

Maximise your macadamia crop with better pollination

THE BASICS OF MACADAMIA POLLINATION

1

Macadamia flowers are borne on racemes containing 100–300 flowers. It takes about 6 to 12 days for all of the flowers on a raceme to open and the flowers produce both pollen and nectar. Importantly, the flowers can only be pollinated when they are fully open.



Macadamia racemes.

Many varieties of macadamias produce more nuts when cross pollinated with another variety.



Top Tip

Diversity is the key to consistent macadamia production

A mix of varieties and a range of pollinators will help you obtain a consistently high yield every season.

MIX & MATCH YOUR MACADAMIA VARIETIES

2

Experiments where the pollen from the flowers of one variety are crossed with the flowers on a raceme of another variety produce more and larger nuts than from pollination within a variety (see table over page).

Because cross pollination has been shown to increase final nut set in trees, growing multiple varieties within a block will improve the rate of cross pollination when pollinators are present.

Nuts of different varieties are usually harvested together. This provides opportunity to spread multiple varieties within a block to improve cross pollination.



To improve pollinator performance, it's best to grow a mix of different varieties within the same row in alternating sequence.

Honey bees in particular prefer to move along a row of trees rather than from one row to another, so having different varieties in the same row will increase the amount of pollen moving between varieties.

Choose varieties for planting carefully because cross pollination can only occur between varieties that flower at the same time.



What you need to know

- Cross pollination between compatible macadamia varieties increases nut set
- The right orchard plantings can promote cross pollination
- Insects are the key to good, consistent pollination
- Knowing what is pollinating your crop can protect and enhance pollination
- Having the right number of hives evenly spaced in an orchard is the easiest way to boost pollinator numbers quickly
- Honey bee hives need to be strong and evenly spaced in an orchard so that bees visit all the flowering trees
- Stingless bees can be great pollinators for macadamias if hives are spaced close enough to ensure good flower visitation
- Other beetles and birds can help with pollination

You can improve the pollination rate in an existing orchard by replacing unproductive or incompatible trees with another variety that is compatible.

3 HAND CROSS-POLLINATIONS BETWEEN DIFFERENT MACADAMIA VARIETIES

POLLEN FROM	NUT VARIETY			
	741	DADDOW	A203	A268
246	○○	○○	ND	○○
344	○	○○	○	○○○
741	–	○○	○	○○○
788	○○	○○○	○	○○
816	○○	○○	○	○○○
842	○	○○○	○	○○○
849	○○○	○○○	ND	○
A4	○	○○	○	○○○
A16	○○	○○	○	○○○
A38	○	○	○	–
A203	○○	○	–	○○○
A268	○○	○	ND	–
Daddow	○○	–	ND	○○○
Nuts per raceme in non-crossed racemes (background pollination)	1.0	0.4	1.6	0.5

How to interpret this table

These are examples of hand cross-pollination trials in Bundaberg orchards, showing increased nut set compared to non-crossed racemes.

- moderate increase in nut set
- large increase in nut set
- very large increase in nut set

ND = no difference detected between cross pollinated and open racemes



Nectar foraging bees can transfer pollen from flower to flower, even if they are not directly collecting pollen. The blue powder used in studies shows how bees can move pollen.

4 INSECT POLLINATORS

Cross pollination requires pollen to be moved between different varieties which may be many metres apart.

While some pollen may be carried by wind, insects are far more effective as pollinators because they move directly between flowers.

Low numbers of insect pollinators in macadamia orchards will limit cross pollination and will likely result in sub-optimal yields.

Insect numbers are affected by weather and surrounding habitat, so it helps to know what is happening in your orchard to make the most of their pollination services.

Monitoring insects visiting your flowers will allow you to adjust your strategies to increase the number and consistency of flower visits across your orchard.

For example, if flower visits are low, introducing honey bees and/or stingless bee hives will significantly boost the number of insects visiting flowers.

How to boost pollination

- Plant the right mix of varieties
- Replace old, dying or poor-yielding trees with compatible varieties
- Develop a pollination plan for your orchard
- Get to know your local beekeepers
- Agree to a pollination contract with your beekeeper or stingless bee supplier.

Honey bees

Although pollen gathering honey bees are more likely to contact the stigma directly and fertilise the flower, both pollen and nectar foragers will pollinate macadamia flowers and improve nut set.

The suggested stocking rate for macadamia orchards is five to eight hives per hectare, but you should check to make sure that honey bees are actively foraging on flowers across your blocks. More hives might be needed if there are other crops or native plants in the area that are more attractive to the bees.

It is important to order hives early enough in 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 avoid misunderstandings about what is being supplied, develop a pollination agreement with your beekeeper.



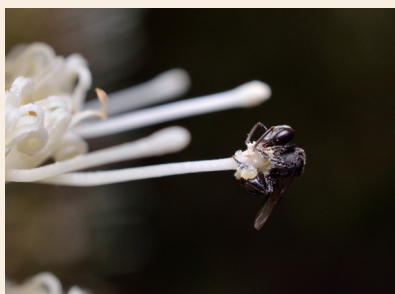
Honey bee pollinating a macadamia flower.

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. Ask your beekeeper to provide strong colonies managed to encourage more pollen collection. Honey bees also need a supply of water, so you need to agree on how this will be provided.

Bees prefer to forage on racemes that are in the sunlight, so careful pruning of trees to open the canopy can increase the number of flowers they visit.

Look for these pollinators on your flowers

- Net winged beetles
- Soldier beetles
- Stingless bees

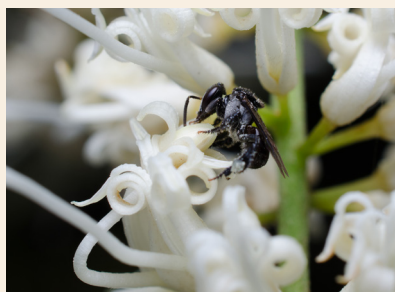


A stingless bee (Tetragonula) pollinating a macadamia flower.

Stingless bees

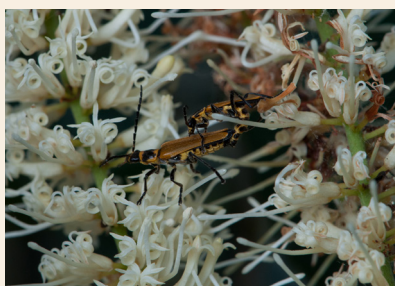
Individual stingless bees are more efficient pollinators than nectar collecting honey bees, but their contribution to pollination in orchards is often limited by the numbers of foraging bees and where the hives are placed.

Preserving local native plants in which stingless bees nest can boost the amount of pollination you can get for free. But if you rely on wild bees you will have less control over the number of bees present. To overcome this natural variability, some beekeepers manage stingless bees in purpose-built hives that can be hired or purchased when needed.



Stingless bee (Tetragonula)

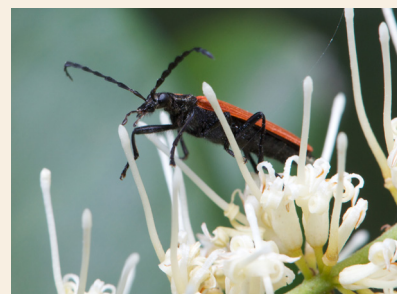
Stingless bees don't fly as far from their hives as honey bees, so their hives need to be put closer together than honey bee colonies. You should look for foraging bees and note where they are throughout the block to decide on the best stocking rate and placement of hives for your orchard.



Soldier beetles pollinating a macadamia flower.

Other pollinators

Beetles, flies and even birds can also contribute to pollination in macadamia orchards.



Net winged beetle pollinating a macadamia flower

If you are lucky enough to have large populations of wild pollinators, make sure that your orchard management practices don't jeopardise pollination.

If you decide to use broad spectrum pesticides just before or during flowering, you may need to add some hives of honey bees afterwards to maintain pollination levels and nut set.

There are no specific management strategies for non-bee pollinators at present, but giving them the right habitat will encourage healthy populations in orchards.

Did you know

.....
Improved cross pollination can increase tree nut set by more than 50 per cent

5 CHECKLIST

DEVELOP A POLLINATION PLAN FOR YOUR ORCHARD

ACTION	YES	NO	COMMENT
Nut set is counted on 10 marked racemes on each of 10 trees and yearly records are maintained to keep track of your levels of pollination			
Hand-crosses are conducted to provide a benchmark of optimum pollination for your orchard's mix of varieties			
New orchards or blocks are established with an appropriate mix and spacing of compatible varieties			
Unproductive trees in single variety blocks are replaced with compatible cross varieties			
Orchard staff can identify common flower-visiting insects (between 10 am and 2 pm when warm and sunny)			
Weekly counts of pollinator numbers are conducted during flowering: walk around 10 fully-flowering trees and count all visible pollinators			
Decide whether the introduction of more honey bees or stingless bees to your orchard is required (if your pollinator activity on flowers is lower than four honey bee equivalents per tree per minute).			
Where dependence on unmanaged pollinators (>50% of flower visitors) is identified, plans are developed to protect or enhance these populations			
Canopies are pruned to increase light penetration to racemes to promote flowering and increase insect pollinator activity			

HIVE MANAGEMENT

ACTION	YES	NO	COMMENT
Pollination agreements are drawn up with beekeepers to detail responsibilities and hive strengths (more than 30,000 bees per hive)			
Honey bee hives are placed in small groups evenly spaced through the orchard, at an initial stocking rate of between 5-8 hives per hectare			
Stingless bee colonies are distributed evenly at closer distances than honey bee colonies, and numbers are increased if required based on pollinator counts			
Beekeeper has provided evidence of compliance with the Australian Honey Bee Industry Biosecurity Code of Practice			



Australian Macadamia Society

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

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

Department of Agriculture and Food (2006) *Bee pollination benefits for nut crops*

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

Funded by the Hort Frontiers Pollination Fund, part of the Hort Frontiers strategic partnership initiative developed by Hort Innovation, with co-investment from pollination reliant industries and contributions from the Australian Government.