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RESEARCH NOTE

Do ants pollinate cashew flowers? An observation on flower damage and nectar thieving by *Crematogaster subnuda* Mayr.

[1*]K. VANITHA, [2]HIMENDER BHARTI,[1] T.N. RAVIPRASAD, [1]H. RAJASHEKARA and [1]G.L. VEENA

[1]ICAR- Directorate of Cashew Research, Puttur, Karnataka, India
[2]Punjabi University, Patiala, Punjab, India

***E-mail:** vanis102@gmail.com

ABSTRACT: Ant-plant associations are greatly diverse leading to mutualistic and/or antagonistic interactions between them. In general, ants are considered as minor pollinators. Ant pollination is rare and restricted to a few plant species. The cashew trees are consistently visited by diverse species of ants. During a survey in the cashew plantations, damage to the reproductive parts of cashew flowers was observed and the ants were noticed in such damaged flowers. This document presents details about nectar thieving by *Crematogaster subnuda* in the cashew flowers and the damage caused to the reproductive parts.

Keywords: Crematogaster, cashew, flowers, nectar

The cashew (*Anacardium occidentale* L.) is an important tree nut crop and is cross-pollinated. Cashew is visited by plenty of ant species throughout its different phenological stages and 49 species have been recorded by Vanitha *et al*. (2015). Ants can be seen on trunk, leaves, shoots, nuts and fruits (cashew apples) and even in fallen rotting apples. Ant species are chiefly attracted to the extra floral nectarines (EFN) present on cashew leaves, shoots, flowers and developing nuts (Rickson and Rickson, 1998). Some predatory species are also recorded on cashew (Peng *et al.*, 2014, Vanitha *et al*., 2015, Mohapatro *et al*., 2015). According to earlier reports, the role of ants as pollinators is speculative as ants move to the base of flowers and buds for the EFN and rarely touches the reproductive parts of the flowers (Bhattacharya, 2004). Ants crawl continuously on the flowers making them unattractive to the foraging bees and are assumed to feed on pollen fluids causing pollen damage and non-viability (Bhattacharya, 2004). However, during the recent floral observations at ICAR-DCR, we noticed the damage on the reproductive floral parts (absence of stamens and style) with the ants in such damaged flowers. Thus, this present investigation was carried out to document the flower damage and nectar thieving by *Crematogaster subnuda* Mayr.

In an experimental plot of ICAR-DCR, Puttur, a total of 98 cashew trees (9 years old) were observed for the presence of ants during March-May 2024. The ant species observed on the trees especially on the flowers were recorded. Insecticidal sprays were avoided in the plot during the observation period. The trees having damaged flower parts were tagged (N=10), and in each tagged tree, five inflorescences were labelled and observed for the activity of ants on cashew flowers at fortnight intervals. A total of 50 inflorescences were observed at fortnight intervals. The number of damaged flowers was recorded twice a day i.e., once at 11.30 am (when an thesis of majority of the male and hermaphrodite flowers had occurred) and at 3.30 pm to have complete data on damaged flowers and the extent of flower damage. The nut set was recorded in those inflorescences and also in the other trees where floral damage was not present.

A total of 1310 fresh flowers were observed during the study. The common ant species noticed on the cashew flowers during the observation include *Anoplolepisgracillipes* (Smith), *Camponotus compressus* (Fab.), *Tapinoma melanocephalum* (Fab.) and *Crematogaster* spp. Majority of these ants were seen foraging on EFNs present on cashew leaves, shoots, flowers and tender nuts. The ant species causing damage to the cashew floral parts was determined as *Crematogaster subnuda* Mayr. using the morphological keys (Fig. 1c-insert). ***C. subnuda*** is a common acrobat ant widely distributed throughout India (Bharti ***et al***., 2016). This species is bright chestnut red coloured (3 to 3.5 mm in length) with the heart shaped gaster, dark or nearly black in colour, it raises its gaster high up vertically in the air while foraging hence known as cocktail ants. Out of 94 cashew trees observed, *C. subnuda* was present only in 10 trees (10.6 %); and in two such trees, the ants were

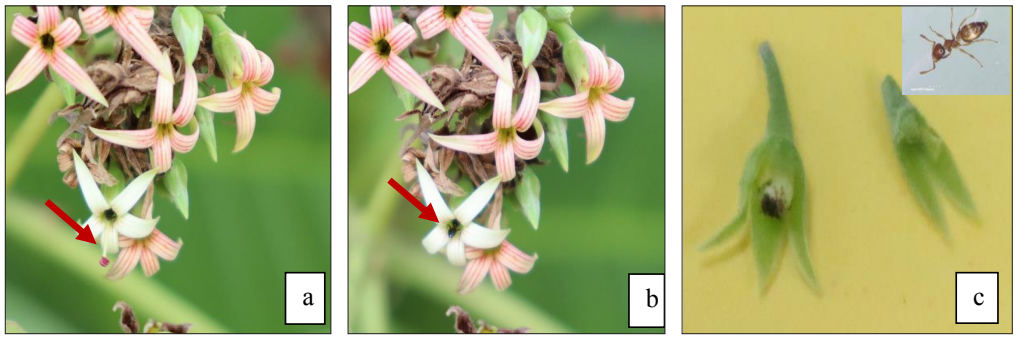

Fig. 1. *C. subnuda* damage in cashew flowers a. long stamen seen in a male flower (arrow) with ant inside, b. long stamen severed in same flower c. dissected damaged male (right) and hermaphrodite flowers (left) showing damaged stamens and style, insert- *C. subnuda*

seen entering into the dried sticks which might be their nests. In the two trees seen with *C. subnuda* nests, 25 and 37 percentage of inflorescences were without damage by *C. subnuda*. As per the report of Galen (1983), more than 25% damage by *Formica neorufibaris gelida* was noticed in the flowers of *Polemonium viscosum* Nutt. *C. subnuda* did not touch the anthers of long stamen, but entered inside and started chewing the base of the stamens in male flowers and stamens and style in hermaphrodite flowers throwing out the chewed floral parts (Fig. 1a, b and c).

Similar observation on severing the base of style or chewing through the ovary during nectar foraging has been reported in *P. viscosum* by *F. n. Gelida* (Galen, 1983). The percentage of fresh flowers damaged by the ants in an inflorescence ranged between 25 and 100 % indicating severity of the damage (N=200). The damage was more on male flowers (74.46 % of the total male flowers) compared to hermaphrodite flowers (47.26 % of the total hermaphrodite flowers). The extent of damage observed at fortnight intervals from March to April indicated the percentage of damaged flowers was higher in the afternoon hours (Fig. 2).The buds were also damaged by these ant species but only to the extent of less than 0.5 %. Due to damage by ants, the flowers dried away subsequently. It was noticed that the damaged flowers were subsequently visited by the ants, sometimes even on second or third day of opening indicating that foraging reward of *C. subnuda* is nectar and not the pollen grains.

An ant spent approximately around 2.87±0.68 minutes/flower during its first visit to fresh flower, and during subsequent visit to the same flowers, the time spent was 0.89 ±0.39 minutes/ flower (Table 1). A maximum of 4.21 minutes was spent in a fresh flower by an ant. The nut set in the inflorescences where *C. subnuda* was present was significantly less (0.86) compared to 2.07 in the inflorescences without damage of ants ($P<0.005$).

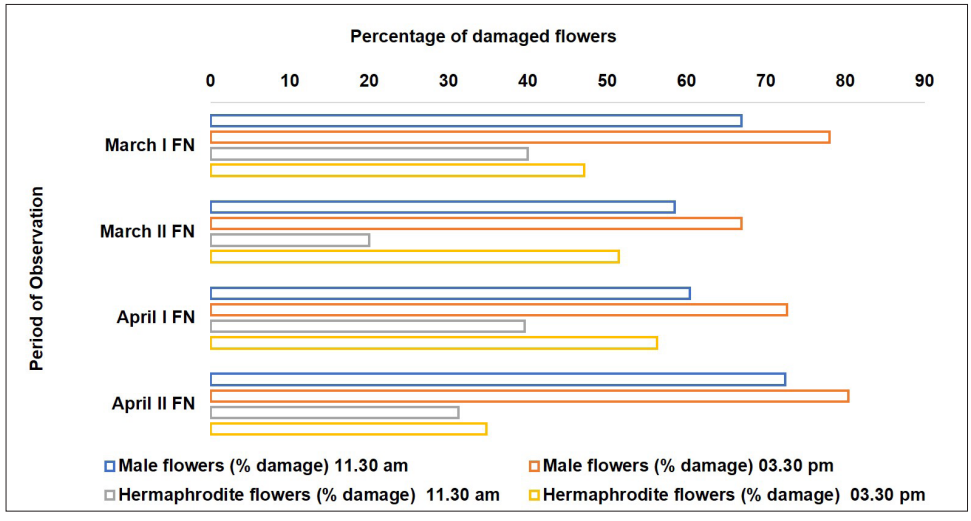

Fig.2. Extent of damaged male and hermaphrodite flowers in morning (FN) and evening (AN) hours in tagged inflorescences, I- first fortnight, II- second fortnight

Additionally, it was observed that the foraging activity of bee species was very less in the inflorescences where *C. subnuda* were present (0.2 bees/10 inflorescences/5 min) compared to other trees (0.6 bees/10 inflorescences/5 min) which could be due to lower foraging reward available to the bees due to damage by ants leading to poor pollination and nut set in those inflorescences. Ants generally repel pollinators by their aggressive nature (Junker *et al*., 2010). There are several evidences to show that ants behave as floral nectar thieves and disrupts plant-pollinator mutualism (Cembrowski *et al*., 2014, Hanna *et al*., 2015, Sinu *et al*., 2017).

Table 1: Time spent/ flower by *C. subnuda* and nut set in cashew

Details of activities	Mean ±SEM
Mean time spent on a fresh flower by *C. subnuda*	2.87 ±0.68 minutes
Mean time spent on a fresh damaged flower by *C. subnuda* in subsequent visits	0.89 ±0.39 minutes
Nut set/inflorescence in trees with *C. subnuda*	0.86 ±0.74 No.
Nut set/inflorescence in trees without *C. subnuda* but with other ant species	2.07 ±1.28 No.

These observations on nectar thieving by *C. subnuda* in the cashew flowers emphasize on monitoring and documentation of different ant species and their role for better understanding of ant-cashew relationship. Ants can threaten cashew-bees mutualism and thus understanding the factors influencing pollination will aid in implementing better management measures.

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