



MORPHOLOGICAL ATTRIBUTES OF SIX COCCINELLID BEETLES RECORDED FROM UDHAM SINGH NAGAR DISTRICT OF UTTARAKHAND, INDIA

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Abstract- The current study elucidates morphological attributes and distribution patterns of six coccinellid beetles, viz. *Oenopia sauzeti*, *Harmonia dimidiata*, *Brumoides suturalis*, *Propylea luteopustulata*, *Micraspis allardi*, and *Anegleis cardoni* found on different host plants. *Brumoides suturalis* was observed to be the smallest, while *Harmonia dimidiata* was the largest among them. All species belonged to the subfamily Coccinellinae and tribe Coccinellini, except for *B. suturalis*, which belonged to the subfamily Chilocorinae and tribe Chilocorini. We examined their morphological characteristics, including male genitalia.

Key words- Coccinellid beetles, distribution patterns, morphological attributes, prey species, male genitalia

INTRODUCTION

Coccinellid beetles (Coleoptera: Coccinellidae) hold significant economic importance due to their role as predators of various soft-bodied insect pests that harm agricultural crops (Pervez 2002; Pervez et al., 2020), and a few of them are important biocontrol agents of scales (Omkar and Pervez 2003) and aphid pests (Pervez and Omkar 2006). According to Vandenberg (2002) about 6000 species of these beetles have been recorded worldwide, of which approximately 4200 species of coccinellids are considered beneficial because of their predatory activity (Rahaman and Aniszewski 2016). Poorani (2002) published an annotated checklist containing details such as scientific names, synonyms, and distributions of approximately 400 species across 79 genera of coccinellids. The Coccinellidae family is classified into six main subfamilies: Stictolotidinae, Chilocorinae, Scymninae, Coccidulinae, Coccinellinae, and Epilachninae. However, recent phylogenetic studies have suggested the existence of a seventh subfamily, Ortaliinae (Slipinski 2007; Kundoo and Khan 2017). All subfamilies are predaceous except subfamily, Epilachninae which is phytophagous. A few coccinellids feed upon pollen or nectar, while others primarily consume fungi or mycophagous (Rahaman and Aniszewski 2016). Both larvae and adults of predatory coccinellid beetles feed on almost 39 species belonging to different groups, including aphids, mealybugs, whiteflies, thrips, jassids, mites, psyllids as well as other small soft-bodied species and their small eggs (Iperti and Paoletti 1999; Rahaman and Aniszewski 2016).

Coccinellids are also valuable bioindicators, offering insights into the overall health of the ecosystems they inhabit (Agarwala et al. 2013).

Adult coccinellids are convex, oval or round in shape and have a wide variety in size, elytral pattern and colour (Megha et al. 2015), which also aid in their identification (Pervez and Adhikari 2020). However, these variations occur both between and within the species and the latter case represents polymorphism. Among various types of polymorphism, colour polymorphism is particularly notable for its ecological and functional significance. Numerous ladybird beetles show elytral colour polymorphism within population (Singh et al. 2016). Due to these differences among the same species it is not enough to use only morphological variation for distinguishing species as they create turbulence for taxonomists. In different coccinellids species, abdominal shape, size and colour are strong morphological characters (Pervez and Adhikari 2020) therefore, the most reliable method for species identification involves the detachment and examination of male genitalia, as genitalia is species specific, hence it becomes necessary to extract genitalia especially in small-sized beetles or those exhibiting different morphs.

Hence, our research aimed to offer more detail and accurate information about coccinellids aiding in their identification, resolving confusion by clarifying their alternative names and provide details about their host plant and prey species. Keeping in view the importance of these coccinellid predators, a

survey to explore ladybird biodiversity was conducted in the Udham Singh Nagar region of Uttarakhand, India.

MATERIALS AND METHODS

Study area: Adult ladybirds were gathered from the agricultural fields located in tarai region of Udham Singh Nagar, Uttarakhand with an altitude 217.93 m, Latitude 30.2937°N, Longitude 79.5603°E from March 2023 to October 2023. These specimens were collected by random selection.

Sampling Method

Ladybird beetles were collected from various study locations using a conventional entomological net on different host plants. Additionally, sweep sampling technique as described by O'Neil et al. (2003) and handpicking was used.

Preservation and identification of specimens

Beetles were killed using ethyl acetate-soaked cotton placed in vials and then transported to the laboratory for identification purposes. Field data of each specimen were recorded. Initially, adult ladybirds were identified based on their physical characteristics, using morphological features observable with the naked eye or with the aid of a magnifying glass. However, for small-sized beetles or those with different morphs, genitalia extraction was necessary. Male genitalia, being unique and species-specific, served as the primary basis for identification. Various published literature sources (Poorani 2002; Saeed et al. 2016; Ahmed et al. 2017; Joshi and Sharma 2008; Mishra and Yousuf 2019; Chaudhary and Singh 2012; Sharma and Joshi 2020) were used for beetle identifications. Beetles were dissected with fine needles under a stereoscope and diagrams of male genitalia were drawn. For genitalia extraction, modified methodology and protocol

described by Pervez and Adhikari (2020) was followed.

RESULTS AND DISCUSSION

A total of 119 coccinellid beetle specimens were collected from the Udham Singh Nagar district of Uttarakhand, representing six genera and six species. *Aneleis cardoni* was the most abundant species, while *Brumoides suturalis* was the least. Among the six species, five (*Oenopia sauzeti*, *Harmonia dimidiata*, *Micraspis allardi*, *A. cardoni*, and *Propylea luteopustulata*) belonged to the Subfamily Coccinellinae and tribe Coccinellini, while *Brumoides suturalis* was classified under Subfamily Chilocorinae and tribe Chilocorini.

1. *Oenopia sauzeti* (Mulsant 1866)/ *Gyrocaria sauzeti* (Miyatake, 1967)

Subfamily - Coccinellinae

Tribe – Coccinellini

Material examined- 2023. vii.26♂♀.

Morphological characters – It is small, measuring approximately 3.2-4.5 mm in length and 2.5-3.5 mm in width. Its body is oval and convex, adorned with glossy elytra. The elytra are lemon yellow, featuring six black spots - two on each elytron and two at the mid-dorsal line where the elytra meet. The head is black, while the pronotum is black with white margins. Ventrally, the body is black.

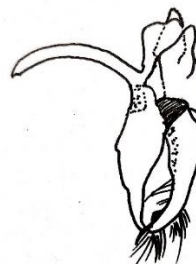
Male genitalia- Siphonal tube elongated, thick, broad and curved at base. Siphonal capsule expended, asymmetrical with outer arm long and inner arm short. Siphonal apex narrow at tip. Parameres long, broad at base, convergent, narrow, and inwardly curved at apex region and covered with hair. Median lobe short, curved and provided with long hair. Trab long, narrow and slightly curved inward.



a



b



c

Fig. 1. *Oenopia sauzeti*: a). adult, b). Siphon, c). side view of tegmen

Host/ Prey range- We found it, feeding on *Aphis gossypii* Glover on cucumber. Other Host and prey are- *Aphis pomi* De Geer on green apple, (Kumari 2019), *A. fabae* Scopoli, *A. gossypii* (Rahatullah et al. 2011, Satpathi 2009), *Aphis kurosawai* Takahashi, *Aphis longisetosa* Basu, *Aphis spiraecola* Patch, *Brachycaudus helichrysi* Kalt., *Brevicoryne brassicae* Linn., *Macrosiphoniella pseudoartemisiae* Shinji, *Macrosiphum rosae* Linn., *Macrosiphoniella sanborni* Gillette, *Melanaphis donacis* Passer., *Myzus persicae* (Sulz.) and *Rhopalosiphum padi* Fabr. (Satpathi 2009). It was also collected from *Zea mays* feeding on *Aphis craccivora* Koch. (Rahatullah et al. 2011).

2. *Harmonia dimidiata* (Fabricius)/ *Coccinella bicolor* (Hope, 1831)/ *Leis dimidiata* (Mulsant, 1850), / *Coccinella quindecimmaculata* (Hope, 1831)

Sub family- Coccinellinae

Tribe- Coccinellini

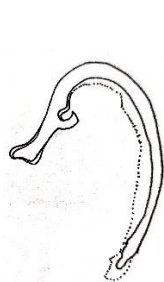
Material examined- 2023. iii.23♂♀.

Morphological characters- Large ladybird measuring between 7.0 and 9.5mm in length and 6.5 to 9.0mm in width. Its body is rounded, shiny, and smooth. The upper 1/3rd part of the elytra is red, while the lower part is black. Some beetles have entirely red elytra with a total of 13 black spots arranged in a pattern of 1-3-2-1/2 on each elytron. The elytral pattern varies depending on their morphs. The pronotum is red with two black spots, possibly with or without macula. The scutellum is triangular with black borders. The head is red with a pair of large black eyes.

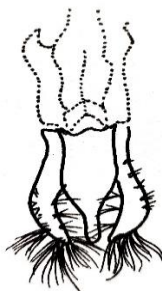
Male genitalia- Siphonal tube curved, elongated, forming a big loop and asymmetrical with broader upper half portion and narrow distally with slightly rounded apex. Siphonal capsule asymmetrical with larger outer arm line with tube and smaller curved inner arm. Tegmen with symmetrical and convergent parameres. Parameres thick, inwardly curved, slightly pointed at apex and covered with hair. Median lobe nearly equal to parameres, broad at base then tapering towards apex and rounded at tip. Trab long, narrow, curved and rounded tip.



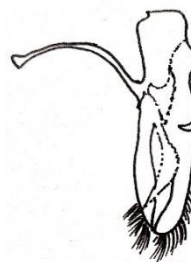
a



b



c



d

Fig. 2. *Harmonia dimidiata* : a). adult, b). Siphon, c). ventral view of tegmen , d). Side view of tegmen

Host /prey range- We found it from Rose and Milk weed (Crown flower) feeding on *M. rosae* and *A. nerii*. Other host and prey are- *Aphis pomi* and *Tetranychus urticae* on apple (Khan et al. 2009), *Cervaphis quercus* Takahashi, a serious pest of oak trees (Agarwala et al. 2009), Citrus psyllid on citrus orchards (Ramya and Thangjam 2016), *A. gossypii*, Thrips, Whitefly, leafhopper (Buragohain et al. 2017), *Capsicum chinense* Jacq pest of king chilli (Thangjam et al. 2020), *A. craccivora* on *Zea mays* (Rahatullah et al. 2011), *A. spiraecola*, *C. rappardi indica* (Omkar and Pervez 2004), *Acyrtosiphon pisum* Harris, *Aphis glycines* Matsumura, *Aphis nasturtii* Kalt., *Brevicoryne brassicae* Linn., *Rhopalosiphum maidis* Fitch, *Schizaphis graminum*

Rondani and *Aphis achyranthi* Theobald (Chaudhary and Singh 2012).

3. *Brumoides suturalis* (Fabricius, 1789)/ *Brumus suturalis* (Mulsant, 1850)

Sub-family- Chilocorinae

Tribe- Chilocorini

Material examined- 2023. v.19♂♀.

Morphological characters- The beetle was small about 2.6- 3.0 mm body length, 2.0- 2.2mm body width. Body oval without hair. Elytra creamy white with three black strips, one on each elytron and one at mid dorsal line. Pronotum reddish brown colour, head

also brown not concealed with a pair of prominent black eyes. Scutellum black, Body ventrally brown.

Male genitalia- Siphon elongated, highly curved forming a large loop, narrow and asymmetrical. Siphonal capsule also asymmetrical with outer irregular shaped shorter arm and inner longer curved arm. Siphonal apex thick and swollen. Tegmen with

symmetrical and large parameres densely covered with hair. Median lobe shorter than parameres and with few hair. Trabe long, narrow at base and swallowing at tip.

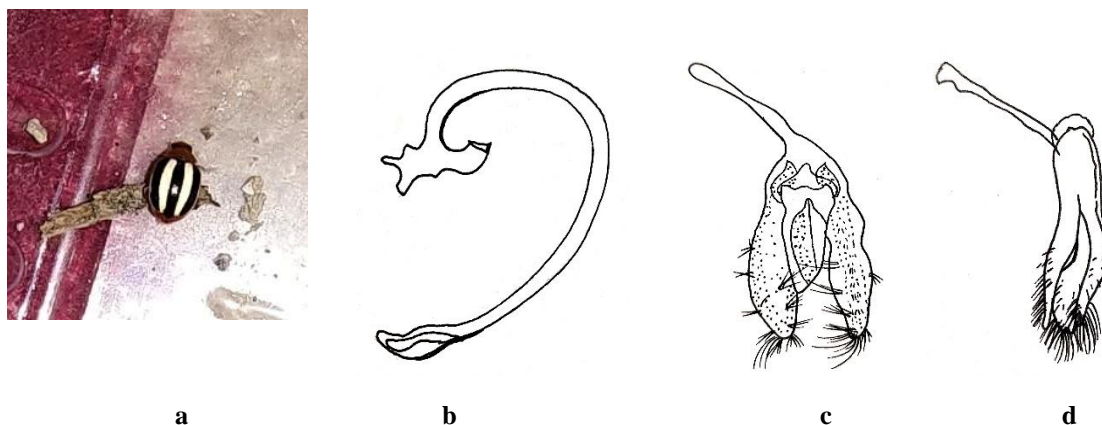


Fig. 3. *Brumoides suturalis*: a). adult, b). Siphon, c). ventral view of tegmen, d). side view of tegmen

Host/ Prey range- We found it from coriander feeding on *Hyadaphis coriandri* Das. Other host prey are-*Macrosiphum miscanthi* Takahashi on wheat, *A. gossypii* on okra, *A. craccivora* on cowpea (Gurung et al. 2019), *A. pisum*, *Aphis fabae* Scopoli, *H. coriandri*, *Therioaphis trifolii* Monell, *Aphis nerii* Boy. (Chaudhary and Singh 2012), *Macrosiphum granarium* Kby, *Phenacoccus solenopsis* Tinsley, *Drosicha mangiferae* Green, *Lipaphis erysimi* Kalt., *Myzus persicae* Sulzer, *B. brassicae*, *Rhopalosiphum maidis* Fitch, *Amrasca devastans* Dist, *Amrasca biguttula* Ishida on potato, lucerne, eggplant, okra, flowers and weeds (Bodlah et al. 2021). It was also found predated on scale insects, psyllids, mealy bugs, white flies, and mites in agroforestry fields, orchards and some forestry trees (Mishra and Yousuf, 2019).

4. *Propylea luteopustulata* (Mulsant)/ *Coelophora insularis* Sicard/ *Coelophora korschefskyi* Mader/*Coelophora luteopustulata* (Mulsant)/ *Coelophora victoriae* Mulsant/ *Oenopia luteopustulata* Korschefsky

Sub-family- Coccinellinae

Tribe- Coccinellini

Material examined- 2023. v.23♂♀.

Morphological characters- Medium sized beetle about 4.5- 5.5mm body length and 4.0- 5.0mm body width. Body oval and convex. Elytra red, orange and yellow with a variety of black patterns depending on their morph. A morph with 11 black spots arranged in a pattern of 1-2-2-1/2 was found. Pronotum black with anterolaterally white spots. Scutellum black continue with black mid dorsal line.

Male genitalia- Siphonal tube curved, Siphonal capsule highly expanded, symmetrical, Siphonal apex c shaped and pointed at tip. Tegmen with symmetrical parameres, broad at base, inwardly curved at mid, slightly rounded at tip and covered with hair. Median lobe of tegmen was segmented, narrow, curved, slightly larger than parameres and rounded at tip. Trab large, narrow proximally but flat and highly broad distally.

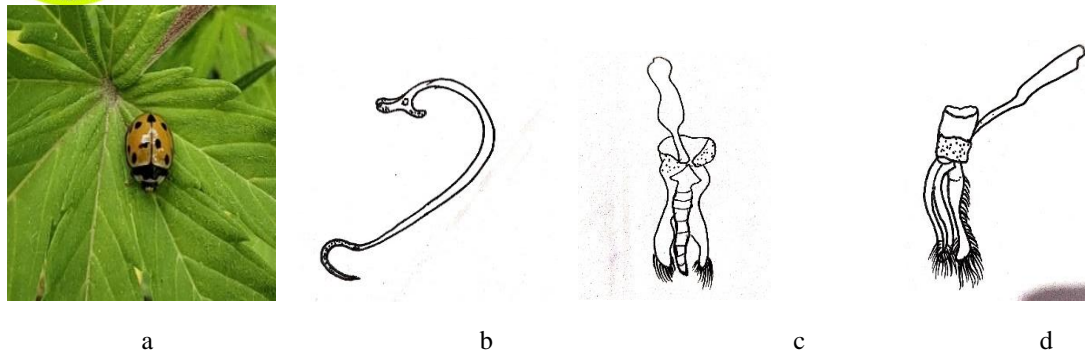


Fig. 4. *Propylea luteopustulata* a). adult, b). Siphus, c). ventral view of tegmen, d). side view of tegmen.

Host/prey range – we found it from *C. sativus* and *Lablab purpureus*, feeding on *A. gossypii*. Other host and prey are- *A. craccivora* on fruit orchards, *L. erysimi*, *B. brassicae* (Khan et al. 2009), *A. fabae*, *Brachycaudus helichrysi* Kalt., *Hyalopterus pruni* Geoffroy, *Macrosiphoniella sanborni* Gill., *Macrosiphum rosae* Linn., *M. persicae*, *R. maidis* and *Sitobion rosaeiformis* Das (Satpathi 2009). It was also collected from radish, brinjal (Sharma et al. 2017), wheat and mustard, feeding on aphids, psyllids and whiteflies (Rahatullah et al. 2011).

5. *Micraspis allardi* (Mulsant)/ *Lemnia allardi* Mulsant/ *Verania allardi* (Mulsant) /*Verania allardi* / *Verania malaccensis* Crotch

Sub-family- Coccinellinae

Tribe- Coccinellini

Material examined- 2023. iv.26♂♀.

Morphological characters- Small to medium sized beetle measuring about 4.6–5.0 mm in length and 3.4–3.6 mm in width. Elytra pink and red with four prominent black spots, two on each elytron, black mid-dorsal line also present. Pronotum with four black spots, two small dot shaped spots at the centre and two large spots at the base of each elytron. It has resemblance with *Micraspis discolor* with respect to pronotal pattern and elytral colour.

Male genitalia- Siphus narrow, thin and curved. Siphonal capsule asymmetrical inner narrow arm and outer wider arm which is expanded, thick and t shaped. Siphonal apex thin, narrow, pointed and slightly curved at tip. Tegmen with median lobe broad at base but slightly pointed at apex and nearly equal to parameres. Parameres strongly convergent and symmetrical. Trabe long, narrow, straight proximally but inward curved distally.

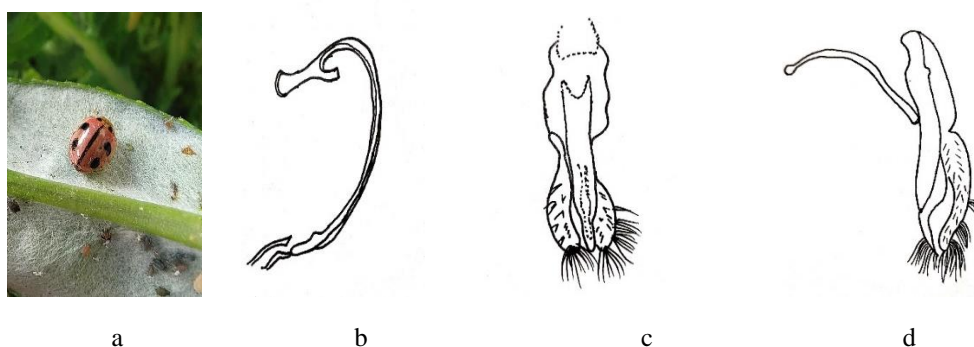


Fig. 5. *Micraspis allardi* a). adult, b). Siphus, c). ventral view of tegmen, d). side view of tegmen.

Host/prey range- We found it, feeding on *Macrosiphum granarium* Kby, *R. maidis* on wheat plants and *Lipaphis erysimi* on mustard. Other host prey are *Aphis fabae* Theobald, *A. gossypii*, *B. brassicae*, *A. craccivora*, *M. persicae* and *L. erysimi*

recorded as its prey (Omkar and Pervez 2004; Satpathi 2009; Chaudhary and Singh 2012). It was also found predated on wheat aphids (Abbas et al. 2013), crops including maize and potato (Ahmad et al. 2017).

6. *Anegleis cardoni* (Weise) /*Verania cardoni*/
Coelophora cardoni/ *Micraspis cardoni*

Sub-family- Coccinellinae

Tribe- Coccinellini

Material examined- 2023. iii.12♂♀.

Morphological characters- The beetles are small to medium in size, ranging from 3.8 to 5.0 mm in length and 3.4 to 4.6 mm in width. Their bodies are rounded, shiny, and devoid of hair. The elytra are either creamy or creamy yellow and display four black linear markings, with two on each elytron; the outer marking slightly curves inward. Additionally,

there is one black spot beneath each linear marking on each elytron. A single black mid-dorsal line is also present. Pronotum creamy with four black spots, two small spots at the centre and two large spots at the base of each elytron. Head creamy white, eyes black.

Male genitalia- Siphonal tube thick, highly curved at apex and slightly curved at mid region. Siphonal apex slightly rounded with spiny structures. Siphonal capsule thick asymmetrical with shorter inner arm and wider, larger outer arm. Parameres are more or less symmetrical, thick, with dense hair on subapical or apical region. Median lobe shorter than parameres, without hair and pointed at tip. Trabes short, and wide distally.

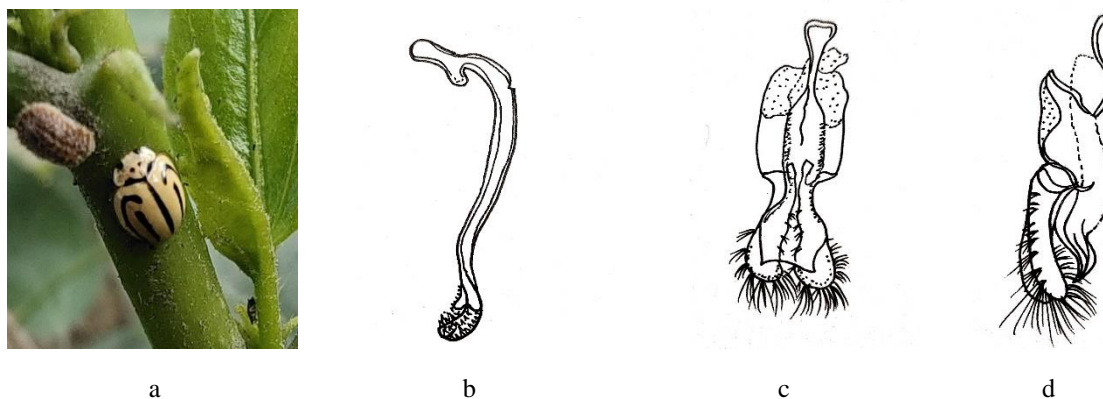


Fig. 6. *Anegleis cardoni* a). adult, b). Siphon, c). ventral view of tegmen, d). side view of tegmen.

Host/prey range- we found it from *Hibiscus rosa sinensis* feeding on *Maconellicoccus hirsutus* (mealybug). Other host and prey are- *A. gossypii* on Chilli (Gurung et al. 2019), *A. craccivora*, *Toxoptera citricida* Kirkaldy, *Toxoptera aurantii* Boyer de Fonscolom, *Centrocooccus insolitus* Green, *B. brassicae* (Omkar and Pervez 2004), *Macrosiphum euphorbiae* Thomas, *A. pisum* Harris (Omkar and Pervez, 2004; Satpathi, 2009), *A. fabae* (Satpathi, 2009), *L. erysimi* (Omkar et al. 2009). It was also found predated on mealy bugs and scale insects of *Hibiscus* (Kumar et al. 2017).

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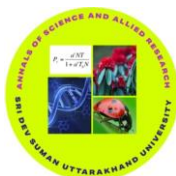
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