



## Notes on diagnosis and biology of *Aenasius bambawalei* Hayat (Hymenoptera: Encyrtidae), a parasitoid of the invasive mealybug, *Phenacoccus solenopsis* Tinsley (Hemiptera: Sternorrhyncha: Pseudococcidae)

J. POORANI, S. K. RAJESHWARI and ANKITA GUPTA

National Bureau of Agriculturally Important Insects, Post Bag No. 2491, H.A. Farm Post, Bellary Road, Bangalore 560024, Karnataka, India.

E-mail: pooranij@gmail.com

---

**ABSTRACT:** *Aenasius bambawalei* Hayat (Hymenoptera: Encyrtidae), is a specific, solitary endoparasitoid of *Phenacoccus solenopsis* Tinsley, a major invasive pest on cotton in all the cotton growing states in India. This paper provides a short diagnostic description of *A. bambawalei* with illustrations to facilitate easy identification and notes on the biology of *A. bambawalei* on *P. solenopsis* in the laboratory. The mean duration of development of *A. bambawalei* from egg laying to pupation was  $8.85 \pm 0.21$  days and pupation to adult emergence took  $7.35 \pm 0.15$  days in males and  $7.00 \pm 0.16$  in females. The mean total duration of development of *A. bambawalei* from egg laying to adult emergence was  $16.10 \pm 0.25$  days (range 14–18 days). The adults survived for 2–4 days on water, but the mean longevity was considerably enhanced on 50% honey ( $70.95 \pm 2.30$  days in females and  $49.00 \pm 2.35$  days in males). Unmated females produced 100% male progeny. Four hyperparasitoids of *A. bambawalei* were recorded on field collected samples namely, *Prochiloneurus pulchellus* Silvestri, *P. albifuniculus* (Hayat *et al.*), and *P. aegyptiacus* (Mercet) (Hymenoptera: Encyrtidae) and *Promuscidea unfasciiventris* Girault (Hymenoptera: Aphelinidae).

**KEY WORDS:** *Aenasius bambawalei*, *Phenacoccus solenopsis*, diagnosis, biology, hyperparasitoids

---

*Phenacoccus solenopsis* Tinsley (Sternorrhyncha: Pseudococcidae), a mealybug of Nearctic and Neotropical origin, has been a major invasive pest in India and Pakistan since 2005 (Hodgson *et al.*, 2008). It has become a major pest of cotton in all the major cotton growing states of India and is the most predominant mealybug species attacking cotton at present (Nagrare *et al.*, 2009). The pest has been found to feed on several other hosts such as okra, tomato, parthenium, brinjal, tobacco, and sunflower, but causes economic losses in cotton. It is reported to have caused a whopping loss of Rs. 159 crore on cotton in the 2008–09 season in Punjab alone and major losses in other cotton growing States during 2007–08 season (NCIPM, 2008).

A solitary endoparasitoid, *Aenasius bambawalei* Hayat (Hymenoptera: Chalcidoidea: Encyrtidae), apparently introduced along with the host, has been recorded from nearly all the cotton growing states on *P. solenopsis* in 2008–09. This parasitoid was reported first from Pakistan as *Aenasius* sp. nr. *longiscapus* Compere. In India, it

started appearing in northwestern India (NCIPM, 2008; Tanwar *et al.*, 2008) and slowly has spread to all the states in peninsular India, causing moderate to high rates of parasitism. It appears to be specific to *P. solenopsis* and was only recently taxonomically described (Hayat, 2009). In view of its potential to control *P. solenopsis*, a simple diagnostic description of this species with illustrations is given to enable easy identification and notes on its biology on the solenopsis mealybug are provided in this paper.

### Diagnosis of *A. bambawalei*

The parasitoid has been taxonomically described in detail by Hayat (2009). In a recent publication from the National Centre for Integrated Pest Management (NCIPM, 2008), the male of *A. bambawalei* is wrongly illustrated as *Promuscidea unfasciiventris* Girault (Hymenoptera: Aphelinidae), a common hyperparasitoid found in association with *A. bambawalei*. The parasitoid is illustrated here (Figs. 1–9) and brief diagnostic characters are provided for easy identification.

**Diagnostic description**

**Female (Fig. 1)**

Length: 1.50–2.30 mm. Body shiny black with metallic reflections. Head (Fig. 3) with large thimble-like setigerous punctures, each slightly less than diameter of anterior ocellus, smooth and bluish-green, spaces between punctures narrow, reticulate and with bronzy shine, frontovertex broad, about half as wide as head. Thorax (‘mesosoma’) dull metallic bluish green to blackish; propodeum posterior to spiracles with bluish-green shine; abdomen (‘metasoma / gaster’) dark brown with bronzy violet to bluish-green tinge. Antenna (Fig. 6) with radicle black; scape cylindrical, yellowish brown, with a brownish patch in middle, which is often faint or absent; pedicel, funicle segments F1 and F2 black, F3 and F4 pale brownish yellow, F5 and F6 yellowish brown, all funicle segments longer than broad; club dark brown, basally brownish yellow, apically strongly truncate. Fore wings (Fig. 8) basally infusate, distal half and costal cell hyaline; hind wings hyaline. Legs, including coxae, black, except as follows: apices of all tibiae yellowish brown to pale brown; all tarsi and mid-tibial spur yellowish to yellowish brown.

**Male (Fig. 2)**

Length: 1.10–1.50 mm. Differs from the female in its generally smaller size, the sculpture and colour of mesothoracic dorsum, in antennal structure, and fore

Fore wing (Fig. 9) hyaline, venation as in female.

Adult females are noticeably larger than males and can be easily sexed based on size and the antennae.

**Biology of *A. bambawalei* on *P. solenopsis***

*Phenacoccus solenopsis* was reared on potato sprouts in ambient conditions of 27±5°C and 65% RH at the National Bureau of Agriculturally Important Insects (NBAIL), Bangalore. The parasitoid was raised on a pure culture of *P. solenopsis* and the parasitized mealybug mummies were collected and kept individually for emergence. Upon emergence, the parasitoid females were allowed to mate and then exposed to mealybugs of II-III instar or above as the first instar mealybugs are much smaller than the parasitoid and rarely parasitized. Observations on time taken from exposure to pupation, pupation to adult emergence and adult longevity on water and 50% honey were recorded. The time taken from exposure to adult emergence was recorded for each emerging parasitoid and considered as the total duration of development.

The parasitoid was observed to parasitize mealybugs of third instar or above. The mean duration from egg laying to pupation was 8.85±0.21 (range 8-11 days) and the pupal period was 6-8 days (Table 1). Female mummies were found to be noticeably larger than males. The mean total duration

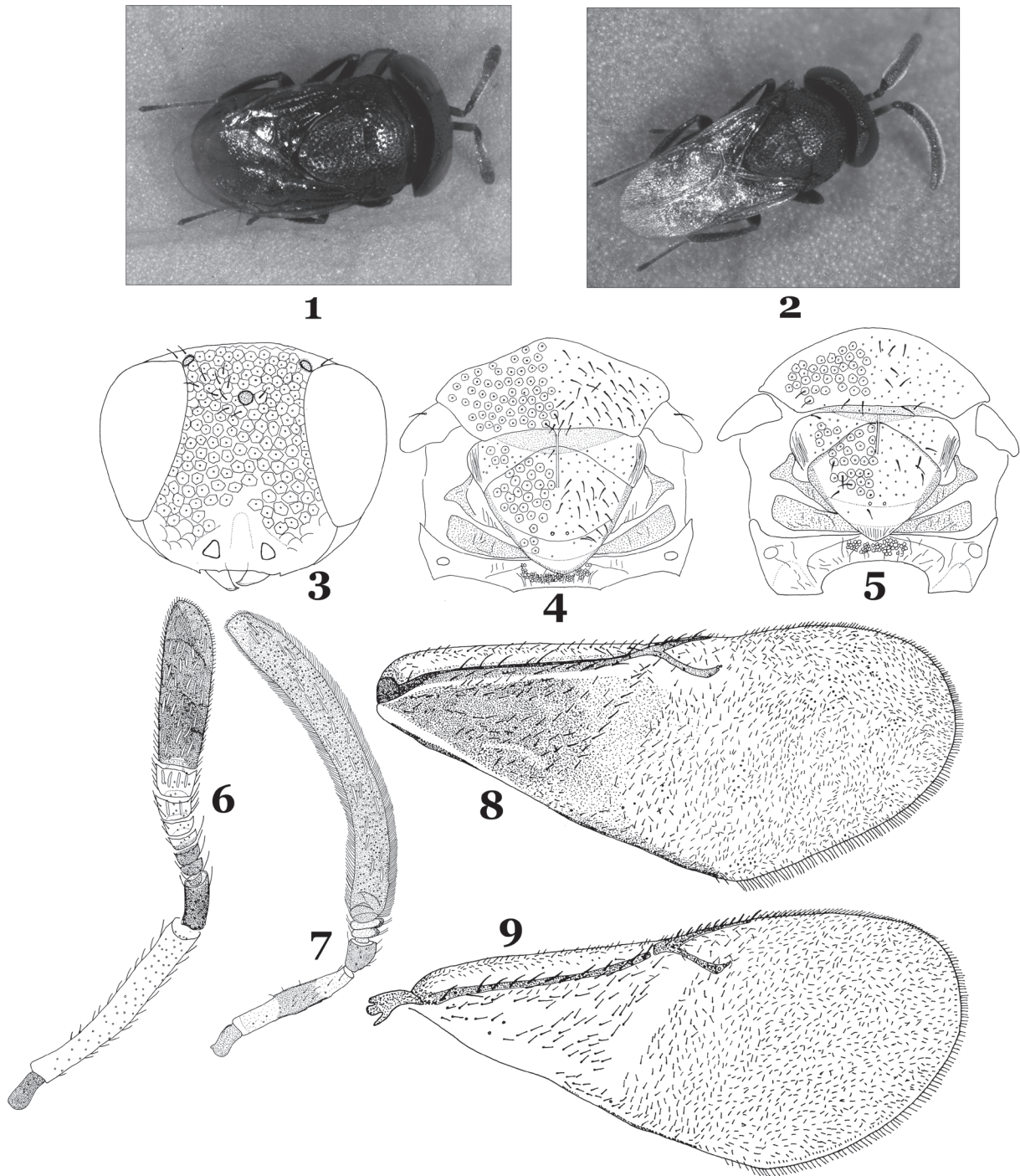
**Table 1. Biological parameters of *Aenasius bambawalei* on solenopsis mealybug**

Stage	Duration (days)	
	Range	Mean±SE
Egg to pupa	8-11	8.85±0.21**
Pupa to adult		
Male	6-8	7.35±0.15**
Female	6-8	7.00±0.16**
Egg to adult	14-18	16.10±0.25**
Longevity on honey (50%)*		
Female	47-86	70.95±2.30*
Male	33-70	49.00±2.35*

\*Mean of 10 individuals; \*\*Mean of 20 individuals

wing venation. Head colour and thimble-like punctures more or less as in female; mesoscutum and scutellum with dark metallic shine; abdomen dark with faint greenish or bronzy shine. Antenna (Fig. 2) dark brown to black; scape cylindrical with a white streak from basal third to apex on ventral side; funicle segments much broader than long, distal two segments short and lodged in a groove at base of club; club single-segmented, long, curved, sausage-shaped.

of development from egg laying to adult emergence was 16.10±0.25 days (range 14-18 days). Adults of both sexes survived for 2-4 days on water. When honey (50%) was provided as adult food, the longevity was considerably enhanced and females lived significantly longer (mean 70.95±2.30 days) than males (mean 49.00±2.35 days). Unmated females were observed to produce all male progeny. *Aenasius vexans* Kerrich, a candidate parasitoid



**Figs. 1-9.** *Aenasius bambawalei* Hayat: 1. Adult female, dorsal view; 2. Adult male, dorsal view; 3. Head, frontal view; 4. Thorax, female; 5. Thorax, male; 6. Antenna, female; 7. Antenna, male; 8. Forewing, female; 9. Forewing, male

used against cassava mealybug, *Phenacoccus herreni* Cox & Williams, has been observed to prefer third instar hosts, with faster development times for males and longer survival of females (Bertschy *et al.*, 2000) as in *A. bambawalei*.

#### Hyperparasitoids of *A. bambawalei*

Four species of hyperparasitoids of *A. bambawalei* were recorded on field collected samples of *P. solenopsis*, namely, *Prochiloneurus pulchellus* Silvestri, *P. albifuniculus* (Hayat *et al.*), and *P. aegyptiacus* (Mercet) (Hymenoptera: Encyrtidae) and *Promuscidea un fasciiventris* (Hymenoptera: Aphelinidae).

*Aenasius bambawalei* appears to be specific to *P. solenopsis*, but recently some specimens purported to have been reared from the papaya mealybug, *Paracoccus marginatus* Williams & Granara de Willink, were received from Coimbatore, Tamil Nadu, for identification. More detailed host-specificity tests need to be carried out to determine the host range of *A. bambawalei*.

*Aenasius bambawalei* appears to be a very good candidate for augmentative releases in nearly all the cotton growing states of India in view of the ease of mass production and high adult longevity. Besides *A. bambawalei*, another species, *A. advena* Compere, is commonly found parasitizing several mealybug pests in India. Hence, care must be taken before introducing *Aenasius phenacocci* (Ashmead), a candidate being considered for introduction against the solenopsis mealybug, in view of the potential for competitive interactions between these species.

#### ACKNOWLEDGEMENT

This work was carried out under the Network Project on Insect Biosystematics funded by the Indian Council of Agricultural Research, New Delhi.

#### REFERENCES

- Bertschy, C., Turlings, T. C. J., Bellotti, A. and Dorn, S. 2000. Host stage preference and sex allocation in *Aenasius vexans*, an encyrtid parasitoid of the cassava mealybug. *Entomologia Experimentalis et Applicata*, **95**: 283–291.
- Hayat, M. 2009. Description of a new species of *Aenasius* Walker (Hymenoptera: Encyrtidae), parasitoid of the mealybug, *Phenacoccus solenopsis* Tinsley (Homoptera: Pseudococcidae) in India. *Biosystematica*, **3**: 21–26.
- Hodgson, C., Abbas, G., Arif, M. J., Saeed, S., and Karar, H. 2008. *Phenacoccus solenopsis* Tinsley (Sternorrhyncha: Coccoidea: Pseudococcidae), an invasive mealybug damaging cotton in Pakistan and India, with a discussion on seasonal morphological variation. *Zootaxa*, **1913**: 1–35.
- Nagrare, V. S., Kranthi, S., Biradar, V. K., Zade, N. N., Sangode, V., Kakde, G., Shukla, R. M., Shivare, D., Khadi, B. M. and Kranthi, K. R. 2009. Widespread infestation of the exotic mealybug species, *Phenacoccus solenopsis* (Tinsley) (Hemiptera: Pseudococcidae), on cotton in India. *Bulletin of Entomological Research*, Published online by Cambridge University Press 19 Feb 2009 doi:10.1017/S0007485308006573.
- NCIPM, 2008. Record of new parasitoids on mealybug, *Phenacoccus solenopsis*. NCIPM Newsletter, **14**: 2.
- Tanwar, R. K., Bhamare, V. K., Ramamurthy, V. V., Hayat, M., Jeyakumar, P., Singh, A. and Bambawale, O. M. 2008. Record of new parasitoids on mealybug, *Phenacoccus solenopsis*. *Indian Journal of Entomology*, **70**: 404–405.

(Received: 31.10.2009; Revised: 16.11.2009; Accepted: 26.11.2009)