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Leafminer flies (Diptera: Agromyzidae) are a highly diverse group of exclusively phytophagous species and they comprise more than 3000 known species worldwide (Braun et al. 2008; 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 females. The feeding punctures, referred to as stippling, can decrease photosynthesis and create entry sites for plant pathogens. Larval mining can also decrease photosynthesis rate and can reduce tissue conductance (Rauf et al. 2000; Chow & Heinz 2004). Sasakawa (1997) recorded 11 species of agromyzid flies from Ryukyus, Japan. Shiao & Wu (1999) worked on the subfamily Agromyzinae of Taiwan and recorded 38 species under 15 genera. Sehgal et al. (1980) have reported 11 species of agromyzid flies associated with 25 different species of leguminous host plants in northern India. In addition, Thapa (2011) has reported 28 species of agromyzid flies belonging to seven genera reared and described on 34 different leguminous host-plants from Pantnagar, Nainital, northern India. Benavent-Corai et al. (2005) published a research article from Brazil on host-plant interactions where eight agromyzid species were reared from 18 plant species of the family Asteraceae. In Poland, about a dozen species of agromyzid leafminers occur on cereals and locally they might occur in high abundance (Walczak & Roik 2010). Scheffer & Lewis (2005), Scheffer et al. (2006, 2007) and Winkler et al. (2009) worked on the molecular phylogeny and systematics of agromyzid flies.

In Bangladesh, agromyzids were reported by

VEGETABLE LEAFMINERS (DIPTERA: AGROMYZIDAE) AND THEIR PLANT HOSTS IN BANGLADESH

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different authors (Rahman et al. 1983; Ahmed 2005; Bhuiya et al. 2011). Information on the host plants of *Liriomyza* sp. is also available for Bangladesh (Aker et al. 2001; Bhuiya et al. 2010). In the present paper, four agromyzid leafminers *Liriomyza chinensis* (Kato), *L. sativae* Blanchard *Melanagromyza obtusa* Malloch and *Ophiomyia phaseoli* (Tryon) and their 17 plant hosts from Bangladesh are being reported.

Materials and Methods: Field study was carried out from January 2011–April 2013 in different cultivated vegetable fields of Bangladesh. Leafminer infested leaves were brought to the laboratory and kept in a controlled environment: temperature (23±1 °C) and humidity (67±2 %RH). Leaves of different host plants were placed in plastic rearing boxes (15x25 cm) with rectangular holes covered with a fine screen for ventilation. Emerging vegetable leafminers were collected and preserved for identification. Lastly, 17 vegetables were confirmed as plant hosts of reared agromyzid flies. The pin and card mounted specimens were imaged with a digital 3D imaging microscope. For identification of leafminer flies keys provided by Sasakawa (1961, 1963a,b), Spencer (19730), Spencer & Steyskal (1986), Shiao et al. (1991), Shiao & Wu (1999),

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Zhu et al. (2002), Dempewolf (2004), and Shiao (2004) were followed. Some critical specimens were sent to the taxonomist of Systematic Entomology Laboratory, NMNH, Smithsonian Institution, Washington, D.C. for confirmation. All identified specimens have been deposited in the Insect Museum, Department of Zoology, University of Chittagong, Bangladesh.

Results: Four vegetable leafminers were reared from the 17 collected vegetables (Table 1).

Table 1. List of reared vegetable leafminers and their host plants.

	Scientific name of vegetable leafminer	Subfamily of vegetable leafminer	Scientific name of host plants with common name in parenthesis
1	<i>Liriomyza chinensis</i> (Kato, 1949)	Phytomyzinae	<i>Allium cepa</i> L. (Onion)
2	<i>Liriomyza sativae</i> Blanchard, 1938		<i>Brassica juncea</i> (L.) Czern (Indian mustard)
			<i>Brassica oleracea</i> var <i>botrytis</i> L. (Cauliflower)
			<i>Brassica oleracea</i> var. <i>capitata</i> L. (Cabbage)
			<i>Brassica rapa</i> L. subsp. <i>rapa</i> (Turnip)
			<i>Citrullus lanatus</i> (Thunb.) Matsum. & Nakai (Water Melon)
			<i>Cucumis melo</i> L. var. <i>melo</i> (Musk Melon)
			<i>Cucumis sativa</i> L. (Cucumber)
			<i>Cucurbita maxima</i> Duchesne (Sweet Gourd)
			<i>Lablab purpureus</i> (L.) Sweet subsp. <i>purpureus</i> (Country Bean)
			<i>Phaseolus vulgaris</i> L. (French Bean)
			<i>Pisum sativum</i> L. (Pea)
			<i>Solanum lycopersicum</i> L. (Tomato)
<i>Solanum melongena</i> L. (Brinjal)			
<i>Vigna unguiculata</i> (L.) Walp. (Cowpea)			
3	<i>Melanagromyza obtusa</i> Malloch, 1914	Agromyzinae	<i>Glycine max</i> (L.) Merr. (Soya Bean)
4	<i>Ophiomyia phaseoli</i> (Tryon, 1895)		<i>Lablab purpureus</i> (L.) Sweet subsp. <i>purpureus</i> (Country Bean)
			<i>Phaseolus aureus</i> Roxb. (Mung Bean)
			<i>Lablab purpureus</i> (L.) Sweet subsp. <i>purpureus</i> (Country Bean)
			<i>Solanum lycopersicum</i> L. (Tomato)
			<i>Vigna unguiculata</i> (L.) Walp. (Cowpea)

Liriomyza chinensis (Kato, 1949) (Image 1)

Liriomyza chinensis (Kato, 1949) comb. and stat. nov. Spencer, 1973, Agromyzidae (Diptera) of economic importance: 164.

Diagnostic characters: Body length 1.3mm; head largely yellow, face, genae and postgenae yellow; occiput and vertical angles brown; orbits slightly brownish-tinged; lunule low semicircular; third antennal segment distinctly angulate, with distinct point at upper corner; wing length 1.3–2.0 mm; mesonotum greyish-black, scutellum entirely dark, femora yellow. In female ninth sternite bearing eight marginal setae.

Host plants: *A. cepa* (Onion) (present study); *A. cepa*, *A. bakeri*, *A. fistulosum*, and *A. odorum* (Sasakawa 1961); *A. porrum* (Martinez, 1982).

Distribution: Bangladesh: Rajshahi (present work), Taiwan, Thailand, Vietnam, France, China, Indonesia, Japan, Republic of Korea, Malaysia and Singapore (Martinez 1982).

Material studied: IMZDCU 004, 1 male, 14.iii.2011, ex. *A. cepa*, Ramchandrapur, Rajshahi, Bangladesh, coll. S. Mazumdar.

Liriomyza sativae Blanchard, 1938 (Image 2)

Liriomyza sativae Blanchard, 1938: An. Soc. Cient. Santa Fe, 126: 352.

Diagnostic characters: Body length 1.12mm; mat gray with black and yellow spots; upper orbit darkened; mesopleuron yellow, black marking along the lower, front, and hind margins; femora yellow; wing length



Image 1. *Liriomyza chinensis* (Kato, 1949)



Image 2. *Liriomyza sativae* Blanchard, 1938

1.3–1.7 mm; orbital setulae sparse, reclinate; third antennal segment small, round; mesonotum brilliantly shining black; three post-sutural and one presutural dorsocentral bristles, acrostichal bristles irregularly in four rows; squamae yellowish, margin and fringe dark; a vertical margin in the 2nd abdominal segment.

Host plants: *B. juncea* (Indian mustard), *B. oleracea* (Cauliflower); *B. oleracea* (Cabbage), *B. rapa* (Turnip), *C. lanatus* (Water melon), *S. lycopersicum* L (Tomato); *S. melongena* (Brinjal), *C. melo* (Musk Melon); *C. sativa* (Cucumber), *C. maxima* (Sweet Gourd) *L. purpureus* (Country Bean); *P. vulgaris* (French Bean), *P. sativum* (Pea), *V. unguiculata* (Cowpea); (present study); *P. vulgaris* (French Bean) (Zhao & Kang 2002).

Distribution: Bangladesh (Bhuiya et al. 2011); North, South, and Central America. In the Pacific it is present in Tahiti, Guam, New Caledonia, American and Western Samoa, Vanuatu, Cook Is. and Hawaii, Jamaica (Spencer 1965); Argentina, Peru, Venezuela (Spencer 1973); Yemen, Oman (Deeming 1992); Sudan, Cameroon (Martinez & Bordat 1996), Nigeria (Deeming & Mann 1999). Japan, Vietnam, Turkey, Indonesia and India (Sasakawa 1961).

Material studied: IMZDCU 005, 2 males and 9 females, 16.vii.2011, ex. *S. lycopersicum*, Chittagong, BARI, Hathazari, coll. S. Mazumdar.

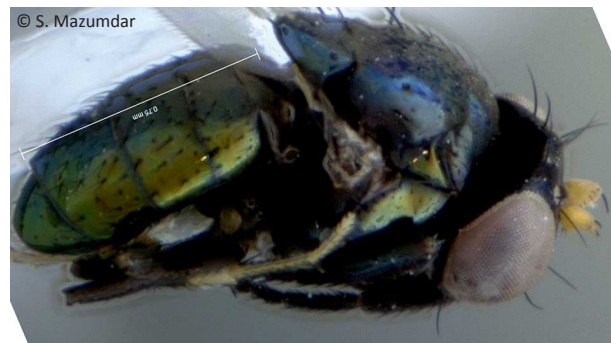


Image 3. *Melanagromyza obtusa* Malloch, 1914

***Melanagromyza obtusa* Malloch, 1914 (Image 3)**

Agromyza obtusa Mali, 1914, Ann. Hist.-Nat. Mus. Hung. 12: 323.

Melanagromyza obtusa Malloch, 1914

Diagnostic characters: Body length 1.60mm, fringe on calypter white to yellowish; ocellar triangle large, extending to dorsal margin of lunule; mesonotum distinctly bluish shining; abdomen greenish; antennae and legs completely black; halteres black with light brown stalks, fore tibia without bristle; wing length 1.25mm.

Host plants: *L. purpureus* (Country Bean), *G. max* (Soya Bean), *P. aureus* (Mung Bean) and *V. unguiculata* (Cowpea) (present work); *Cajanus* (Arhar), *Dunbaria* (Heyne's Pigeonpea); *Flemingia* (Slender Flemingia); *Rhynchosia* (Himalayan Snoutbean), and *Tephrosia* (White Hoary Pea) (Shanower et al. 1998).

Distribution: Bangladesh: Chittagong, CU campus; Hathazari; Cox's Bazar, St. Martin's Island (present work); India (Yadav & Yadav 2013); Myanmar, Nepal, Pakistan, Philippines, Thailand, Vietnam, China, Taiwan, Indonesia, Malaya, Sri Lanka, New Guinea and Japan (Delfino & Hardy 1967; Shanower et al. 1998, 1999; Spencer 1973) and Australia (Spencer 1999).

Material studied: IMZDCU 002, 2 males, 28.vii.2011, ex. *L. purpureus*, Chittagong, Panchlaish, coll. S. Mazumdar.

***Ophiomyia phaseoli* (Tryon, 1895) (Image 4)**

Oscinis phaseoli Tryon, 1895: Trans. Nat. Hist. Soc. Qd. 1:4 *Agromyza phaseoli* Coquillett, 1899: Proc. Linn. Soc. N.S.W. 24: 128.

Diagnostic characters: Body length 1.50mm; frons mat gray, Gena and postgena lightly brown tinged; ocellar triangle; orbit slightly shining; orbital bristles four pairs; orbital setulae 3–4 pairs; halter, squama, and fringes milky white between 2nd to 3rd orbital bristles.

Host plants: *L. purpureus* (Country Bean), *S.*



Image 4. *Ophiomyia phaseoli* (Tryon, 1895)

lycopersicum (Tomato) and *P. aureus* (Mung Bean) (present study), *Phaseolus vulgaris*, *Vigna unguiculata*, *V. aconitifolia*, *V. aurea*, *V. calcarata*, *V. mungo*, *V. radiate*, *Cajanus cajan*, *Glycine max*, *Lablab niger* (= *Dolichos lablab*), *Pisum sativum*, *Canavalia ensiformis*, *Crotalaria juncea*, *C. laburnifolia*, *C. mucronata*, *Macroptilium atropurpureum*, *M. lathryoides*, *Phaseolus panduratus* and *P. semierectus* (Waterhouse 1998).

Distribution: Bangladesh: Chittagong, CU campus; Hathazari; Cox's Bazar, St. Martin's Island (present work); China, Hong Kong, India, Indonesia, Iraq, Israel, Jordan, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Taiwan, Thailand, Japan, Burundi, Congo (Zaire), Egypt, Ethiopia, Kenya, Madagascar, Mauritius, Malawi, Mali, Nigeria, Reunion, Rwanda, Senegal, South Africa, Sudan, Tanzania, Uganda, Zambia, Zaire, Zimbabwe, Australia, Carolineis, Fiji, Guam, Hawaii, Micronesia, Irian, Jaya, Marianais, Papua new guinea, Samoa, Brunei and Laos (Waterhouse 1998; Shiao & Wu 1999).

Material studied: IMZDCU 003, 2 females, 19.ii.2011, ex. *L. purpureus*, Chittagong, Panchlaish, coll. S. Mazumdar.

Discussion: In Bangladesh, Alam et al. (1964) and Alam (1965) listed five species of Agromyzid flies under three genera, *Agromyza* sp., *A. ablaza*, *Melanagromyza cunetans*, *M. obtusa*. and *Ophiomyia phaseoli* as crop pests from East Pakistan (now Bangladesh). Rahman et al. (1983) noted *M. phaseoli*; Biswas (2001) mentioned *O. phaseoli* and *M. sozae* as pests of Soybean & Ahmed (2005) recorded *Agromyza theae* Cotes as tea pest. *O. phaseoli* is one of the major pests of Black Gram in Bangladesh causing serious damage to the crop (Rahman 1991; Mia 1998; Prodhan et al. 2000). In the present study the leafminers *L. chinensis*, *L. sativae*,

M. obtusa and *O. phaseoli* were reared from different plant hosts which are not recorded earlier. Moreover, *L. chinensis* was reared from Onion (*A. cepa*) which constitutes its first record from Bangladesh together with the additional host record. It also occurs as a serious pest on *Allium* spp. in China, Japan, Malaysia, Singapore, Thailand (Spencer 1973, 1990; Chen et al. 2003), Korea (Hwang & Moon 1995), Vietnam (Andersen et al. 2002) and Taiwan (Shiao 2004). *L. sativae* is among the most serious polyphytophagous insect pests of vegetables and ornamental plants in the world (Spencer 1973; Kang 1996). It has been spreading rapidly across Asia and is now found on the borders of the EU, i.e., in Western Turkey (Civelek et al. 2004) whereas it has been reported for the first time by Bhuiya et al. (2011) in Bangladesh. In the present study, the most common agromyzid species was *Liriomyza sativae* reared from Indian mustard, Cauliflower, Cabbage, Turnip, Water Melon, Tomato, Brinjal, Musk Melon, Cucumber, Sweet Gourd, Country Bean, French Bean, Pea and Cowpea. Besides, Zhao & Kang (2002) reported French Bean as a host of *L. sativae*. Spencer (1990) noted that *M. obtusa* is not host-specific. In addition Shanower et al. (1998) reported five host plant genera in the legume family as hosts: *Cajanus* (e.g., Arhar), *Dunbaria* (e.g., Heyne's Pegionpea); *Flemingia* (e.g., Slender Fremingia), *Rhynchosia* (e.g., Himalayan Snoutbean), and *Tephrosia* (e.g., White Hoary Pea). This pest was reared from *L. purpureus* (Country Bean), *G. max* (Soya Bean), *P. aureus* (Mung Bean) and *V. unguiculata* (Cowpea) in the present investigation. According to Waterhouse (1998) *O. phaseoli* is known to attack at least 40 plant species. Most of its important hosts belong to the legume tribe Phaseoleae and particularly to the genus *Phaseolus* (Waterhouse 1998). In the present study it was reared from Country Bean, Tomato and Mung Bean.

Conclusion: The results indicate the importance of different species of leafminers and their plant hosts especially vegetables in development of strategies for farmer education in the integrated pest management (IPM) programs.

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