

The potential role of stingless bees in mango pollination

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Stingless bees (Hymenoptera: Apidae) are eusocial bees (Michener, 2000) and closely related to honeybees, bumble bees, carpenter bees and orchid bees (Roubik, 1989). There are over 500 species of stingless bees worldwide, belonging to 36 genera, found in most tropical and subtropical parts of the world; including Africa, Australia, Southeast Asia and tropical America (Michener, 2000). Stingless bees are common flower visitors to at least 90 crop species and have been reported as effective pollinators of nine cultivated food and fruit crops, including mango (Heard, 1999). They can be one of the most common mango flower visitors (Willcox *et al.*, 2019; Anderson *et al.*, 1982) and are the only bees, other than honeybees, that can be effectively managed in hives and deployed into mango crops in tropical regions.

Mango (*Mangifera indica* L.) is one of the most widely grown and important fruit crops worldwide (FAOSTAT, 2018). A typical mango tree has hundreds of pyramidal panicles, which can grow up to 30 cm long and produce thousands of tiny flowers of about 5-10mm in diameter (Figure 1a & b). Mango has two types of flowers: male (staminate) and hermaphrodite (or perfect) flowers (Figure 1c). The flower sex ratio varies between cultivars, environmental conditions and even among trees of the same cultivar (Ramírez & Davenport, 2016). The importance of insects in mango pollination has frequently been

demonstrated and a number of insects, including different species of honeybees, stingless bees and flies, frequently visit mango flowers (Ramírez & Davenport, 2016; Huda *et al.*, 2015; Dag & Gazit, 2000).

The European honeybee, *Apis mellifera* Linnaeus, is considered an effective mango pollinator in some parts of the world; however, in many countries, it often plays a negligible role in mango pollination and only visits mango flowers occasionally (Ramírez and Davenport, 2016). Native stingless bees and/or flies are reportedly more effective pollinators than honeybees in Australia (Willcox *et al.*, 2019; Anderson *et al.*, 1982), India (Reddy, 2010) and some other countries (Huda *et al.*, 2015; Sung *et al.*, 2006).

Our research at Western Sydney University focuses on investigating the pollination efficiency of stingless bees and other wild pollinators in mangoes. In 2019, we performed floral visitor surveys on plantations of cv. Kensington Pride mangoes at eight field sites in the Northern Territory (NT), Australia. Our surveys show that a stingless bee, *Tetragonul amellipes* (Friese), is the dominant flower-visiting insect, followed by a hoverfly, *Mesembrius bengalensis* (Wiedemann), and then blowflies, *Chrysomya* sp. (Singh *et al.*, 2019).

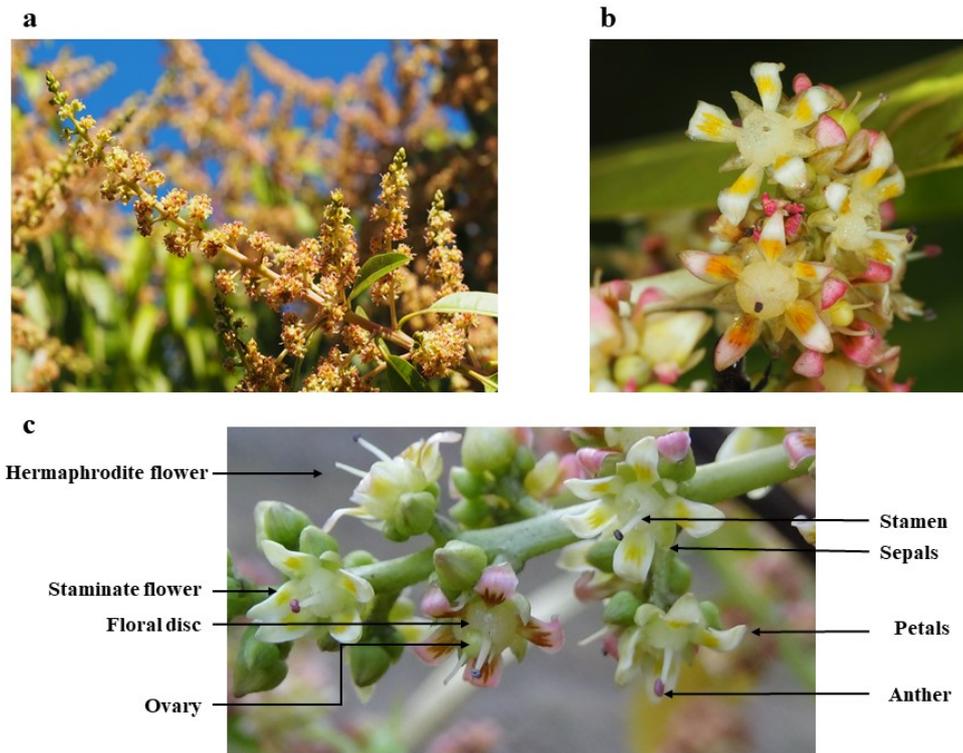


Fig. 1. Typical structure of a panicle (a) and flower (b) and, different types of flowers and floral morphology (c) of Kensington Pride mango variety (Photo: James Makinson and Gaurav Singh)

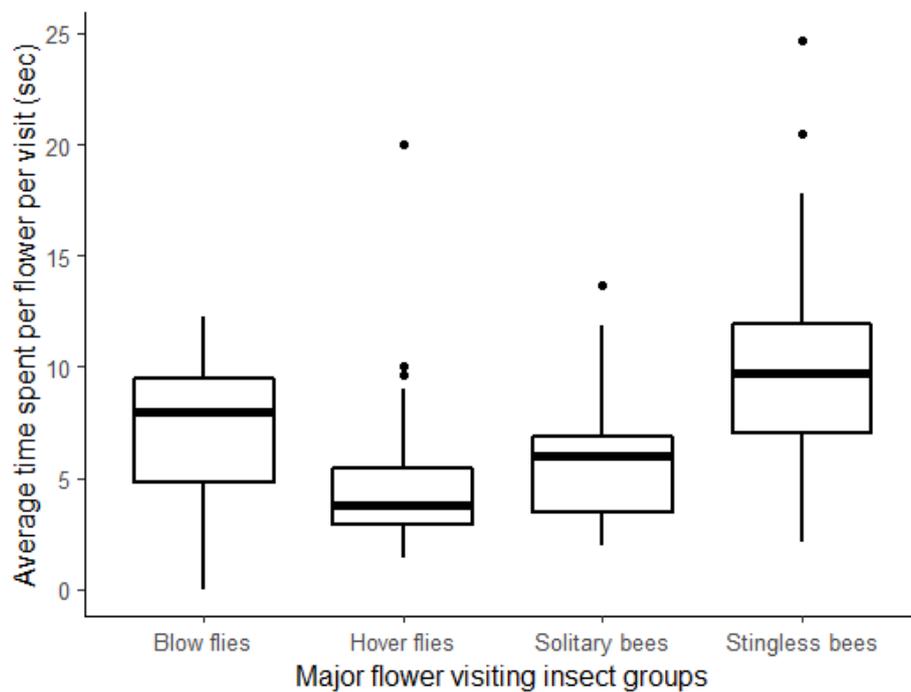


Fig. 2. Average time spent per flower by major floral visitors in mango orchards

Stingless bees actively forage for both nectar and pollen and spend more time on mango flowers than flies and honeybees (Figure 2). Owing to their small size, stingless bees fit completely in the middle of a mango flower (Figure 3) and repeatedly walk around and across the flowers with their abdomen and legs actively contacting the flower's reproductive parts. Stingless

bees carry pollen grains distributed widely over their bodies and deposit more pollen grains per single visit compared to other pollinators (Willcox *et al.*, 2019; Anderson *et al.*, 1982). Surprisingly, only a few *A. mellifera* visits were recorded during our surveys at any of the eight farms in the NT, which suggests that mango flowers are not a first-choice food for honeybees.



Fig. 3. A stingless bee, *Tetragonula mellipes* on a mango flower (Photo: James Makinson)

Our observations show that stingless bees frequently visit mango flowers in the NT of Australia, but occur in low numbers towards the centre of orchard blocks of trees. Therefore, moving stingless bee hives into the mango crop is likely to increase their abundance and ability to provide pollination services across the orchards, potentially increasing the productivity of mango farms.

Acknowledgements:

“Stingless bees as effective managed pollinators for Australian horticulture” is funded by the Hort Frontiers Pollination Fund, part of the Hort Frontiers strategic partnership initiative developed by Hort Innovation, with co-investment from

Syngenta Asia-Pacific, OLAM International, Western Sydney University, Griffith University and contributions from the Australian Government.

We would like to express our sincere thanks to the staff and management of Cheeky Farms, Jenko's Mangoes, Skliros Produce, Tou's Garden Pty Ltd, Manbullo Ltd, and PTA Docking Pty Ltd, for allowing researchersto work and stay on their properties.

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