

Research articles

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Field recovery of *Anagyrus lopezi* (De Santis) (Hymenoptera: Encyrtidae), an introduced parasitoid of cassava mealybug, with a note on its hyperparasitoids from Tamil Nadu, India**J. Poorani^{1*}, J. Diraviam², B. Tamilselvan² and R. Thanigairaj¹**¹ICAR-National Research Centre for Banana, Thogamalai Road, Thayanur Post, Tiruchirappalli 620 102, Tamil Nadu, India²ICAR-Krishi Vigyan Kendra, Pulutheri, R.T. Malai Post, Kulithalai, Karur district 621 313, Tamil Nadu, India**Corresponding author: pooranij@gmail.com**

Cassava mealybug, *Phenacoccus manihoti* Matile-Ferrero (Hemiptera: Pseudococcidae) is the most dreaded pest of cassava worldwide and it was first reported from Kerala, India in April 2020 (Joshi *et al.* 2020) and soon after found on a larger scale in the cassava growing areas of Tamil Nadu (Sampathkumar *et al.* 2021). *Anagyrus lopezi* (De Santis) (Hymenoptera: Encyrtidae), a specific endoparasitoid of *P. manihoti* of South American origin, has proved to be highly effective in managing *P. manihoti* in more than 25 countries in sub-Saharan Africa (Herren & Neuenschwander 1991) and Thailand in Southeast Asia (Wyckhuys *et al.* 2019). In fact, it is considered to be one of the most outstanding and successful parasitoids ever used in the history of classical biological control of introduced pests. In India too, *A. lopezi* was introduced in August 2021 by the ICAR-National Bureau of Agricultural Insect Resources, Bangalore, in collaboration with

the International Institute of Tropical Agriculture (IITA), Republic of Benin. After completion of the mandatory quarantine studies on its biology, safety and host specificity, open field releases of the parasitoid were done in cassava farmers' fields in Tamil Nadu in March 2022 (ICAR, 2022).

Severe infestation of *P. manihoti* was noticed in cassava fields in Karur District, Tamil Nadu, in April-May 2022. In a Frontline Demonstration on cassava mealybug management, ICAR-Krishi Vigyan Kendra, Pulutheri, Karur District, procured about 600 parasitoids from Tapioca and Castor Research Station (TNAU), Yethapur, and released the wasps on 26.5.2022 in three cassava fields at Semparaipatti Village (Pothuravuthanpatti Panchayat, 10.7927° N, 78.3193° E) and two fields at Valayalkaranpudur Village (Renganathapuram South Panchayat, 10.9223°N, 78.1928°E), in Krishnarayapuram

Block, Karur District. Here we report the establishment of *A. lopezi* in the site of release in Karur District, Tamil Nadu, based on field recovery of the parasitoids.

The parasitoid was recovered from the original site of release at Semparaipatti (Latitude 10.788452° Longitude 78.318769°) in fairly large numbers on August 18, 2022 (Fig. 1). Totally 870 adults of *A. lopezi* (Fig. 2a–c) were collected from parasitized mealybug samples of which 425 were females and 445 were males. The sex ratio was slightly skewed in favour of males and males (51.15%) outnumbered females (48.85%). Large number of mummified mealybugs were also recovered.

It indicated that the parasitoid had established well in the areas of release within a fairly short period of about three months. Four hyperparasitoids, *Prochiloneurus pulchellus* Silvestri (Fig. 2d), *Prochiloneurus albifuniculus* (Hayat *et al.*) (Fig. 2e), *Prochiloneurus aegyptiacus* (Mercet) (Fig. 2f) (Hymenoptera: Encyrtidae) and *Promuscidea unfasciativentris* (Girault) (Hymenoptera: Eriaporidae) (Fig. 2g), were also reared from the mealybug mummies. Totally 88 numbers of hyperparasitoids emerged from the mummified mealybugs. Of these, *P. aegyptiacus* (59.09% of the total hyperparasitoids collected) and *P. pulchellus* (14.78%) were more predominant than *P. unfasciativentris* (22.73%) and *P. albifuniculus* was the least collected hyperparasitoid (3.41%). All these four are

widely distributed in India. *Promuscidea unfasciativentris* is probably the most common hyperparasitoid of mealybug parasitoids in Indian conditions and it is widely distributed in the Oriental and Afrotropical regions. *Prochiloneurus aegyptiacus*, *P. albifuniculus* and *P. pulchellus* are hyperparasitoids of primary mealybug parasitoids through their hosts such as *Paracoccus marginatus* Granara de Willink, *Coccidohystrix insolita* (Green), *Phenacoccus solenopsis* Tinsley, *Nipaecoccus* spp. and several other mealybugs in India (Hayat, 2006; unpublished data). Two eulophids (*Tetrastichus* sp. and *Aprostocetus* sp. nr. *purpureus* (Cameron)) also emerged from the tangled masses of cassava mealybug in large numbers but their precise role / hosts could not be ascertained.

Agricola & Fischer (1991) reported five hyperparasitoids of *A. lopezi* from Togo, including *Chartocerus* sp. (Signiphoridae), *Prochiloneurus insolitus* and *P. aegyptiacus* (Encyrtidae), *Tetrastichus* sp. (Eulophidae) and *Marietta leopardina*. Neuenschwander *et al.* (1987) reported ten species of hyperparasitoids reared from *A. lopezi* in Nigeria, with *Prochiloneurus* spp. and *Chartocerus* spp. being the most common. In the Universal Chalcidoidea Database, *Prochiloneurus bolivari* Mercet, *P. pulchellus* Silvestri, *P. aegyptiacus* and *P. insolitus* are listed as hyperparasitoids of cassava mealybug in Africa (Noyes 2019).

Interestingly, the population of indigenous predators like *Hyperaspis maindroni* Sicard and chrysopids was low in the mealybug samples collected from the areas of parasitoid release, possibly due to competition for the common food source. No other species of mealybug was found on the cassava plants from which sampling was done and all the hyperparasitoids reported here were associated with *A. lopezi* only. Until now, hyperparasitoids of *A. lopezi* have not been documented from India after its field release. The hyperparasitoids recorded in this study are

among the most commonly collected in association with various mealybugs in India.

Prochiloneurus aegyptiacus and *P. pulchellus* have been already recorded as hyperparasitoids of *A. lopezi* through cassava mealybug in Africa (Noyes, 2019) but *Prochiloneurus albifuniculus* and *Promuscidea un fasciati ventris* appear to be new associations for this host. At present, the extent of hyperparasitism is low and it is unlikely to have any significant adverse effects on the field efficacy of *A. lopezi* against cassava mealybug.



Fig. 1. Clockwise from top: a, b. Mummified cassava mealybugs; c. *Anagyrus lopezi* adults collected from parasitized cassava mealybug samples.

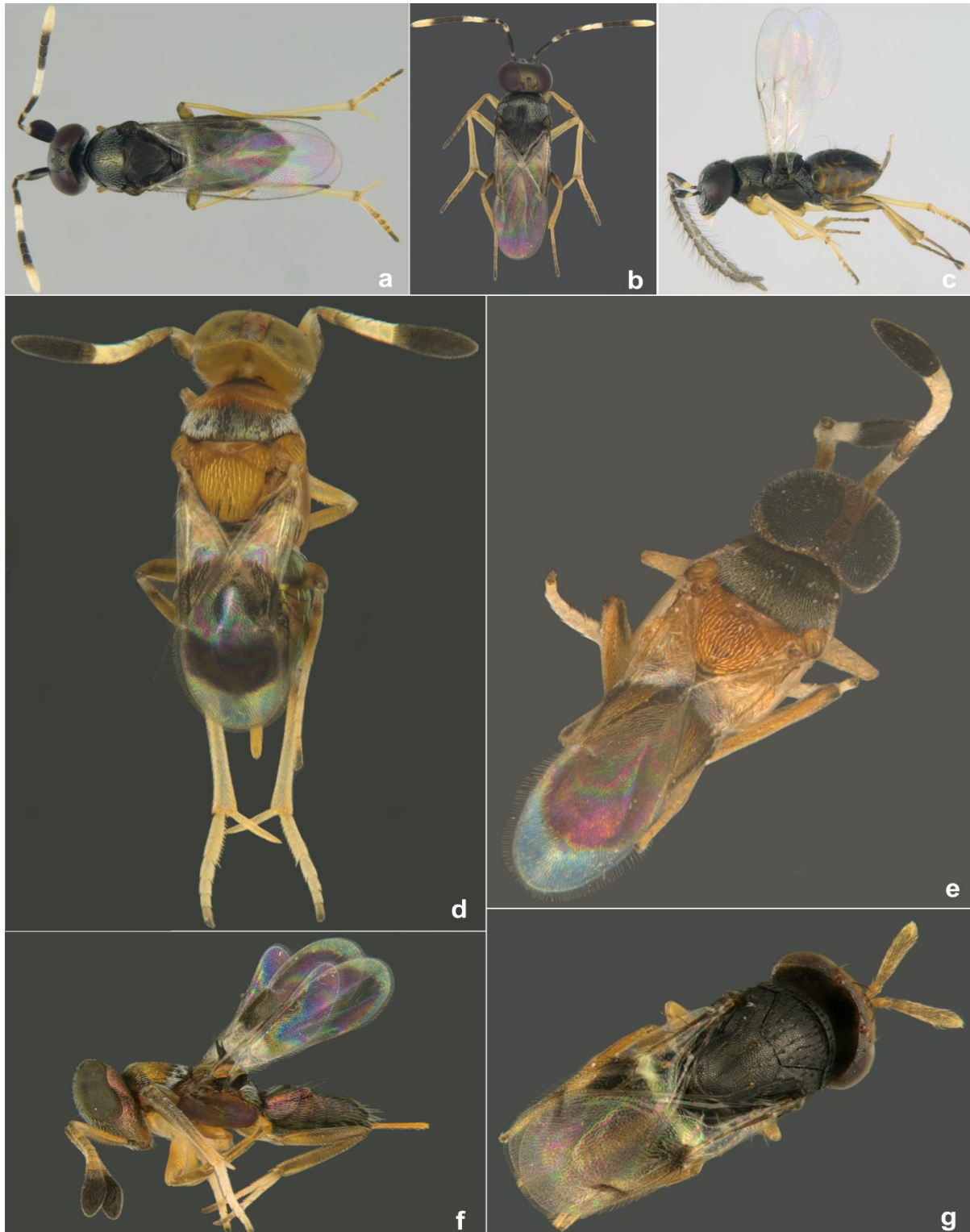


Fig. 2. *Anagyrus lopezi* and its hyperparasitoids: a, b. *Anagyrus lopezi*, female; c. *Anagyrus lopezi*, male; d. *Prochiloneurus pulchellus* Silvestri, dorsal view; e. *Prochiloneurus albifuniculus* (Hayat *et al.*), dorsal view; f. *Prochiloneurus aegyptiacus* (Mercet), lateral view; g. *Promuscidea unfasciiventris* (Girault), dorsal view.

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