



Chelonine (Hymenoptera: Braconidae: Cheloninae) Parasitoids of Lepidopteran Leafminers in the Indian Subcontinent, with Notes on Taxonomic Character

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ABSTRACT

Two new species viz., *Chelonus (Areselonus) caeruleus* sp. nov. and *Chelonus (Areselonus) lithocolletiscus*, sp. nov., are described as new to science from the northern part of India. These two species were reared from *Acrocercops caerulea* (Meyrick) and *Lithocolletis virgulata* (Lepidoptera: Gracillariidae). Materials about other species viz., *Ascogaster acrocercophagus* Shujaiddin and Varshney and *C. (A.) chailini* (Walker and Huddleston) have also been recorded. The importance of apico-dorsal spine of metasoma for taxonomy is discussed. An updated checklist of chelonine leafminer parasitoids from the Indian subcontinent is also provided.

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Authors' Contribution

ZA conceived the idea of the project. ZA and KP carried out the sampling, analysed the data and wrote the manuscript. KAK contributed in final preparation of the manuscript. HAG, KAK and FK provided suggestions and corrections.

Key words

Hymenoptera: Braconidae: Cheloninae, Parasitoids, leafminers, India, Pakistan

INTRODUCTION

Leaf mining insects are considered as serious pests, which damage plant leaves in several ways (Spencer, 1990). The majority of the leaf mining larvae belong to the Lepidoptera, followed to a lesser degree by Diptera, Coleoptera and Hymenoptera (Csoka, 2003). Among the lepidopteran leafminers the family Gracillariidae includes small-sized moths with white marks on the wings. Several species are considered severe pests in various parts of the world (Davis, 1987). Parasitoid insects play the most important role as the natural enemies of leaf miners. In some cases, they cause more than 90% mortality and have great potential in biological pest control programs (Hawkins *et al.*, 1993). Parasitoids of leaf miners are exclusively from the order Hymenoptera. Among the parasitic Hymenoptera chalcids (Chalcidoidea) and Ichneumonidae and Braconidae (Ichneumonoidea) are the most important group associated with leaf miners.

As far as Indian subcontinent is concerned, there is lack of information on braconid parasitoids especially reared from leaf-mining Lepidopteran hosts. So far only two species of chelonine parasitoids associated with lepidopteran leafminers described from India (Shujaiddin and Varshney, 1997; Ahmad and Gharamh, 2018).

The chelonine parasitoids belong to the subfamily Cheloninae of braconid wasps with approximately 1400 described species in 17 genera worldwide (Yu *et al.*, 2012; Kittel and Austin, 2014). All chelonines are believed to be solitary koinobiont endoparasitoids especially of larval Lepidoptera (Shaw and Huddleston, 1991). Kittel *et al.*, 2016 in their comprehensive phylogenetic analysis of chelonine wasps treated *Microchelonus* Szépligeti as junior synonyms of *Chelonus* Jurine and also synonymised several subgenera of *Microchelonus* like *Baculonius* Braet and van Achterberg, *Carinichelonus* Tobias and *Scabrichelonus* He, Chen and van Achterberg. However, they did not comment on the status of subgenera of other *Microchelonus* (*Areselonus*, *Megachelonus*, *Parachelonus*, *Rasnichelonus*, and *Stylochelonus*). The subgenus *Areselonus* of the genus *Chelonus* Jurine was named by Braet (1999) to accommodate a species in which

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the carapace ends in an apical spine-like protuberance and vein SR1 of the fore wing is reduced. Huddleston and Walker (1994) as well as Braet (1999) consider the presence of dorso-apical spine is a distinct lineage within the genus *Chelonus*. This aberrant character was also found in *Ascogaster* sp. (Braet, 1999). Here in the present work, we also found the same character in *Ascogaster acrocercophagus* Shujaiddin and Varshney. Apart from this the same character is also observed in *Chelonus (Areselonus) caeruleus* sp. nov., which shares similarities with subgenus *Chelonus* s.str. (Antennae of female more than 16 flagellomere). *Chelonus (Areselonus) chailini* (Walker and Huddleston, 1987); *Chelonus (Areselonus) pongamiae*, sp. nov. and *Chelonus (Areselonus) spinigaster* Ahmad and Gharamh, 2018 have similarities with subgenus *Microchelonus* s. str. (Antenna of female with 16 segments). Hence, all Indian chelonine species reared from leafminers possess this characteristic which includes genera *Ascogaster*, *Chelonus* s. str. *Microchelonus* s. str. Thus, the presence of this character has some association with leaf-mining behaviour rather than considering it as a separate lineage. Walker and Huddleston (1987) suggested the function of the dorso-apical spine is to use as an anchor or as a lever to give an extra push to the newly emerged adults in making their way out of the host cocoon. Therefore, the separate identity of subgenus *Areselonus* is uncertain. Further comprehensive studies of both morphological and molecular analysis will reveal the clear position of this group. At present, the authors are not able to make any taxonomic change to the status of subgenus *Areselonus* due to unavailability of type material. This subgenus contains only five described species (Yu *et al.*, 2012; Ahmad and Gharamh, 2018; Long *et al.*, 2019).

The objective of this study is to describe and illustrate two new species viz., *Chelonus (Areselonus) caeruleus* and *Chelonus (Areselonus) lithocolletiscus*, sp. nov., from *Acrocercops caerulea* (Meyrick) and *Lithocolletis virgulata* (Lepidoptera: Gracillariidae), respectively on their natural host plant *Dolichos lablab*, *Pongamia glabra*

and *Terminalia bellerica*. An updated checklist of chelonine leaf-miner parasitoids from the Indian subcontinent is also provided in this paper (Table I).

MATERIALS AND METHODS

This study was conducted in the vicinity of western Uttar Pradesh (North India) to identify parasitoids of leaf miners along the roadside at AMU university campus. The parasitoids were reared in the laboratory in glass jars of 8"×4" in size in the insectory at 25⁰±2⁰ C with 70% R.H. The leaves with lepidopteran leaf miners were collected from the plants and transferred to the rearing jars of 8"×4". A complete data set such as the date of collection, locality, and name of host plant was maintained. The emerged parasitoids were preserved initially in 75% alcohol with a few drops of glycerol. These specimens were later mounted on cards. The reared parasitoids were separated based on morphological characters. Photos of body profile were taken by a Nikon SMZ 1000 stereo zoom microscope with attached camera. Measurements of the different parts were made with the help of an ocular micrometer fitted in Nikon SMZ stereomicroscope. We have followed van Achterberg (1993) for the terminologies of various body parts and wing venation and Eady (1968) for the terminology of micro-sculpture. The specimens were deposited in the Insect Collection of the Department of Zoology, Aligarh Muslim University, Aligarh, India (ZDAMU).

1. *Ascogaster acrocercophagus* Shujaiddin and Varshney

Ascogaster acrocercophagus Shujaiddin and Varshney, 1997: 95-97. ♀. India, Uttar Pradesh (ZDAMU).

Diagnosis

Antennae 35-39 segmented, scape more than 3.0× as long as broad, forewing vein 3-SR longer than vein r and hind tibia 3.5× as long wide.

Table I. Updated checklist of Chelonini (Hym., Braconidae) parasitoids of leaf-miner from Indian subcontinent.

Species	Reference	Distribution
<i>Ascogaster acrocercophagus</i> Shujaiddin and Varshney	Shujaiddin and Varshney (1997); Ahmad <i>et al.</i> (2018); Present study	India
<i>Ascogaster quadridentata</i> Wesmael	Bellows and Fisher (1999)	Pakistan
<i>Chelonus (Areselonus) caeruleus</i> Ahmad and Pandey, sp. nov.	Present study	India
<i>Chelonus (Areselonus) chailini</i> (Walker and Huddleston)	Walker and Huddleston (1987); Braet (1999); Present study	India
<i>Chelonus (Areselonus) pongamiae</i> Ahmad and Pandey, sp. nov.	Present study	India
<i>Chelonus (Areselonus) spinigaster</i> Ahmad and Gharamh	Ahmad and Gharamh (2018)	India

Material examined

2♀♀, 8♂♂, India: Uttar Pradesh, Bulandshahr; 11. xi. 2007; ex. *Acrocercops syngamma* Meyrick on *Mangifera indica* L., (coll. Zubair Ahmad); 5♀♀, 7♂♂, India; Uttar Pradesh, Bijnor, 1.vii.2013, ex. *Acrocercops phaeospora* Meyrick (coll. Zubair Ahmad) (ZDAMU);

Host

Acrocercops syngamma Meyrick.

Distribution

India: Uttar Pradesh.

2. *Chelonus (Areselonus) caeruleus*, Ahmad and Pandey sp. nov.

(Fig. 1)

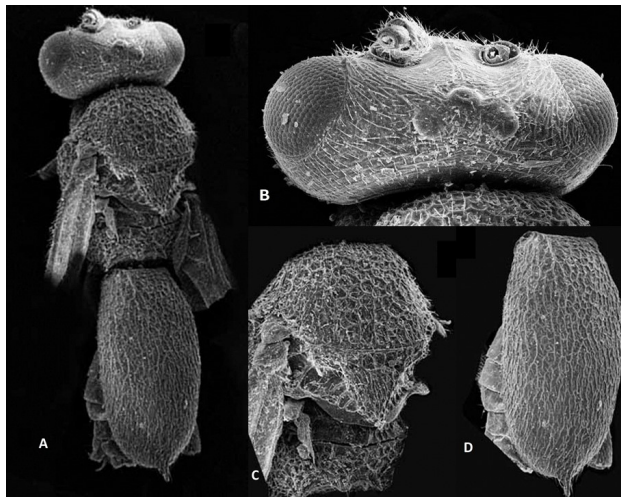


Fig. 1. *Chelonus (Areselonus) caeruleus* sp. nov., female, holotype; **A**, Habitus, dorsal aspect; **B**, Head dorsal aspect; **C**, Mesosoma dorsal View; **D**, Metasoma dorsal view.

Material examined

Holotype: ♀, INDIA: Uttar Pradesh, Aligarh, 26.10.68, ex *Acrocercops caerulea* (Meyrick) on *Dolichos lablab* (coll. Shujauddin) (ZDAMU). Paratype, 1♀, with same data as holotype (ZDAMU).

Diagnosis

Chelonus (Areselonus) caeruleus differs from all known *Areselonus* group of species by antennae of a female with more than 16 segments; metasoma in lateral view 2.0-2.3× as long as high, about twice as higher behind than at base i.e. distinctly increasing in height posteriorly, scutellar sulcus with five mid-longitudinal carinae. If the new species consider near to the subgenus *Chelonus* s.str., then *C. (A.) caeruleus* sp. nov., is closely related to *C. (C.)*

gastrus Narendran *et al.* (1990) but differs in the following characters: (i). Scutellum pubescent rugoso-reticulate (scutellum shiny, pubescent rugose and strigose) (ii). Hind coxa smooth and hairy, 2.0× as long as wide (hind coxa rugose, 1.6× as long as wide) (iii). 3-SR 2.7× as long as r (5: 3) (3-SR about as long as 1.2× r (6: 5) (iv). Frons transversely striated just above the antennal socket and longitudinal Striated between the antennal socket (frons coarsely punctate with a mid-longitudinal carina) (v). Carapace completely black (carapace black except basal yellow band) (vi). Prescutellar furrow broad with five mid longitudinal carinae (prescutellar furrow broad with three strong mid longitudinal carina) (vii). Ventral opening reaches more than half of the metasoma (ventral opening reaches almost upto the middle of the abdomen).

Description

Female: Body length: 2.5 mm; Length of fore wing: 1.7 mm; length of antenna: 1.7 mm.

Head

ca2.8× as wide as long in dorsal view; eye 2× as temple in dorsal view; OOL:POL: AOL : OD = 7:4:2:2; vertex and temple strigoso-punctate with hairs; frons smooth, just above the antennal socket transversely striated and between antennal socket having longitudinally striation; face almost 2× as wide as long, rugulose, clypeus punctate with hairs; malar space 2× basal width of mandible (6:3); antenna 18 segmented, distinctly shorter than body length, flagellomeres gradually decreasing in length towards apical; F₁₄-F₁₆ slightly longer than F₁₃.

Mesosoma

1.3× as long as its height; mesoscutum rugoso-reticulate, notauli distinct by the presence of deeper reticulation along the notaular lines, mesonotum with a mid-longitudinal carina, prescutellar furrow broad with mid longitudinal carina and four lateral carina; scutellum rugoso-reticulate; metanotum with crenulated furrow; propodeum rugoso-reticulate; mesopleuron rugoso-reticulate,

Wings

Fore wing slightly infusate, 2.1× as long as wide; stigma almost 2× as long as wide 1-R1 slightly longer than stigma; r shorter than half the breadth of stigma, r :3-SR: SR1 = 5: 3: 17, fore wing shorter than body length.

Legs

Hind coxa smooth and hairy; almost 2× as wide as long, length of femur, tibia, and basitarsus of hind leg 2.3× 3.57× and 2.3× their width, respectively.

Metasoma

Metasoma 1.72× as long as wide; Metasoma slightly longer than mesosoma; carapace rugoso-reticulate with two strong longitudinal carina at basal one-fourth part of the metasoma; ventral opening reaches more than half of the metasoma; ovipositor short hardly visible laterally.

Colour

Body black except for the following: antenna, tegulae, all femora and apex of tibia, ovipositor, veins (except M+CU) light brown; stigma, M+CU dark brown, all tarsus and tibial spurs yellow.

Male

Unknown

Host

Acrocercops caerulea (Meyrick)

Distribution

India: Uttar Pradesh

Etymology

The species name is derived from the name of the host species.

3. *Chelonus (Areselonus) chailini* (Walker and Huddleston)

Chelonus chailini Walker and Huddleston, 1987: 437-440. ♀. Malasia, (BMNH).

Material examined

1♀, 3♂♂, INDIA; Uttar Pradesh, Aligarh, 17. viii.2006, ex. *Acrocercops phaeospora* Meyrick (coll. Kavita Pandey) (ZDAMU); 5♀♀, 7♂♂, INDIA; Uttar Pradesh, Bulandshahr, 11.viii.2012, ex. *Acrocercops phaeospora* Meyrick (coll. Zubair Ahmad) (ZDAMU).

Hosts

Acrocercops caerulea Meyrick, *A. Diffluella* van Deventer, *A. globulifera* Meyrick, *Epicephala chalybacma* Meyrick. *A. phaeospora* Meyrick recorded doubtfully from India by Walker and Huddleston, 1987, *A. phaeospora* (present record)

Distribution

China; Malaysia; India (Uttar Pradesh); Papua New Guinea.

4. *Chelonus (Areselonus) lithocolletiscus* Ahmad and Pandey, sp. nov.

(Fig. 2)

Material examined

Holotype: ♀, India: Uttar Pradesh; Aligarh, 28 VII 2005, ex. *Lithocolletis virgulata* on and *Pongamia glabra* (coll. K. Pandey) (ZDAMU). Paratype, 1♀, 2♂♂, with same data as holotype (ZDAMU). Paratype, 4♀♀, 1♂, India: Uttar Pradesh; Aligarh, 11 VIII 2007, ex. *Lithocolletis virgulata* on *Terminalia bellerica* (coll. Z. Ahmad).

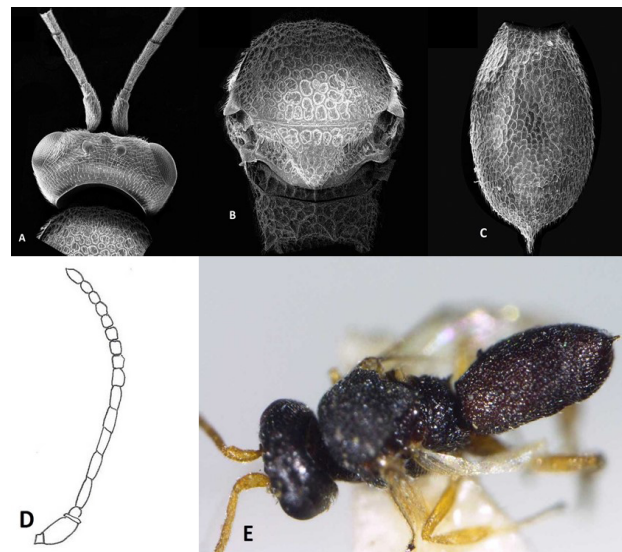


Fig. 2. *Chelonus (Areselonus) lithocolletiscus*, sp. nov., female, holotype; **A**, Head dorsal view; **B**, Mesosoma dorsal view; **C**, Metasoma dorsal view; **D**, Female antenna; **E**, Body profile dorso-lateral view.

Diagnosis

C. (A.) lithocolletiscus sp. nov., closely related to *C. (A.) chailini* (Walker and Huddleston) but differs in the following characters: (i). Mesoscutum punctate reticulate (mesoscutum reticulate rugose) (ii). Propodeum reticulate (propodeum reticulate rugose) (iii). 3-SR as long as r, (3-SR 1.3× as long as r) (iv). Scape 2× as long as wide (scape 2.3× as long as wide). The new species also differs from other known Indian species viz., *C. (A.) spinigaster* Ahmad and Gharamh by metasoma not declivous but making an angle with the spine (Metasoma strongly declivous below the spine); clypeus punctate (clypeus rugose).

Description

Female: Body length: 2.42 mm; Length of fore wing: 1.87 mm; Length of antennae: 1.67 mm.

Head

2.5× as wide as long; eyes almost 2× temple; frons concave area smooth, medially convex punctate and at

sides longitudinally striated; OOL: POL: AOL : OD = 6.5: 3: 2; vertex and temple pubescent, striated; face strigose, almost 2× as wide as long, only at the margin of eyes with longitudinally striated; clypeus wide almost 2× as wide as long, punctate with hairs; malar space 1.5× basal width of mandible; scape 2× as long as wide; antennae 16 segmented, flagellomeres gradually decreasing in length apically.

Mesosoma

1.42× as long its height; mesoscutum, punctate reticulate, notauli finely impressed; scutellum punctate reticulate; propodeum 2.0× as wide as long reticulate with a short median longitudinal carina present; metanotum with longitudinal carina.

Wings

Stigma 2.5× as long as wide; 1.1× 1-R1, 3-SR as long as r; SR1 slightly curved.

Legs

Length of femur, tibia and basitarsus of hind legs 3.5, 4.0 and 4.0× their maximum width.

Metasoma

Metasoma convex, reticulate, converging carina on basal fourth and a spine at apex; in lateral view 3.3× as long as height (40:12); ovipositor sheath 1.2× longer than hind basitarsus hairy; ovipositor pointed, ventral opening reacting at the apex.

Colour

Body brownish black; antennae yellow gradually becoming yellowish brown towards apex; eyes greyish; ocelli brown; legs yellow; hind femur and apex of hind tibia yellowish brown; coxae red testaceous, wings hyaline; stigma C+SC+R and 1-R1 brown, rest of the vein pale.

Male

Same as holotype:

Host

Lithocolletis virgulata on *Pongamia glabra* and *Terminalia bellerica*.

Distribution

India: Uttar Pradesh

Etymology

The species name refers to the generic name of the host plant.

CONCLUSION

The Indian subcontinent has one of the unique biodiversity rich region of the world because of its varied climatic and geographical features. It occupies almost 4.4 million km² area and considered as the confluence point of three biographic realms viz., the palearctic, afro-tropical and Indo-Malayan. This unique bio ecoregion exhibits a great variety of ecological habitats which harbors rich faunal and floral diversity and provide ample scope to sustain numerous species of insects and host plants. However, the greater part of this region is unexplored. More exploration in future will provide further knowledge of the faunal wealth of this region. Our findings of two new species reared from the leafmining lepidopteran larvae from the trees near the agrarian ecosystem provide important evidence that the wild area, as well as agrarian ecosystem could have more species fauna in the surrounding territories.

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Statement of conflict of interest

The authors have declared no conflict of interest.

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