INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print); 2222-5234 (Online)
Website: https://www.innspub.net
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Vol. 27, Issue: 4, p. 104-109, 2025

RESEARCH PAPER OPEN ACCESS

First record of *Brachymeria excarinata* Gahan, 1925 (Hymenoptera: Chalcididae) parasitizing *Plutella xylostella* (L.) (Lepidoptera: Plutellidae) in west Africa

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Key words: Pests, Endoparasitoids, Biological control, Senegal

DOI: https://dx.doi.org/10.12692/ijb/27.4.104-109 Published: October 14, 2025

ABSTRACT

Specimens of *Brachymeria excarinata* Gahan (Hymenoptera: Chalcididae) were collected in April 2016 from *Brassica oleracea* L. (Brassicaceae) cabbage plots at Lac Rose (14°49'52.93" N, 17°09'20.94" W), Senegal. This represents the first documented occurrence of this parasitoid species associated with the diamondback moth, *Plutella xylostella* (L.) (Lepidoptera: Plutellidae), in both Senegal and West Africa. The parasitoids emerged from field-collected larvae of *P. xylostella*, which were subsequently reared under laboratory conditions. Specimens were identified by Gérard Delvare, an internationally recognized taxonomist and specialist in Chalcidoidea (Hymenoptera). At the time of sampling, the climatic conditions at Lac Rose were characterized by an average annual minimum temperature of 23°C. The detection of *B. excarinata* adds to the known complex of natural enemies of *P. xylostella*, potentially enhancing the prospects for its biological control in the region.

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INTRODUCTION

The genus *Brachymeria* Westwood (Hymenoptera: Chalcididae) comprises numerous species (Gibson, 1996), most of which are solitary endoparasitoids of Lepidoptera and Diptera. Some species are known to be facultative or obligate hyperparasitoids (Delvare, 2025).

Brachymeria excarinata has been reported as an endoparasitoid of the pupae of *Earias insulana* (Boisduval) (Lepidoptera: Noctuidae) in North Africa, particularly in Egypt (Mohammed *et al.*, 2020). Other parasitoid hymenopterans also target the larvae and pupae of *Pieris brassicae* (L.) (Lepidoptera: Pieridae) in various agroecosystems. Additionally, *B. excarinata* has been identified as a hyperparasitoid of *Cotesia plutellae* (Hymenoptera: Braconidae) (Khaliq *et al.*, 2016), as well as of certain Diptera and Hymenoptera families (Joseph *et al.*, 1973).

The genus *Brachymeria* has a global distribution, with approximately 200 described species, including 42 from the Neotropical region (Biever *et al.*, 1994; Mitchell *et al.*, 1997; Munir *et al.*, 2015) and 71 from the Oriental region (Joseph *et al.*, 1973). Several species have also been reported in other parts of the world, including 27 in North America (Khaliq *et al.*, 2016), 25 in Vietnam (Narendran *et al.*, 2016), 11 in Brazil (De Santis *et al.*, 1980), and 3 in the British and Irish fauna (Dale-Skey *et al.*, 2016). In the vicinity of Pakistan, 16 species have been recorded in Iran (Roodi *et al.*, 2016) and 8 in India (Husain *et al.*, 1982). In southern Sindh, pupae of *Earias* spp. have been parasitized by *Brachymeria bicolorata* on cotton and cereal crops (Ishrat *et al.*, 1987). In Karachi, an unidentified *Brachymeria* species was reported parasitizing fruit fly pupae (Samad *et al.*, 1971; Ahmed *et al.*, 1987), while two other species were found parasitizing the pupae of capsule worms (Sheikh *et al.*, 1987).

Despite these reports, relatively little research has focused specifically on this genus (Khokhar *et al.*, 1971). The diversity of *Brachymeria* species identified across various ecosystems reflects the ecological heterogeneity and adaptability of the genus.

The present study documents, for the first time, the occurrence of *B. excarinata* as a parasitoid of the diamondback moth, *Plutella xylostella* (L.), in Senegal.

MATERIALS AND METHODS

Sampling sites

The study was conducted in the Niayes region, which accounts for over 80% of Senegal's horticultural production. This coastal zone extends approximately 180 km along the northern maritime fringe of the country, from Dakar to Saint-Louis, encompassing the western parts of Thiès and Louga. The width of the region ranges from 5 to 30 km inland. Sampling was concentrated in the peri-urban area of Dakar, specifically at two localities: Gorom and Lac Rose. These sites exhibit favorable edaphic, hydrological, and climatic conditions for horticultural activities, particularly vegetable cultivation. The soils are either rich in organic matter with a shallow water table or consist of less fertile, non-leached ferruginous soils. The microclimate of this peri-urban zone is influenced by the proximity of Lac Rose and the Atlantic Ocean, creating relatively stable growing conditions. However, some plots within broader horticultural zones may be more exposed to wind and temperature fluctuations.

Sampling protocol

The study was carried out during two distinct seasons: the hot dry season (February to May) and the rainy season (June to September). At each selected site, twenty (n = 20) cabbage plants per plot were randomly sampled on a weekly basis, from transplanting to harvest.

Larval and pupal stages of *Plutella xylostella* were collected from randomly selected plants.

Collected larvae were reared individually in 12-well culture plates (Thermo Fisher Scientific, France) in the laboratory, each provided with fresh cabbage leaf fragments. Upon pupation, the pupae and any parasitoid cocoons were transferred to small individual containers (2 × 2 cm chambers) until

emergence. Emerging parasitoids were identified to species level. The parasitism rate was then calculated as the proportion of parasitized individuals relative to the total number of host larvae and pupae observed. To assess the climatic context of the sampling sites, the average annual minimum temperature was estimated using the "ClimaPlots" plugin in QGIS, based on the GPS coordinates of the plots where *B. excarinata* was recorded at Lac Rose.

RESULTS AND DISCUSSION

In April 2016, individuals of *Brachymeria excarinata* Gahan (Hymenoptera: Chalcididae) were collected from cabbage (*Brassica oleracea* L., Brassicaceae) plots at Lac Rose (14°49'52.93" N, 17°09'20.94" W) (Fig. 1).

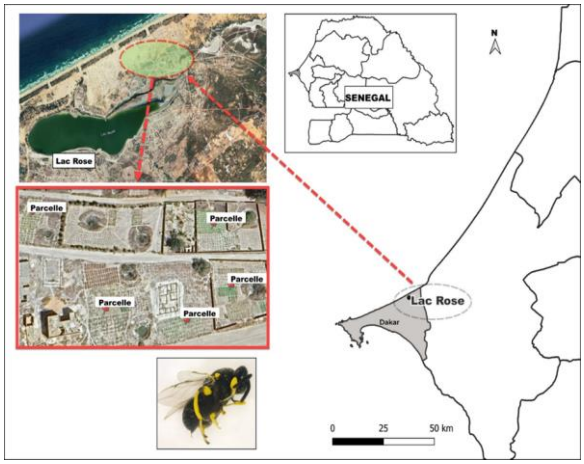

Fig. 1. Lac Rose area where the species *B. excarinata* was reported in cabbage plot

This represents the first confirmed record of *B. excarinata* as a parasitoid of the diamondback moth, *Plutella xylostella* (L.) (Lepidoptera: Plutellidae), in both Senegal and West Africa. The species was identified by Gérard Delvare, an internationally recognized taxonomist and specialist in Chalcidoidea (Hymenoptera), who formerly headed the CIRAD entomology laboratory (France) and led capacity-building programs for scientists from the Global South.

Some specimens were deposited in his private reference collection in France. His classification framework, which integrates morphological characters and recent molecular phylogenies, supports the recognition of Chalcididae as a valid family (Delvare, 2025).

Additional specimens were submitted to the entomology laboratory of the Institut Fondamental d'Afrique Noire (IFAN, Dakar, Senegal) and to the Agroecology Laboratory of the Department of Animal Biology at Cheikh Anta Diop University of Dakar (UCAD).

Although *B. excarinata* is known to parasitize a wide range of phytophagous hosts, in Senegal it has so far only been recorded from *P. xylostella*. The species is generally adapted to temperate and subtropical climates. Its occurrence in Senegal is likely linked to international trade, particularly with North African countries (Sanae, 2013). Senegal has been increasingly importing agricultural commodities such as onions, cabbages, carrots, and potatoes from North Africa (Gueye, 2013). *B. excarinata* is established in Egypt, where females are known to parasitize several Lepidopteran species (Mohammed *et al.*, 2020). It is plausible that immature stages of the parasitoid (i.e., within infested host larvae) were unintentionally introduced through imported cabbage or potato consignments from this region (Labou *et al.*, 2016). A similar introduction pathway was reported for *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae), a species recently introduced into Senegal via tomato imports from North Africa. Since its introduction, *T. absoluta* has become established in the Dakar region and throughout the coastal Niayes zone (Brévault *et al.*, 2014).

Parasitoid Hymenoptera are often attracted to host crops, which act as "bait crops." Adult parasitoids require continuous sources of nectar to ensure survival and reproductive success.

They preferentially inhabit areas with abundant floral resources, which have been shown to increase their fecundity and longevity (Idris et Grafius, 2001; Lee and Heimpel, 2008). Their performance is also influenced by the genotype of the host plant (Sarfraz *et al.*, 2008). Host caterpillars feeding on nitrogen-rich (Sarfraz and Keddie, 2009) or sulfur-rich plants (Ulmer *et al.*, 2005; Sarfraz *et al.*, 2010; Dosdall *et al.*, 2011) generally result in enhanced parasitoid

development and survival. Apart from climatic factors, the local abundance of nutritional resources is a key determinant of parasitoid presence and efficacy.

Climate change poses a potential threat to biological control programs, particularly if rising temperatures disrupt synchrony between pest and parasitoid life cycles (Hance *et al.*, 2007).

Nevertheless, biological control agents capables of physiological or behavioral adaptation to changing climatic conditions may continue to be effective. Understanding the thermal tolerances and temperature responses of parasitoid species is critical to optimizing biological control strategies (Golizadeh *et al.*, 2008). *B. excarinata* is known to perform well under cooler climatic conditions, with optimal development observed at average temperatures around 22°C (range: 15–28°C), suggesting greater efficacy in temperate rather than tropical environments (Bahar *et al.*, 2012). At Lac Rose, specimens were collected under climatic conditions where the average annual minimum temperature was 23°C, as determined using the "ClimaPlots" plugin in QGIS based on GPS coordinates from the sampling plots (Fig. 2).

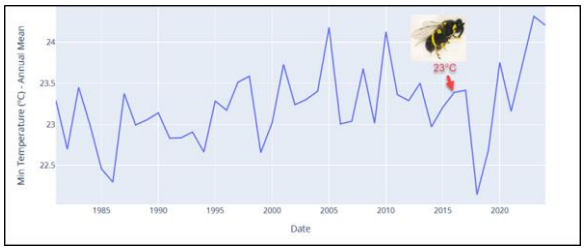

Fig. 2. Average annual minimum temperatures at the plots where the species was reported at Lac Rose (Qgis "ClimaPlots")

From January 2010 to January 2016, the average annual temperature at Lac Rose declined notably, from 24.12°C to 23.38°C. This cooling trend may have created favorable conditions for *B. excarinata*, which appears to prefer relatively mild temperatures to optimize parasitism (Bolter and Laing, 1993; Bahar *et al.*, 2012). However, since its initial detection, the parasitoid appears to have declined, potentially due to the recent warming observed in the area after 2020. Despite this, the coastal Niayes region characterized by relatively stable and moderate temperatures remains a promising zone for the potential establishment of *B. excarinata*. Its successful establishment could enhance the diversity of natural enemies of *P. xylostella* and contribute to more sustainable management of this key pest in Senegalese cabbage production systems.

CONCLUSION

Hymenopteran parasitoids play a critical role in both natural and agricultural ecosystems by influencing and regulating the population dynamics of numerous insect pests (Godfray, 1994). Among these, members of the family Chalcididae represent a particularly important group of beneficial parasitoids. Many species within this family have been effectively employed in classical and augmentative biological control programs targeting a wide range of economically significant pest species (Marchiori *et al.*, 2002; Prakash *et al.*, 2016).

ACKNOWLEDGMENTS

Many thanks to Gérard Delvare for identifying the *B. excarinata* specimens and to Dominique Bordat for proofreading this note. Many thanks also to the GEDAH master's students who collected these specimens during their sampling in the cabbage plots at Lac Rose.

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