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PARASITIDS (HYMENOPTERA) OF LEAFMINER FLIES (DIPTERA: AGROMYZIDAE) FROM BANGLADESH

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Abstract: The objective of this study was to determine hymenopteran parasitoids attacking leafminers (Agromyzidae: Diptera) in Bangladesh. Four parasitoid species, viz. *Chrysocharis pentheus* (Walker), *Neochrysocharis formosa* (Westwood) and *Cirrospilus* sp. belonging to family Eulophidae and *Opius* sp. under family Braconidae of the order Hymenoptera are reported as new to the fauna of Bangladesh. All parasitoids were reared from three agromyzid flies namely *Liriomyza sativae* Blanchard, *Melanagromyza obtusa* Malloch and *Ophiomyia phaseoli* (Tryon).

Keywords: Agromyzid leafminers, Bangladesh, new record, Parasitoids.

The leafminers (Diptera: Agromyzidae) are pests of economic importance on several vegetable and ornamental plants growing around the world. The known world of vegetable leafminers is more than 3000 species (Gençer 2004; Shahreki et al. 2012). Damage is caused by larval feeding in the spongy mesophyll layer of the leaf and by the feeding and oviposition punctures of the agromyzid females. The feeding punctures, referred to as stippling, can decrease photosynthesis and create entry sites for plant pathogens. Agromyzid larval mining can also decrease photosynthesis rates and can reduce tissue conductance (Rauf et al. 2000; Chow & Heinz 2004). The hymenopteran parasitoid complexes associated with agromyzid flies are of great importance

in biological control (Johnson 1993; Murphy & LaSalle 1999). Parasitoids that are among natural enemy's assemblages of agromyzid leafminers are dominated by Eulophidae, Braconidae and Pteromalidae that attack the larval and pupal stages of the flies (Waterhouse & Norries 1987; Gratton & Welter 2001). A number of parasitoids of leafminers have been recorded throughout the world (de Roman & de Hamity 1985; Heimpel & Meloche 2001; Petcharat et al. 2002; Tran et al. 2005; Li & Seal 2010). More than 140 species of parasitoids as natural enemies of *Liriomyza* belonging to agromyzid leafminer flies have been reported from the world (Liu et al. 2009). The present study constitutes the first record of parasitoids of agromyzid leafminers as no earlier report is available from Bangladesh.

MATERIALS AND METHODS

A field study was carried out from January 2011 to April 2013 in different cultivated vegetable fields of Bangladesh to find out hymenopteran parasitoids of agromyzid leafminers. Leafminer-infested leaves were brought to the laboratory and kept in a controlled temperature (23±1°C) and humidity (67±2%RH). Leaves of different host plants were placed in plastic rearing

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boxes (15X25 cm), with the rectangular holes covered with a fine screen for air ventilation. Emerging parasitoids and their host agromyzid leafminers were collected and preserved for identification. The pin and card mounted specimens were imaged with a Digital 3D imaging Microscope. For identification of agromyzid parasitoids keys provided by Gibson et al. (1997), Goulet & Huber (1993), Narendran (2011) and Hansson (1997) were used. All identified specimens have been deposited in the Insect Museum, Department of Zoology, University of Chittagong, Bangladesh.

RESULTS

Four hymenopteran parasitoid species were reared from three agromyzid leafminers. The identified parasitoids and their leafminer hosts are given in Table 1.

Chrysocharis pentheus (Walker, 1839) (Image 1)

Entedon pentheus Walker, 1839: 38. Lectotype, designated by Graham 963b: 225, deposited in The Natural History Museum, London SW7 5BD, England. Type locality: United Kingdom. *Chrysocharis pentheus* (Walker).

Material studied: IMZDCU 0021, 3 males, 16.ii.2011, ex. *S. lycopersicum*, Hathazari, Chittagong, Bangladesh, coll. S. Mazumdar.

Diagnostic characters: Body length 1.2mm, metallic blue green; antenna brown, scape yellow; three-fourth of coxae and tertsae brownish; femora and tibiae pale yellow to white; forewing completely hyaline, relatively broad: 2.0–2.15 times longer than wide; pronotum small, narrow, invisible dorsally.

Host: *L. sativae* (Agromyzidae: Diptera) (present study), Bruchidae, Curculionidae (Coleoptera); Agromyzidae, Cecidomyiidae (Diptera); Cynipidae, Tenthredinidae (Hymenoptera); Bucculatricidae, Coleophoridae, Elachistidae, Eriocraniidae, Gelechiidae, Gracillariidae, Heliozelidae, Lyonetiidae, Momphidae, Nepticulidae, Tischeriidae, Yponomeutidae (Lepidoptera) (Noyes 2009); Agromyzidae (Diptera), Gracillariidae (Lepidoptera) (Mafi & Ohbayashi 2010).

Distribution: Bangladesh - Chittagong (present work); Austria, Bulgaria, Canada, Canary Islands, China, Croatia, Cyprus, Czech Republic, Denmark, England, Finland, France, Germany, Greece, Hungary, Israel, Italy, Japan, Korea, Macedonia, Malaysia, Moldova, Netherlands, Norway, Poland, Romania, Slovakia, Spain, Sweden, Switzerland, Taiwan, Turkey, Ukraine, United States of America, Ussr, Serbia (Noyes 2009; Mafi & Ohbayashi 2010).

Table 1. List of parasitoids reared from agromyzid leafminers

	Parasitoid spp.	Host
Eulophidae: Entedontinae		
1	<i>Chrysocharis pentheus</i> (Walker, 1839)	<i>Liriomyza sativae</i> Blanchard, 1938
2	<i>Neochrysocharis formosa</i> (Westwood, 1833)	<i>Melanagromyza obtusa</i> Malloch, 1914 <i>Liriomyza sativae</i> Blanchard, 1938
Eulophidae: Eulophinae		
3	<i>Cirrospilus</i> sp.	<i>Liriomyza sativae</i> Blanchard, 1938
Braconidae: Opiinae		
4	<i>Opius</i> sp.	<i>Liriomyza sativae</i> Blanchard, 1938 <i>Melanagromyza obtusa</i> Malloch, 1914 <i>Ophiomyia phaseoli</i> (Tryon, 1895)



Image 1. *Chrysocharis pentheus* (Walker, 1839), lateral view.

Neochrysocharis formosa (Westwood, 1833) (Image 2)

Closterocerus formosus Westwood, 1833: 420. Type status unknown, deposited in Hope Department, Oxford Univeristy, Oxford, England. Type locality: United Kingdom.

Chrysocharis obscuripes; Hansson, C. 1990: 46–47. New synonym of *Neochrysocharis formosa* (Westwood).

Material studied: IMZDCU 008, 5 males, 23.iii.2012, ex. *S. lycopersicum*, Hathazari, Chittagong, Bangladesh, coll. S. Mazumdar.

Diagnostic characters: Body length: 1.6mm, scape almost entirely pale yellow, thoracic dorsum with strong and dense reticulation and dorsum slightly flattened; mesoscutum with notaular depressions narrow and distinct throughout; postmarginal vein 0.5–1.0 times as long as stigma vein; coxae dark metallic in contrast to legs.

Host: *L. sativae* (Agromyzidae: Diptera) (present study); *Tuta absoluta* (Gelechiidae: Lepidoptera) (Luna et al. 2011).

Distribution: Bangladesh - Chittagong, Hathazari;



Image 2. *Neochrysocharis formosa* (Westwood, 1833), lateral view.



Image 3. *Cirrospilus* sp. dorsal view.

Holarctic, Mexico, North Africa and Southeast Asia (Noyes 2002, 2003), widespread distribution in West Palearctic, Nearctic region, Africa and Europe (Gençer 2004); Argentina (Luna et al. 2011).

Genus *Cirrospilus* Westwood, 1832 (Image 3)

Cirrospilus Westwood, 1832: 128. Type species: *Gyrolasella elegantissimus* Westwood; by monotypy.

Material studied: IMZDCU 009, 1 male, 06.xi.2012, ex. *S. lycopersicum*, Hathazari, Chittagong, Bangladesh, coll. S. Mazumdar.

Diagnostic characters: Body length 1.1mm; funicle 2 segmented in both sexes; notaulus usually complete, straight, ending at or near junction of anterior margin of scutellum and axilla; scutellum usually with longitudinal submedian grooves, although sometimes indistinct or even absent except for coloration; postmarginal vein at most 1.5 times longer than stigmal vein, often equal to or shorter in length; petiole very short.

Host: *L. sativae* (present study); *Phyllocnistis citrella* (Gracillariidae: Lepidoptera) (Urbaneja et al. 2001), Leafminers (Lepidoptera and Diptera) (Zhu et al. 2002).

Distribution: Bangladesh - Chittagong (present work); worldwide (Noyes 2009).

Genus *Opius* Wesmael, 1835 (Image 4)

Opius Wesmael, 1835: 113; Fischer, 1972b: 67–69. Type species (designation by Muesebeck and Walkley (1951), validated by ICZN Opinion 1497 (1988): *Opius pallipes* Wesmael, 1835.

Material studied: IMZDCU 001, 2 males, 3 females, 06.vii.2011, ex. *S. lycopersicum*, Hathazari, Chittagong, Bangladesh, coll. S. Mazumdar.



Image 4. *Opius* sp., lateral view

Diagnostic characters: Body length 1.2mm; occiput not margined; 2RS without thickening; outer margin of first subdiscal cell completely formed or first subdiscal cell apically anterior margin of clypeus rounded or straight; mandibles in the resting position closed; temple without diagonal fold in the middle; maxillary palpi 6-segmented, labial palpi 4-segmented; fore wing with three sub marginal cells; r arising behind the base of the stigma; marginal cell closed; none particularly thickened vein visible; second sub marginal cell relatively elongate; mesosoma without particular colour markings, spine or process; tarsomere 2-4 not remarkably short; metasomal tergites separated through a fine suture, not uniform (fused) like structure formed or tergites not fused to form carapace.

Host: *M. obtusa*, *O. phaseoli* and *L. sativae* (present study); fruit-infesting Tephritidae, leaf-mining Agromyzidae and Anthomyiidae (Diptera) (Wharton &

Norrbom 2013).

Distribution: Bangladesh - Chittagong, Panchlaish, Potenga, Cox's Bazar, Rajshahi, RU campus (present work); India, Australia, Bulgaria, Brazil, Venezuela, Senegal, England, Papua New Guinea, Western And South-Eastern Australia, Philippine Islands, Bismarck-Archipelago, South Africa, Singapore, Argentina, Costa Rica, Colombia, Congo Republic (Belokobylskij et al. 2004; Fischer 2005; Samiuddin et al. 2009); Belgrade, Serbia and Montenegro (Brajković et al. 2005).

DISCUSSIONS

The parasitoids viz. *C. pentheus*, *N. formosa*, *Cirrospilus* sp. and *Opius* sp. were recorded from three vegetable leafminers namely *Liriomyza sativae*; *Melanagromyza obtusa* and *Liriomyza sativae*; *Liriomyza sativae*; and *Liriomyza sativae*, *Melanagromyza obtusa* and *Ophiomyia phaseoli* respectively. In Japan, *C. pentheus* is a very common parasitoid of Agromyzidae such as: *Agromyza albipennis* Meigen, *A. oryzae* Munakata, *Phytomyza horticola* Gourea, *P. ranunculi* Schrank, *P. paniculatae* Sasakawa, *Calycomyza humeralis* Roser, and *Agromyzid* sp. on *Gentiana* (Mafi & Ohbayashi 2010) where as *C. pentheus* has been found in *L. sativae* (Agromyzidae: Diptera) in the present study. Moreover, Luna et al. (2011) reported *N. formosa* as a parasite of *Tuta absoluta* (Gelechiidae: Lepidoptera) where as it has been reared from *L. sativae* (Agromyzidae: Diptera) in the present study. In addition, among them *N. formosa* was the most abundant species accounting for approximately 57% of all reared parasitoids. A total number of 22 species of genus *Cirrospilus* has been described in North America, (Burks 1979; Gates 2000). In addition, Zhu et al. (2002) provided a key to twenty Chinese *Cirrospilus* species. *C. vittatus* was reared from leafminers *L. sativae* and *L. trifolii* in Iran (Asadi et al. 2006). Besides, Urbaneja et al. (2001) reported it as a pest of *Phyllocnistis citrella* (Gracillariidae: Lepidoptera). In the present study only a single specimen of *Cirrospilus* sp. was found from *L. sativae*. As a parasitoid of *Ophiomyia phaseoli*, *Opius phaseoli* was recorded in East Africa and Ethiopia (Greathead 1975; Abate 1991; Waterhouse 1998). The rapid control of *Ophiomyia phaseoli* was achieved in Hawaii following the introduction of *Opius phaseoli* and *O. importatus* (Waterhouse 1998). Chen & Weng (2005) published an overview of the Opiinae from China where he listed 121 species. Nineteen new Indian species of the genus *Opius* under the subfamily Opiinae were described by Samiuddin et al. (2009). On the other hand, *Opius* sp. has been reported in the present study for the first time. This species has been collected from

M. obtusa; *O. phaseoli* and *L. sativae*. The present investigation reveals that *Opius* sp. is a comparatively common parasitoid among other reared parasitoids obtained from the three agromyzid flies.

CONCLUSION

This study implies that these native parasitoids might be considered for control of agromyzid leafminer pests.

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