



First record of *Brachymeria excarinata* Gahan, 1925 (Hymenoptera: Chalcididae) as a hyperparasitoid of *Charops bicolor* (Szepligeti, 1906) (Hymenoptera: Ichneumonidae) from India

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Abstract The parasitoid species, *Brachymeria excarinata* Gahan, 1925 (Hymenoptera: Chalcididae) is recorded for the first time from rice growing areas of India as hyperparasitoid of *Charops bicolor* (Szepligeti, 1906), a larval parasitoid of paddy yellow stem borer (YSB) *Scirpophaga incertulas* (Walker). Diagnostic characters supported with photographs have been included for identification of both parasitoid and hyperparasitoid of *S. incertulas*.

Keywords *Brachymeria excarinata* · *Charops bicolor* · Hyperparasitoid · Paddy

Rice production experiences approximately 25% yield loss every season due to insect pests in India [5]. Among them stem borer (*Scirpophaga incertulas*), is the most widespread and serious pest infesting rice plants from seedling stage to maturity causing dead hearts at vegetative stage and white heads at flowering and maturity stages. To control this monophagous pest, many synthetic insecticides are available; however, they pose serious environmental risks causing pest resistance. In this context biological control is the most logical, economical, and environmentally sound pest management strategy. The search for suitable and sustainable alternatives like bioagents which are highly specific to the target pest are imperative. Gupta and Maheshwary [6] first time reported the larval parasitoid *Charops bicolor* parasitizing the rice yellow stemborer from India and is a

well-known larval parasitoid of YSB in the paddy growing areas. Rao et al. [12] reared *C. bicolor* from the rice skipper, *Pelopidas mathias* Fabricius. This was also reported from the same host by Daniel and Ramaraju [4].

Genus *Brachymeria* Westwood (Hymenoptera: Chalcididae) are known to be a primary parasitoids of different families of Orthoptera, Lepidoptera, Homoptera, Coleoptera, and Diptera and also found to be hyperparasitizing few families of Hymenoptera and Diptera [8]. This genus is worldwide in distribution with 200 species including 71 species from the Oriental region [7]. Joseph et al. [8] published a monograph on Oriental *Brachymeria* in which a few rice pests were included as hosts of several *Brachymeria* sp. Three species of genus *Brachymeria* have been recorded as exclusively pupal parasitoids of paddy leaf folder worldwide [1, 3, 9, 10, 13] and [11].

Extensive surveys were conducted in major rice growing areas of Odisha (ICAR-National Rice Research Institute), Andhra Pradesh (Srikakulam) and New Delhi (ICAR-Indian Agricultural Research Institute), India during 2017–2021. Serious incidence of *S. incertulas* was observed both during Kharif and Rabi seasons. Dead hearts were brought to the laboratory and dissected for the parasitized larvae of yellow stem borer. The larvae were then kept singly in glass tubes of 5 cm diameter and reared on paddy stem bits at 25 ± 2 °C and 65 ± 2 % R.H. The tubes were secured by white muslin cloth and rubber bands. Periodical observations were recorded for the emergence of parasitoids. It was observed that after completion of feeding on the host, the parasitoid larvae moved out of the stem and formed a cocoon with characteristic marking of black and white. The larval parasitoid emerged from few pupae after 8 to 9 days. The emerged parasitoid identified as *Charops bicolor* based on the keys given by Barrion and Listinger [2]. The remaining pupae were kept individually in the glass vials for further observations.

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Few days later, another hymenopteran emerged from the pupae of *C. bicolor* which was identified as *Brachymeria excarinata*. From these observations it was confirmed as a solitary hyperparasitoid of *C. bicolor*. Sex ratio of emerged specimens was female biased. The percent parasitization of Charops was studied at ICAR-NRRI from the years 2017 to 2021. The percentage parasitization was 3%, 3%, 9%, 7%, 8%, respectively, however, the hyperparasitization percentage of *B. excarinata* in those years was 40%, 40%, 10%, 12.5% and 11.1%, respectively. The probable reason for low parasitization of Charops on yellow stem borer in the years 2017 and 2018 was low may be due to higher hyperparasitization. Further laboratory observations indicated that this hyperparasitoid selects the pre-pupal stage of *C. bicolor* for oviposition. The emerged parasitoids and hyperparasitoids were collected using aspirator and were then suitably processed for taxonomic studies. The specimens were deposited in alcohol at National Pusa Collection (NPC), Division of Entomology, ICAR-Indian Agricultural Research Institute. Diagnosis of both *C. bicolor* and *B. excarinata* were observed under a stereo zoom binocular as follows:

C. bicolor (Fig. 1a) were identified by following characters, viz., black body with yellow orange markings on the antennal bases, legs, and abdomen; antennae and metasoma

dark brown; legs more or less yellowish; hind femur yellowish brown; base of tarsus I yellow; petiole wholly reddish; abdomen yellowish brown. Body measurements for female (in mm) are as follows: body length 8.41; head length 1.18; head width 0.91; interocellar distance 0.30; gena width 0.18; thorax length; 2.03; longitudinal eye diameter 1.07; fore wing 4.34; fore wing width 1.24; length of hind femur 1.85; total antenna length 6.23.

B. excarinata Gahan, 1925 (Fig. 1b) were identified by following characters, viz., body generally black; eyes greyish yellow; ocelli pale yellow; tegula yellow; all coxae and trochanters black; all femora black with yellow apices; all tarsi yellow; wings hyaline with dark brown veins; vertex, face and occiput with setigerous pits; interstices carinate and rugose; pre-orbital carina distinct; scrobal area polished and reaching anterior ocellus; mesosoma with close umbilicate pits; scutellum gently declined posteriorly with apical part narrowly reflexed; gaster ovoid and slightly pointed posteriorly; tergite 1 smooth and shiny; tergite 2 with dense minute punctures. Body measurements for female (in mm) are as follows: body length 2.9; head length 0.8; head width 0.86; interocellar distance 0.20; gena width 0.10; thorax length 1.08; longitudinal eye diameter 0.59; fore wing length 1.99; forewing width 0.69; marginal vein length 0.29; sub

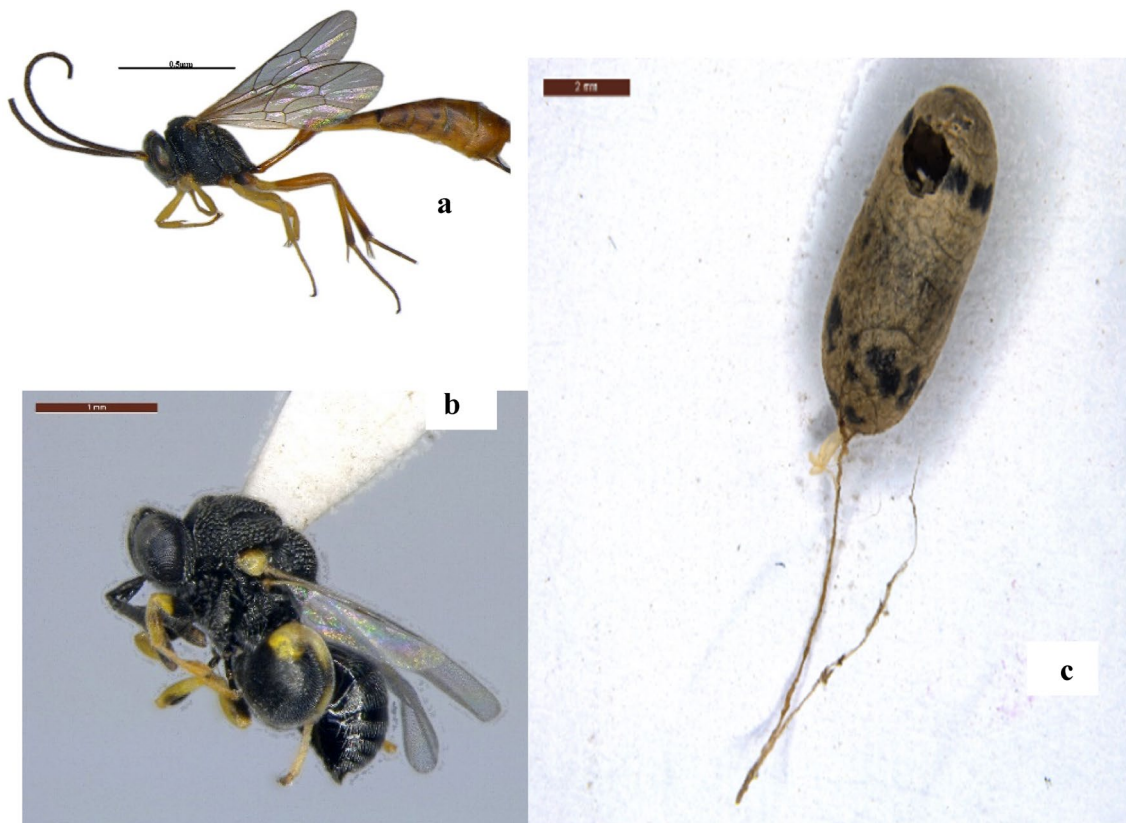


Fig. 1 a *Charops bicolor* adult b *Brachymeria excarinata* adult c Emergence hole of *B. excarinata* in *C. bicolor* cocoon

marginal vein length 0.61; length of hind femur 1.21; width of hind femur 0.71; total antenna length 1.12.

To the best of our knowledge, present study is the first record of chalcid hyperparasitoid *B. excarinata* on the parasitoid *C. bicolor*. *Brachymeria excarinata* can disrupt biological pest control by suppressing the population of their parasitoid host Charops leading to pest outbreak. There is no eco-friendly strategy that can be used to control hyperparasitoid as they are biologically very similar to their parasitoid host. To reduce the hyperparasitoid pressure on primary parasitoid a push pull strategy could be a promising approach to push *Brachymeria excarinata* away from the *Charops bicolor* and pull them into traps by using blend of infochemicals. To do this there is a need to study the chemical ecology of hyperparasitoid foraging behavior as till date hyperparasitoids are understudied as pest insects.

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Declarations

Conflict of interest The authors declare that they have no conflict of interest.

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