A macadamia's best friend

ANYONE with a passion for macadamias may suspect that these crunchy golden kernels don't actually grow on trees. Due to their relative scarcity, it takes more than peanuts to buy them.

But grow on trees they do. And one of the keys to coaxing more nuts from each tree lies in lifting the efficiency of their pollination. For this to be achieved, someone must become intimately acquainted with the trees' most frequent flower visitors: bees.

Entomologist Dr Tim Heard has spent endless hours observing the behaviour of bees in macadamia orchards from Gympie in southern Queensland to Bowraville in northern New South Wales. Most of these orchards fall within the natural geographic range of the macadamia tree (*Macadamia integrifolia*) which originates in eastern Australia's subtropical coastal forests.

The macadamia has a generalist mode of pollination. This means it has not coevolved with any particular pollinator species. As a result it has a broad diversity of flower visitors.

In a study of 15 macadamia orchards, Heard observed four species of birds and 55 species of insects visiting macadamia flowers. Most of these species, however, were just passing through. The real macadamia lovers are the introduced honey bee *Apis mellifera* L. and the stingless bee *Trigonia carbonaria* Smith, a native of Australia's north-east coast. Between them these two species made up 96% of all floral visits.

Tim Heard

The stingless bee, *Trigonia carbonaria* Smith: an important pollinator of the macadamia tree.

Heard began his bee research eight years ago with the University of Queensland's Department of Entomology. At that time studies in Hawaii, where stingless bees do not occur, had shown that honey bees can increase macadamia yields. But the efficiency of the stingless bee as a pollinator and hence its role in increasing nut set had not been investigated.

To assess the performance of *T. carbonaria*, Heard designed an field experiment that compared the nut set of openly-pollinated macadamia flowers with those visited only by stingless bees.

The trial revealed that although honey bees and stingless bees interact with macadamia flowers in different ways, both are effective pollinators. Macadamia growers can therefore benefit by luring greater numbers of both species to their orchards.

How they behave

'To be efficient, a pollinator must acquire pollen and deposit it in a viable state on the receptive stigma of flowers,' Heard says. 'On macadamia flowers, stingless bees mainly collect pollen and honey bees mainly collect nectar.

'Pollen-collecting stingless bees land on the raceme (flower-bearing stem), then climb to the tops of the styles and gather the pollen deposited there. In doing so, they come into contact with the stigma.

'The activity of nectar-collecting honey bees is focused at the base of the flowers, but because of their relatively large size, they often come into contact with the pollen clumps on the sides of the stylar tip and occasionally into direct contact with the stigma. They also collect pollen incidentally while grooming.'

Both honey bees and stingless bees were also found to engage in a furtive practice known as 'floral robbing'. Robbing visits have little chance of resulting in pollination as the stigma of an opening flower is still covered by the anthers. Further, the stigma will not be receptive for another few days.

Through this and other studies, Heard and his colleagues have gained knowledge of bee behaviour that can be applied in practical ways to enhance production in macadamia orchards.

For example, the abundance of stingless bees is known to depend on the extent of natural vegetation surrounding orchards. Preserving this vegetation can therefore enhance pollination and nut set, thus boosting yields. Orchardists in extensively-cleared areas can achieve a similar effect by introducing hives to the area. This is called managed crop pollination.

Heard's studies have helped growers to adopt efficient managed-pollination practices. His research into how weather affects the flight activity of stingless bees has enabled the prediction of where and when hives should be transported, and of whether the bees' activity will correspond to flowering in crops that adjoin areas of natural vegetation. He has also developed a method for transferring natural colonies of stingless bees into boxes for managed pollination.

Heard is now working on plant and insect interactions of a different kind with CSIRO's Division of Entomology. He is studying the behaviour of herbivorous insects that are potential biocontrol agents in order to better understand host specificity. This project has taken him to Mexico in search of biocontrol candidates. Let's hope that back in Gympie his bee research is bearing fruit.

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More about bees

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