

Research articles

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First record of predation behaviour of *Perillus bioculatus* (Fabricius, 1775) (Pentatomidae: Asopinae) predating on *Aulacophora indica* (Gmelin, 1790) (Coleoptera: Chrysomelidae) a pest of bitter gourd in agro-ecosystem of Bihar, India

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Abstract

Perillus bioculatus (Fabricius) (Pentatomidae: Asopinae) was reported for the first time as predator of adult and immature pumpkin beetle, *Aulacophora indica* (Gmelin, 1790) (Coleoptera: Chrysomelidae), feeding on bitter gourd. Detailed description of *P. bioculatus* is provided along with field data and photographs, showing predation behavior. Distribution of *P. bioculatus* has also been given in India and elsewhere.

Keywords: Hemiptera, Pentatomidae, *Perillus bioculatus*, bitter gourd, *Aulacophora indica*, biocontrol, Bihar.

Introduction

The members of the subfamily Asopinae, are commonly known as predatory stink bugs, characterized by a strong four segmented rostrum. First segment of rostrum is thickened which makes it easier to prey upon. This subfamily comprises nearly 303 species from 63 genera worldwide (Rider *et al.*, 2018) and nearly 30 species in 17 genera from India (Salini, 2019). Two spotted stink bug, *Perillus bioculatus* is a native of North America and spread from Mexico to Canada (Froeschner, 1988). However, it was reported that this species was recently reported from many European countries (Derjanschi and

Elisoveţcaia, 2014 and Elisoveţcaia and Derjanschi, 2016). More or less at the same time, Prasad and Pal (2015) reported for the first time from North India (Meerut, Uttar Pradesh). Kaur (2020) reported *Perillus bioculatus* from Himachal Pradesh and Punjab and described morpho taxonomy and external genitalia. Both the nymph and adult of *P. bioculatus* are specialized predators of egg masses, larvae and adults of Colorado potato beetle, *Leptinotarsa decemlineata* (Say) in field populations, and effectively control the beetle in small scale release trials and in cage studies, both in different European countries and in the United States (Hough-Goldstein and McPherson, 1996). *Perillus bioculatus* has

been introduced into various parts of Europe since 1966 viz. Belgium, Czechoslovakia, France, Germany, Hungary, Italy, Poland, Russia, Slovakia, Ukraine and former Yugoslavia and also in Asia to control the Colorado potato beetle, *L. decemlineata* with varying success (Briand, 1936; Lipa, 1976; Tamaki and Butt, 1978; Jermy, 1980; Gusev, 1991; DeClercq, 2000 and Rabitsch, 2008).

In the present studies, *P. bioculatus* was first time reported as a potential hemipteran predator in agro-ecosystem of Bihar on pumpkin beetle, *Aulacophora indica* (Gmelin, 1790) belonging to family Chrysomelidae under field condition on bitter gourd plant. Predation behaviors and additional diagnostic characteristics of *P. bioculatus* along with its distribution have been provided. Species of *Aulacophora* cause serious damage of cucurbits, including *Aulacophora indica* (Gmelin, 1790) which is pest on number of cucurbits, viz. watermelon, cucumber, giant pumpkin, bottle gourd, bitter gourd Etc.

Materials and Methods

During field survey, *Perillus bioculatus* (Fabricius) (both adult and immature forms) predating on adult and grub of pumpkin beetle, *Aulacophora indica* (Gmelin, 1790) belonging to family Chrysomelidae (Fig. 2a & 2b) were collected in the bitter gourd cultivation at Thakurbari Mard (N: 25.056244, E: 85.566066) and Gokhulpur (N: 25.327458, E: 85.409104) in

Nalanda district of Bihar. Photographs of both predator (pentatomid bug) and pest (*A. indica*) were taken by using camera Nikon D7000 in field.

Specimens were collected carefully and killed by using killing jar having ethyl acetate. Collected specimens were set and pinned and identified. Additional diagnostic characters have been provided for *Perillus bioculatus*. Measurements of various body parts and images were taken with Leica M 205A. The specimens were deposited in the National Zoological Collection of Zoological Survey of India, Kolkata.

Results

The predatory pentatomid bug *Perillus bioculatus* has been reported for the first time from eastern part of India (Nalanda, Bihar) predating upon pumpkin beetle, *Aulacophora indica* (Chrysomelidae) a major pest of bitter gourd in Bihar. During the present studies, it has been observed that both adult and immature forms of *P. bioculatus* feeding on the grub and adult of *Aulacophora indica* (Fig. 2a, 2b), which is a serious pest of bitter gourd plant. *Perillus bioculatus*, was also found to be predating on the grubs of *Zygogramma bicolorata* Pallister (Coleoptera: Chrysomelidae) on *Parthenium* from Meerut (Uttar Pradesh), North India (Prasad and Pal, 2015) and larvae of poplar leaf beetle, *Chrysomela populi* L. (Coleoptera: Chrysomelidae), on poplar plant from Turkey's Anatolian side (Tarla and Tarla, 2018).

Perillus bioculatus (Fabricius, 1775) (Fig. a-h).

General body features: Macropterous form, body oblong, ovate, shiny, body length 10.51 mm. in male (Fig. 1e) and 10.91 mm. in female (Fig. 1a). Head, pronotum and scutellum coarsely and sparsely punctate, while corium finely punctate. *Perillus bioculatus* shows sexual dimorphism, as the colour of male (reddish brown with dark patterns on head, pronotum, scutellum and corium) is different from female (light dusky brown with dark patterns on head, pronotum, scutellum and corium).

Male

Dorsal Coloration:

Head is black and punctate; eyes are brownish; ocelli dark red; antennal segments are black; pronotum is bicolour with anterior reddish and posterior black portion; anterior half of pronotum is provided with two broad transverse black spots more or less triangular in shape. scutellum is reddish brown with a central Y-shaped black fascia, anterolateral margins of scutellum and clavus are black. Corium is black with outer margins reddish brown.

Ventral Coloration:

Head, rostrum, sternum and peritreme are black; abdomen is reddish in colour with broad black fascia with pilose (except 3rd segment), 4th, 5th and 6th segments laterally.

Legs are black, mid and hind tibia provided with light brown annulations in the middle, spiracles are black.

Structure:

Head: Head wider than long (Fig. 1g), coarsely and sparsely punctate, apex rectilinear, lobes are of equal length. Head length: 1.120 mm, head width across eye: 2.230 mm, inter-ocular distance: 1.223 mm. Antennae five-segmented, A1: 0.227 mm<A3: 0.802<A2: 0.908 mm<A4: 1.207 mm< A5: 1.266 mm. Rostrum robust, four-segmented, reaching mesocoxae (Fig. 1h), R3: 0.394 mm<R4: 0.561 mm<R1: 0.932 mm< R2: 1.121 mm.

Thorax: Pronotum sub-triangular, wider than long, pronotal length 2.534 mm and width 5.823 mm, anterior pronotal angles obtusely rounded with a spine, posterior pronotal angles rounded (Fig. 1g); scutellum slightly longer than broad (length: 3.713 mm and width: 3.668 mm) (Fig. 1e), apex rounded; hemelytral membrane passing tip of abdomen (Fig. 1f); fore and mid tibia slightly shorter than femora.

Abdomen: Abdomen slightly longer than broad (length: 5.338 mm and width: 5.280 mm) (Fig. 1f).

Female:

Dorsal Coloration:

Head is brownish with a tinge of black and punctate; eyes brownish; ocelli dark red;

antennal segment I, II and basal part of III are light brown, while rest are black in colour; pronotum is bicolour with anterior light brown and posterior part dark brown; anterior part of pronotum is provided with two broad triangular shaped, transverse brownish black spots. Scutellum light brown with a central Y-shaped brownish-black fascia; anterolateral and basal margins of corium light brown (Fig. 1a).

Ventral Coloration:

Head is brown, prosternum is yellowish with an anterolateral black fascia, middle portion of mesosternum is black, metathoracic scent gland peritreme light brown with black spots; abdomen light brown in colour with broad black continuous fascia on III, IV, V and VI segments sub-laterally. Legs are dark brown, mid and hind tibia with light brown annulations in the middle, spiracles black (Fig. 1b).

Structure:

Head: Head wider than long (Fig. 1c), coarsely and sparsely punctuate, apex rectilinear, lobes are of equal length. Head length: 1.242 mm, head width across eye: 2.381 mm, inter-ocular distance: 1.210 mm. Antennae five-segmented, A1: 0.289 mm < A2: 0.991 mm < A3: 1.037 mm < A5: 1.142 mm < A4: 1.256 mm. Rostrum robust, four-segmented, reaching mesocoxae (Fig. 1d), R3: 0.436 mm < R4: 0.6 mm < R1: 0.974 mm < R2: 1.134 mm.

Thorax: Pronotum sub-triangular, wider than long, pronotal length 3.111 mm and width 6.450 mm; anterior and posterior pronotal angles same as in case of male (Fig. 1c); scutellum slightly broader than long (length: 3.921 mm and width: 4.173 mm) (Fig. 1a), apex rounded; hemelytral membrane passing tip of abdomen (Fig. 1b).

Abdomen: Abdomen slightly longer than broad (length: 6.188 mm and width: 6.039 mm). Ventroanterior and ventroposterior margins of VII abdominal sternite is medially concave, look like an inverted broad U-shaped (Fig. 1b).

Material examined: 1 ♂, 1 ♀, Thakurbari Mard, Nalanda, Bihar, N: 25.056244, E: 85.566066, 25.viii.2021, coll. M.E. Hassan and party; 1 ♂, 1 nymph, Gokhulpur, Nalanda, Bihar, N: 25.327458, E: 85.409104 on 27.viii.2021, coll. M.E. Hassan and party.

Distribution: India (Bihar, Himachal Pradesh, Punjab, Uttar Pradesh), *Elsewhere:* Bulgaria, Canada, Czechoslovakia, France, Germany, Greece, Mexico, Republic of Moldova, Russia, Serbia, Turkey, USA, Yugoslavia.

Discussion

Aulacophora indica (Coleoptera: Chrysomelidae) is one of the major pests of bitter gourd (*Momordica charantia*) of the family Cucurbitaceae, which is an important vegetable crop in India which have a unique bitter taste and medicinal value, as bitter gourd

is considered a rich source of vitamins (88 mg / 100 g of vitamin C) and minerals. Bitter gourd has medicinal value and is used for curing diabetes, asthma, blood diseases and rheumatism. Drinking fresh bitter gourd juice is recommended by naturopaths and roots and stem of wild bitter gourd are used in many ayurvedic medicines.

Mature and immature stages of *Aulacophora indica* (Gmelin, 1790) cause serious damage of cucurbits including bitter gourd. It causes large holes in leaves and may cause partial or complete defoliation, sometimes they also damage flowers (Sahu and Samal, 2020). No information is available about the natural control of this beetle. Present studies are the first to report *P. bioculatus* as predator on mature and immature stages of *Aulacophora indica*, a potential bio-control agent under field condition on bitter gourd plant. Generally, immature *P. bioculatus* approaches pumpkin beetle, *Aulacophora indica* for predation and penetrate its rostrum (4th segment completely) in the lower abdomen (ventrally) of the mature beetle. In the IPM, of *A. indica*, addition of new dimension of *P. bioculatus* as predator will complement the pest management in bitter gourd ecosystem and other cucurbits. Among hemipteran predator, *Perillus bioculatus*, is an important natural biocontrol agent of the pumpkin beetle, *Aulacophora indica* under field condition on bitter gourd plant. Adults and nymphs of *Perillus bioculatus* were observed predating both mature beetle and immature stages

(grubs). Further studies have to be conducted for the estimation of predation potential of *Perillus bioculatus* to the pumpkin beetle, *A. indica* both under laboratory and in natural condition so that *P. bioculatus* can be introduced in bitter gourd and other cucurbit ecosystems in India.

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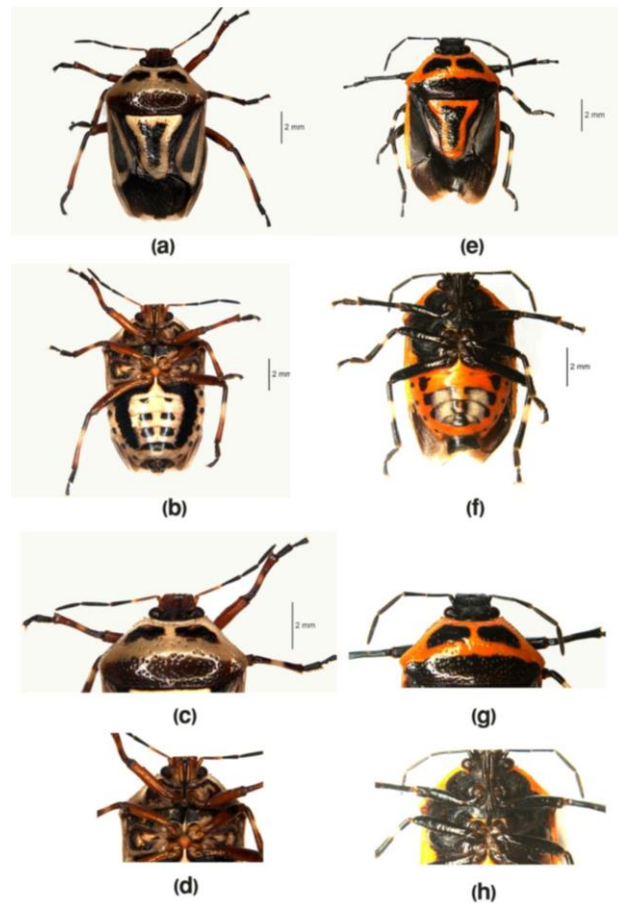


Fig 1

Fig. 1. *Perillus bioculatus*. (female, a-d), **1a.** Dorsal view **1b.** Ventral view, **1c.** Head and pronotum (dorsal view), **1d.** head and thorax (ventral view), (male, e-h), **1e.** Dorsal view, **1f.** Ventral view, **1g.** Head and pronotum (dorsal view), **1h.** Head and thorax (ventral view).

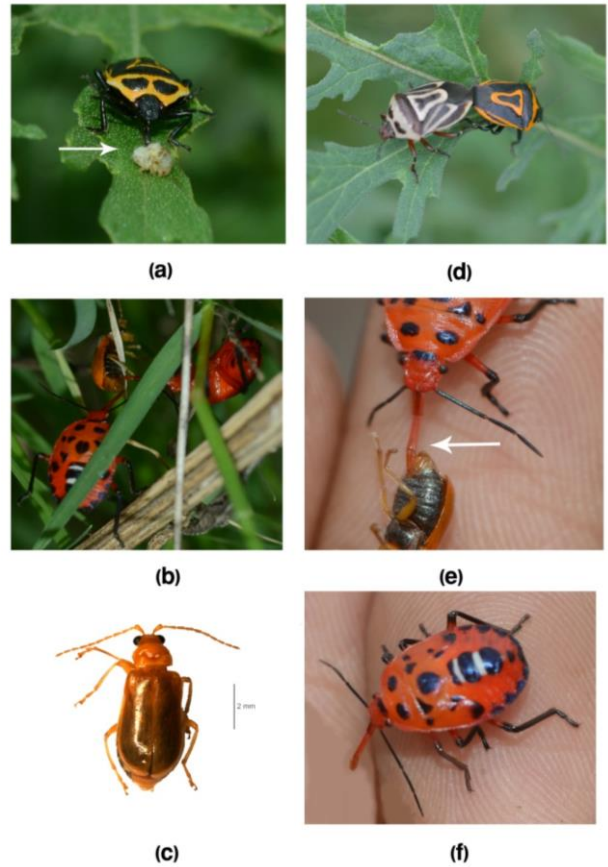


Fig 2

Fig. 2a. *P. bioculatus* predating on the grub, **2b.** Immature forms of *P. bioculatus* predating on adult of *Aulacophora indica*, **2c.** Mature *Aulacophora indica* (dorsal view), **2d.** showing mating behaviour of *P. bioculatus* in the field, **2e.** Immature *P. bioculatus* penetrated its rostrum (4th segment completely) in the lower part of abdomen (ventrally) to the mature *A. indica*, **2f.** nymph of *P. bioculatus*.

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