy) are recorded on individual trees over multiple years, providing a benchmark to assess changes in pollination			
Orchard staff can identify female and male flower phases			
Trees are regularly checked for open female flowers and pollen producing male flowers, along with weather records, to understand the pattern of flowering in the orchard			
Orchard staff can identify common insects visiting flowers			
The number of pollinators active on ten trees in a block is counted			
When or where pollinator activity is lower than usual, managed honey bee hives are brought in to maintain pollination levels			
If hives are not usually brought in for pollination, the level of reliance on local honey bees is known and plans made to replace this service when needed			
Where dependence on unmanaged pollinators is known to occur (ie more than half of flower visitors), management plans are developed to protect or enhance their numbers			

HIVE MANAGEMENT			
ACTION	YES	NO	COMMENT
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 orchard, at an overall stocking rate of between 2-4 hives per hectare			

Howlett et al (2017) *Optimising pollination of macadamia and avocado in Australia* 125 p.

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

Images courtesy of Brian Cutting and Lisa Evans of Plant & Food Research NZ, unless otherwise stated.

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