Brazilian Journal of Biology®

ISSN 1519-6984 (Print)
ISSN 1678-4375 (Online)

Notes and Comments

Brachymeria koehleri (Hymenoptera: Chalcididae): first record as hyperparasitoid in *Dione juno juno* (Lepidoptera: Nymphalidae) pupae

R. A. Pinheiro[a]*, J. C. Zanuncio[b], R. Toma[c], J. B. Isaac Junior[d], M. A. Soares[e], C. A. Santos[d], J. E. Serrão[a], M. J. S. Cabral[e] and M. T. Tavares[f]

[a]Universidade Federal de Viçosa – UFV, Departamento de Biologia Geral, Viçosa, MG, Brasil

[b]Universidade Federal de Viçosa – UFV, Instituto de Biotecnologia Aplicada à Agropecuária – BIOAGRO, Departamento de Entomologia, Viçosa, MG, Brasil

[c]Fiocruz Mato Grosso do Sul, Campo Grande, MS, Brasil

[d]Universidade Federal dos Vales do Jequitinhonha e Mucuri – UFVJM, Departamento de Ciências Biológicas e da Saúde, Diamantina, MG, Brasil

[e]Universidade Federal dos Vales do Jequitinhonha e Mucuri –– UFVJM, Departamento de Agronomia, Diamantina, MG, Brasil

[f]Universidade Federal do Espírito Santo – UFES, Departamento de Ciências Biológicas, Vitória, ES, Brasil

Passion fruits are nutritious for fresh and industrial consumption (Zhang et al., 2021). Insect pests, such as defoliating caterpillars, including *Dione juno juno* (Cramer, 1779) (Lepidoptera: Nymphalidae), defoliate completely *Passiflora* spp. plants (Passifloraceae) at high population densities (Boiça Júnior et al., 2008).

Biological control is an environmentally safe method to manage harmful arthropods. Parasitoid insects are known for their effectiveness and specificity as biological control agents and they are mainly of the Diptera and Hymenoptera orders (Scaramozzino et al., 2020).

Seventy-three species have been described for the genus *Chetogena* (Rondani, 1856) (Diptera: Tachinidae) (O'Hara et al., 2019, 2021), including *Chetogena scutellaris* (Wulp, 1890) (Diptera: Tachinidae) (O'Hara et al., 2019), an endoparasitoid of Arctiidae, Geometridae, Noctuidae, Pieridae, Saturniidae, Sphingidae and Zygaenidae (Lepidoptera) caterpillars (Arnaud, 1978).

Chalcididae are usually primary and solitary endoparasitoids, but some of its species are gregarious parasitoids or hyperparasitoids of Coleoptera, Diptera, Hymenoptera and Lepidoptera (Narendran and Van Achterberg, 2016).

This study reports the first record of *Brachymeria koehleri* (Blanchard, 1935) (Hymenoptera: Chalcididae) as a hyperparasitoid in *D. juno juno* pupae trough *C.* aff. *scutellaris*. It also registers, for the first time, the association of a *Chetogena* species with *D. juno juno* in South America.

Forty-one lepidopteran pupae were collected from *Passiflora edulis* (Passifloraceae) plants in the Horticulture sector (S 18º 12'12,276", W 43º34'16.86; 1,387 m.a.s.l.) of the Universidade Federal dos Vales do Jequitinhonha e Mucuri (UFVJM) in Diamantina, State of Minas Gerais, Brazil.

Adults of Lepidoptera emerged in the laboratory were kept in a cage (33 × 33 × 33 cm), photographed, and sent to Dr. Olaf Hermann Hendrik Mielke (Universidade Federal do Paraná, Biological Sciences Sector, Department of Zoology, Curitiba, State of Paraná, Brazil), who identified the species as *Dione juno juno* (Lepidoptera: Nymphalidae).

Pupae of *D. juno juno* were dissected and the puparia of dipteran parasitoids found transferred to a 500 ml plastic pots until emergence of adult of dipteran parasitoid or hyperparasitoids.

Specimens of Tachinidae flies that emerged from *D. juno juno* pupae were fixed in 70% ethanol and sent to the taxonomist Dr. Ronaldo Toma (FIOCRUZ Mato Grosso do Sul, Campo Grande, State of Mato Grosso do Sul, Brazil). These specimens were identified based on Parchami-Araghi's (2008) and Thompson's (1968) redescriptions, and voucher specimens were deposited in the Zoological Reference Collection at the Universidade Federal do Mato Grosso do Sul, Brazil.

Specimens of Chalcididae that emerged from Tachinidae pupae were fixed in 70% ethanol and sent to the taxonomist Dr. Marcelo Teixeira Tavares (Universidade Federal do Espírito Santo, Department of Biological Sciences, in Vitória, State of Espírito Santo, Brazil). These specimens were identified based on the key of Andrade and Tavares (2009), the description of Blanchard (1935), and compared with the holotype of *B. koehleri* deposited in the Collection of IMYZA (Instituto de Microbiología y Zoología Agrícola at Hurlingham, Buenos Aires, Argentina).

The flies, wasps and chrysalis were photographed using a Canon EOS Rebel T7I camera and Segurimax© LED lights.

Eight *C.* aff. *scutellaris* larvae emerged from *D. juno juno* pupae (Figure 1A, C). This is the first record of a species of *Chetogena* parasitizing pupae of *D. juno juno* in South America. *Chetogena scutellaris* has been reported in *D. juno juno* pupae in Costa Rica (Janzen and Hallwachs, 2009). This parasitoid has also been obtained from pupae of *Anaea troglodyta* (Fabricius, 1775), *Brassolis sophorae* (Linnaeus, 1758) and *Opsiphanes invirae* (Huebner, 1818) (Lepidoptera:

*e-mail: rodrigo6450@gmail.com
Received: February 2, 2022 – Accepted: October 31, 2022

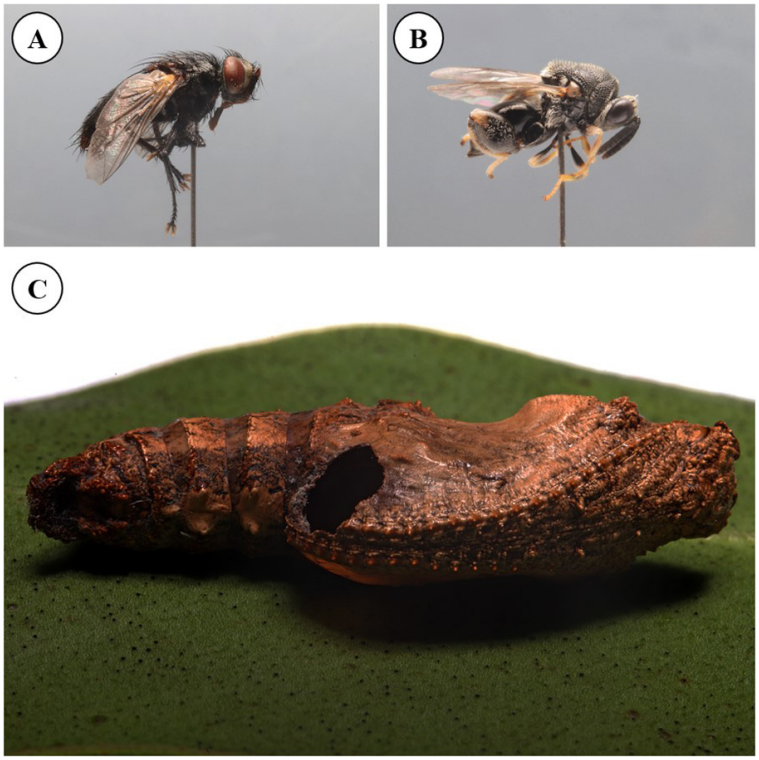

Figure 1. Primary parasitoid *Chetogena* aff. *scutellaris* (Diptera: Tachinidae) (A) size: 1.0 cm; Hyperparasitoid *Brachymeria koehleri* (Hymenoptera: Chalcididae) (B) size: 0.6 mm; and parasitized pupa of *Dione juno juno* (Lepidoptera: Nymphalidae) (C) size: 2.7 cm.

Nymphalidae) in the State of Pará, Brazil, and in the state of Florida, United States (Tinôco et al., 2010; Salvato et al., 2009). Furthermore, *C. scutellaris* has been recorded from pupae of *Anticarsia gemmatalis* (Hübner, 1818), *Alabama claycea* (Hübner, 1823), *Chrysodeixis includens* (Walker, 1857), *Helicoverpa zea* (Boddie, 1850), *Pseudaletia unipuncta* (Haworth, 1809), *Spodoptera eridania* (Stoll, 1781), *Spodoptera frugiperda* (J.E. Smith, 1797), *Trichoplusia ni* (Hübner, 1803), (Lepidoptera: Noctuidae), and *Hypena scabra* (Fabricius, 1798) (Lepidoptera: Erebidae) in Costa Rica and Peru, and *Strymon acis* (Drury, 1773) (Lepidoptera: Lycaenidae) in the state of Florida, EUA (Salvato et al., 2012; Sourakov and Mitchell, 2002). *Chetogena* spp., parasitized *C. includens* (Lepidoptera: Noctuidae) in Mato Grosso, Brazil (Massarolli et al., 2018).

Five Chalcididae wasps, emerged from pupae of the parasitoid *C.* aff. *scutellaris*, were identified as *B. koehleri* (Figure 1B). In Brazil, *B. koehleri* was reported as a hyperparasitoid of *C. scutellaris* through *Opsiphanes invirae* (Huebner, 1818) (Lepidoptera: Nymphalidae), in Pará (Tinôco et al., 2012) and was also reported as a hyperparasitoid of *Lespesia melloi* (Gil-Santana, Nihei & Nunez, 2014) (Diptera: Tachinidae) through pupae of *Thagona tibialis* Walker, 1855 (Lepidoptera: Lymantriidae) (Tavares et al., 2013), in *Lespesia* sp. (Diptera: Tachinidae) through pupae of *Parides ascanius* (Cramer, 1775) (Lepidoptera: Papilionidae) in Rio de Janeiro, Brazil (Tavares et al., 2006).

This is the first record of *B. koehleri* as a hyperparasitoid in a *Chetogena* species in South America. It is also the first report of a *Chetogena* species parasitizing *D. juno juno*. *Chetogena* aff. *scutellaris* may have potential as a control agent of *D. juno juno*, but the hyperparasitism relationship with *B. koehleri* is potentially harmful to this natural enemy.

Acknowledgements

To Olaf Hermann Hendrik Mielke for identifying the lepidopteran reported in the study. To Jim O'Hara for clarifying doubts about the name *Chetogena scutellaris*. To the photographer Dayvson Ayala Costa for the photographs used in the manuscript. To the Brazilian institutions "Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES- Finance Code 001)" and "Programa Cooperativo sobre Proteção Florestal (PROTEF) do Instituto de Pesquisas e Estudos Florestais (IPEF)" for financial support.

References

ANDRADE, T.V. and TAVARES, M.T., 2009. Revisão de Ceyxia, stat. rev., (Hymenoptera, Chalcididae, Brachymeriini). *Revista Brasileira de Entomologia*, vol. 53, no. 4, pp. 511-548.

ARNAUD, P.H., 1978. A host-parasite catalog of North American Tachinidae (Diptera). Department of Agriculture. *Science and Education Administration*, vol. 1, no. 1319, pp. 860.

BLANCHARD, E.E., 1935. Apuntes sobre calcididos argentinos (Hym. Chalc.). *Revista de la Sociedad Entomológica Argentina*, vol. 7, pp. 103-122.

BOIÇA JÚNIOR, A.L., ANGELINI, M.R. and OLIVEIRA, J.C.D., 2008. Aspectos biológicos de *Dione juno juno* (Cramer) (Lepidoptera: Nymphalidae) em genótipos de maracujazeiro. *Revista Brasileira de Fruticultura*, vol. 30, no. 1, pp. 101-105. http://dx.doi.org/10.1590/S0100-29452008000100019.

JANZEN, D.H. and HALLWACHS, W., 2009 [viewed 22 February 2022]. *Dynamic database for an inventory of the macrocaterpillar fauna, and its food plants and parasitoids, of Area de Conservacion Guanacaste (ACG), northwestern Costa Rica (nn-SRNP-nnnnn voucher codes)* [online]. Available from: http://janzen.sas.upenn.edu

MASSAROLLI, A., HOFFMANN, A.L., FAVETTI, B.M. and BUTNARIU, A.R., 2018. Ichneumonids (Hymenoptera) and tachinid flies (Diptera) associated to lepidopterans in soybean crops. *Journal of Agricultural Science*, vol. 10, no. 7, pp. 167-173. http://dx.doi.org/10.5539/jas.v10n7p167.

NARENDRAN, T.C. and VAN ACHTERBERG, C., 2016. Revision of the family Chalcididae (Hymenoptera, Chalcidoidea) from Vietnam, with the description of 13 new species. *ZooKeys*, vol. 576, pp. 1-202. PMid:27110185.

O'HARA, J.E., HENDERSON, S.J. and WOOD, D.M., 2019. *Preliminary checklist of the Tachinidae of the world*, NADS, 681 pp. [online]. Available from: http://www.nadsdiptera.org/Tach/WorldTachs/Checklist/Worldchecklist.html

O'HARA, J.E., WOOD, D.M. and GONZALEZ, C.R., 2021. Annotated Catalogue of Tachinidae (Insecta, Diptera) of the Chile. Zookeys, vol. 1064, no. 1988, pp. 1-200. https://doi.org/10.3897/zookeys.1064.62972.

PARCHAMI-ARAGHI, M., 2008. Identity of the previously unrecognized *Chetogena flaviceps* and its synonymy with *C. scutellaris* (Diptera: tachinidae). *Journal of Entomological Society of Iran*, vol. 28, no. 1, pp. 61-66.

SALVATO, M.H., SALVATO, H.L. and HENNESSEY, M.K., 2009. *Chetogena scutellaris* (Diptera: Tachinidae) an endoparasite of larval *Anaea troglodyta floridalis* (Nymphalidae). *Journal of the Lepidopterists Society*, vol. 66, no. 2, pp. 113-114. http://dx.doi.org/10.18473/lepi.v66i2.a5.

SALVATO, M.H., SALVATO, H.L. and STIREMAN 3rd., J.O., 2012. *Chetogena scutellaris* (Diptera: Tachinidae), an endoparasite of larval *Strymon acis* bartrami (Lycaenidae). *Journal of the Lepidopterists Society*, vol. 66, no. 2, pp. 113-114. http://dx.doi.org/10.18473/lepi.v66i2.a5.

SCARAMOZZINO, P.L., DI GIOVANNI, F., LONI, A., GISONDI, S., LUCCHI, A. and CERRETTI, P., 2020. Tachinid (Diptera, Tachinidae) parasitoids of *Lobesia botrana* (Denis & Schiffermüller, 1775) (Lepidoptera, Tortricidae) and other moths. *ZooKeys*, vol. 934, pp. 111-140. http://dx.doi.org/10.3897/zookeys.934.50823. PMid:32508497.

SOURAKOV, A. and MITCHELL, E.R., 2002. Laboratory biology of *Chetogena scutellaris* (Diptera: Tachinidae), a parasitoid of Noctuidae, reared on fall armyworm and cabbage looper. *The Florida Entomologist*, vol. 85, no. 2, pp. 341-343. http://dx.doi.org/10.1653/0015-4040(2002)085[0341:LBOCSD]2.0.CO;2.

THOMPSON, W.R., 1968. The Tachinids of Trinidad. VIII. Phorocerines. *Memoirs of the Entomological Society of Canada*, vol. 100, no. suppl S56, pp. 5-207. http://dx.doi.org/10.4039/entm10056fv.

TINÔCO, R.S., RIBEIRO, R.C., VILELA, E.F., LEMOS, W.D.P., ZANUNCIO, J.C. and NIHEI, S.S., 2010. Primeiro registro de *Chetogena scutellaris* Wulp (Diptera: Tachinidae) parasitando pupas de *Opsiphanes invirae* e *Brassolis sophorae* (Lepidoptera: Nymphalidae) no Pará, Brasil. In: EMBRAPA AMAZÔNIA ORIENTAL. *Resumo do 23° Anais do Congresso (ALICE). Congresso Brasileiro de Entomologia*, 2010, Natal. Natal: Sociedade Brasileira de Entomologia.

ZHANG, X., WEI, X., ALI, M.M., RIZWAN, H.M., LI, B., LI, H., JIA, K., YANG, X., MA, S., LI, S. and CHEN, F., 2021. Changes in the content of organic acids and expression analysis of citric acid accumulation-related genes during fruit development of yellow (*Passifora edulis f favicarpa*) and Purple (*Passifora edulis f edulis*) Passion Fruits. *International Journal of Molecular Sciences*, vol. 22, no. 11, pp. 5765. http://dx.doi.org/10.3390/ijms22115765. PMid:34071242.

TAVARES, M.T., NAVARRO-TAVARES, A.B. and ALMEIDA, G.D.S., 2006. The species of Chalcididae (Hymenoptera) parasitoids of Parides ascanius (Cramer), an endangered Papilionidae (Lepidoptera) from rest-ingas of southeastern Brazil. *Zootaxa*, vol. 1197, no. 1, pp. 55-63.

TAVARES, W.S., LEGASPI, J.C., TAVARES, M.T., NUNEZ, E., PINTO, R. and ZANUNCIO, J.C., 2013. Brachymeria koehleri (Hymenoptera: Chalcididae) as a hyperparasitoid of Lespesia melloi (Diptera: Tachinidae) pupae in Thagona tibialis (Lepidoptera: Lymantriidae) caterpillars in Brazil. *The Florida Entomologist*, vol. 96, no. 4, pp. 1635-1638. http://dx.doi.org/10.1653/024.096.0457.

TINÔCO, R.S., RIBEIRO, R.C., TAVARES, M.T., VILELA, E.F., LEMOS, W.D.P. and ZANUNCIO, J.C., 2012. Brachymeria spp. (Hymenoptera: Chalcididae) parasitizing pupae of Hersperidae and Nymphalidae (Lepidoptera) pests of oil palm in the Brazilian Amazonian region. *Florida Entomologist*, vol. 95, no. 3, pp 788-789. https://doi.org/10.1653/024.095.0335.