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Checklist of Leafminer Parasitoids in Turkey, with two new Records

(Diptera: Agromyzidae)

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Abstract: An annotated parasitoid list of the Turkish Agromyzidae fauna is presented. Thirty-nine parasitoids are recorded. Valid names, their hosts, host plants within Turkey and references for each species are given. The parasitoid species *Chrysocharis pentheus* (Walker, 1839) and *Diglyphus pachyneurus* Graham, 1963 are recorded as new to the Turkish fauna.

Key words: Diptera, Agromyzidae, parasitoid list, new records, Turkey

Introduction

Agromyzidae (leafmining flies) is one of the largest fly families, with more than 2742 valid species belonging to 27 genera worldwide (SPENCER 1989). Agromyzids are typically phytophagous, with larvae living in tissues of living plants. Larvae of most leafminers feed within the leaf parenchyma. Some species are serious pests of cultivated plants e.g. *Liriomyza* spp. (SPENCER 1973, 1990; CERNY et al. 2001). *Liriomyza* is a cosmopolitan group of pests that consists of more than 300 species. Larvae of this genus are polyphagous, attacking ornamental and vegetable crops in the families Asteraceae, Brassicaceae, Cucurbitaceae, Fabaceae, Solanaceae, and many other families of plants. Infestation by *Liriomyza* spp. can cause both direct and indirect damage. *Liriomyza* spp. are known to have many natural enemies, particularly in their native home in the New World. In Asia 41 species of parasitoids in four different families were found (CHIEN & KU 1998; LIN & WANG 1992; MURPHY & LA SALLE 1999). However, in general and under natural conditions, parasitism is usually low early in crop development and gradually increases as

the crop matures (PARRELLA 1987). At least 23 species of parasitoids have been used in biological control programmes against *Liriomyza trifolii* and *Liriomyza sativae* in Senegal, California, Hawaii, Barbados, Marianas, Tonga, Taiwan and Guam (PETCHARAT et al. 2002).

Parasitoid assemblages of dipteran leafminers are dominated by Eulophidae, Braconidae and Pteromalidae that attack the larval and pupal stages of the flies. Overall, data from agricultural ecosystems suggest that agromyzid leafminers are attacked by a diverse assemblage of hymenopteran parasitoids that often are responsible for significant levels of leafminer mortality (GRATTON & WELTER 2001). Parasitoids also have been used successfully to control leafminer infestations in greenhouses (MINKENBERG & VAN LENTEREN 1986).

Many factors induce leafminer outbreaks, but the loss of natural enemies due to widespread use of insecticides is one of the most important. Parasitoids are the major group of natural enemies of leafminers, and they have played a very important role in leafminer suppression in natural ecosystems or cultivated areas with reduced insecticide use. Leafminer parasitoids have been intensively and extensively investigated and evaluated in many countries with more than 100 species reported, and several species, such as *Diglyphus begini* (Ashmead, 1904) and *Dacnusa sibirica* Telenga, 1934 were successfully used as biological control agents in commercial greenhouses planted with vegetables and ornamentals, especially tomato and chrysanthemum in Europe and North America (CHEN et al. 2003; JOHNSON 1993; MURPHY & LA SALLE 1999). *Diglyphus isaea* (Walker, 1838) and its congener, *D. begini*, are effective augmentative biological control agents against *Liriomyza* leafminers infesting a wide range of greenhouse and field-grown crops and ornamentals (ONCUER 1991).

Herein a comprehensive list of the Turkish leafmining fly parasitoid fauna is presented, based on a revision of previously published data (CAMPOBASSO et al. 1999; CIVELEK & ÖNDER 1999; CIVELEK et al. 2002; CIKMAN & UYGUN 2003; GENCER 2004; ONCUER 1991; UYGUN et al. 1995). Additionally, newly recorded species were added to the Turkish parasitoid fauna. Representative species were deposited in the laboratories of the Mugla University, Technical Education Faculty; Harran University, Agricultural Faculty, Plant Protection Department; Şanliurfa and Cumhuriyet University, Faculty of Science and Art, Department of Biology, Sivas, Turkey.

Checklist of Leafminer Parasitoids

There are Thirty-nine species included in this paper which are compiled from all studies done about Turkey through the end of 2003. Of these species, 16 belong to Braconidae, 22 species are Eulophidae, and 1 species is in the Pteromalidae. The species are listed in alphabetical order according to the family and genus. Information on the species is given in order of "host pest, host plant and reference". Among the 40 species *Chrysocharis pentheus* (Walker, 1839) and *Diglyphus pachyneurus* Graham, 1963 are new records for the Turkish fauna.

Family: Braconidae

1. *Bracon intercessor* Nees, 1834
   Liriomyza huidobrensis (Blanchard, 1926); *Cucumis sativus* [Cucurbitaceae]; CIVELEK et al. (2002)
2. *Bracon (Glabrobracon) osculator* Nees, 1811
   Liriomyza trifolii (Burgess, 1880); *Sinapis arvensis* [Brassicaceae]; CIKMAN & UYGUN (2003)
3. *Cotesia cupreus* (Lyle, 1925)
   Chromatomyia horticola (Goureau, 1851); *Malva silvestris* [Malvaceae]; CIKMAN & UYGUN (2003)
   Liriomyza trifolii; *Vicia faba* [Fabaceae]; CIKMAN & UYGUN (2003)
4. *Cotesia ruficrus* (Haliday, 1834)
   Chromatomyia horticola; *Matricaria* sp. [Asteraceae]; CIKMAN & UYGUN (2003)
   Liriomyza strigata (Meigen, 1830); *Cucumis sativus* [Cucurbitaceae]; CIKMAN & UYGUN (2003)
   Liriomyza trifolii; *Vicia faba* [Fabaceae]; CIKMAN & UYGUN (2003)
5. *Dacnusa gentianae* Griffiths, 1966
   Chromatomyia horticola; *Pisum sativum* [Fabaceae]; CIVELEK & ONDER (1999)
6. *Opius (Nosopoea) ambiguus* Wesmael, 1835
   Liriomyza trifolii; *Vigna sinensis* [Fabaceae]; CIKMAN & UYGUN (2003)
7. *Opius (Phaedrotoma) exiguus* Wesmael, 1835
   Chromatomyia horticola; *Medicago sativa* [Fabaceae]; CIKMAN & UYGUN (2003)
   Liriomyza cicerina (Rondani, 1875); *Cicer arietinum* [Fabaceae]; CIKMAN & UYGUN (2003)
8. *Opius gafsaensis* Fischer, 1964
   Liriomyza trifolii; *Vigna sinensis* [Fabaceae]; CIKMAN & UYGUN (2003)
   Liriomyza congesta (Becker, 1903); *Medicago sativa* [Fabaceae]; CIKMAN & UYGUN (2003)
9. *Opius (Pendopius) ilicis* Nixon, 1939
   Liriomyza congesta; *Medicago sativa* [Fabaceae]; CIVELEK & ONDER (1999)

10. *Opius (Opiothorax) lonicerae* Fischer, 1958
Liriomyza trifolii; *Vigna sinensis* [Fabaceae]; CIKMAN & UYGUN (2003)
11. *Opius meracus* Fischer, 1960
Liriomyza huidobrensis; *Cucumis sativus* [Cucurbitaceae]; CIVELEK et al. (2002)
12. *Opius (Misophthora) monilicornis* Fischer, 1962
Liriomyza cicerina; *Cicer arietinum* [Fabaceae]; ODE & HEINZ (2002)
13. *Opius osogovoensis* Fischer, 1964
Chromatomyia horticola; *Myagrum perfoliatum* [Brassicaceae]; CIKMAN & UYGUN (2003)
Liriomyza trifolii; *Vigna sinensis* [Fabaceae]; CIKMAN & UYGUN (2003)
14. *Opius pallipes* Wesmael, 1835
Chromatomyia horticola; *Myagrum perfoliatum* [Brassicaceae]; CIKMAN & UYGUN (2003)
Liriomyza cicerina; *Cicer arietinum* [Fabaceae]; CIKMAN & UYGUN (2003)
Liriomyza trifolii; *Vigna sinensis* [Fabaceae]; CIKMAN & UYGUN (2003)
15. *Trachionus pappi* (Zaykov, 1982)
Chromatomyia horticola; *Sinapis arvensis* [Brassicaceae]; CIVELEK & ONDER (1999)
16. *Utetes rotundiventris* (Thomson, 1895)
Liriomyza cicerina; *Cicer arietinum* [Fabaceae]; ONCUER (1991)

Family: Eulophidae

17. *Chrysocharis liriomyzae* Delucchi, 1954
Chromatomyia horticola; *Cardaria draba* [Brassicaceae]; CIKMAN & UYGUN (2003)
Liriomyza trifolii; *Brassica oleracea* [Brassicaceae]; CIKMAN & UYGUN (2003)
18. *Chrysocharis pentheus* (Walker, 1839)
Liriomyza trifolii; *Lycopersicon esculentum* [Solanaceae]; **new for Turkey**
19. *Chrysocharis phryne* (Walker, 1839)
Agromyzidae; Unknown; DOGANLAR (1985)
20. *Cirrospilus vittatus* Walker, 1838
Chromatomyia horticola; *Brassica napus* [Brassicaceae]; CIKMAN & UYGUN (2003)
21. *Closterocerus smaragdulus* (Graham, 1963)
Liriomyza trifolii; *Heliotropium europaeum* [Boraginaceae]; CIKMAN & UYGUN (2003)
22. *Diaulinopsis arenaria* (Erdös, 1951)
Liriomyza cicerina; *Cicer arietinum* [Fabaceae]; CIKMAN & UYGUN (2003)
23. *Diglyphus chabrias* (Walker, 1838)
Chromatomyia horticola; *Sonchus* sp. [Asteraceae]; GENCER (2004)
24. *Diglyphus crassinervis* Erdös, 1958
Liriomyza huidobrensis; *Cucumis sativus* [Cucurbitaceae]; CIVELEK et al. (2002)

Liriomyza trifolii; *Lycopersicon esculentum* [Solanaceae]; CIVELEK et al. (2002)

25. *Diglyphus isaea* (Walker, 1838)
    Agromyzidae; Unknown; DOGANLAR (1985)
    Liriomyza strigata; *Lycopersicon esculentum* [Solanaceae]; UYGUN et al. (1995)
    Liriomyza trifolii; *Lycopersicon esculentum* [Solanaceae]; UYGUN et al. (1995)
    Liriomyza huidobrensis; *Lactuca sativa* [Asteraceae], *Phaseolus vulgaris* [Fabaceae]; CIVELEK & ONDER (1999)
    Liriomyza cicerina; *Cicer arietinum* [Fabaceae]; CIKMAN & UYGUN (2003)
    Liriomyza congesta; *Medicago sativa* [Lamiaceae]; CIKMAN & UYGUN (2003)
    Phytomyza petoei Hering, 1924; *Mentha aquatica* [Lamiaceae]; CIVELEK & ONDER (1999)
    Phytomyza tetrasticha Hendel, 1927; *Mentha aquatica* [Lamiaceae]; CIVELEK & ONDER (1999)
26. *Diglyphus minoeus* (Walker, 1838)
    Liriomyza congesta; *Medicago sativa* [Lamiaceae]; CIKMAN & UYGUN (2003)
    Liriomyza trifolii; *Capsicum annum* [Solanaceae]; CIKMAN & UYGUN (2003)
27. *Diglyphus pachyneurus* Graham, 1963
    Chromatomyia horticola (Goureau, 1851); *Lactuca sativa* [Asteraceae]; **new for Turkey**
28. *Neochrysocharis ambitiosa* Hansson, 1990
    Phytomyza chelonei Spencer, 1969; Primulaceae [Dicots]; CIKMAN & UYGUN (2003)
    Liriomyza cicerina; *Cicer arietinum* [Fabaceae]; CIKMAN & UYGUN (2003)
    Liriomyza strigata; *Cucumis sativus* [Cucurbitaceae]; CIKMAN & UYGUN (2003)
29. *Neochrysocharis arvensis* Graham, 1963
    Chromatomyia horticola; *Sonchus* sp. [Asteraceae]; GENCER (2004)
    Liriomyza trifolii; *Lycopersicum esculentım* [Solanaceae]; GENCER (2004)
30. *Neochrysocharis chlorogaster* (Erdös, 1966)
    Chromatomyia horticola; *Sinapis arvensis* [Brassicaceae]; CIVELEK & ONDER (1999)
31. *Neochrysocharis formosa* (Westwood, 1833)
    Liriomyza huidobrensis; *Cucumis sativus* [Cucurbitaceae]; CIVELEK et al. (2002)
    Phytomyza chelonei; Primulaceae; Cikman & Uygun (2003)
32. *Neochrysocharis pictipes* (Crawford, 1912)
    Liriomyza cicerina; *Cicer arietinum* [Fabaceae]; CIKMAN & UYGUN (2003)
    Liriomyza trifolii; *Brassica oleraceae* [Brassicaceae]; CIKMAN & UYGUN (2003)
33. *Neochrysocharis sericea* (Erdös, 1954)
    Liriomyza cicerina; *Cicer arietinum* [Fabaceae]; CIKMAN & UYGUN (2003)

Liriomyza trifolii; *Lycopersicon esculentum* [Solanaceae]; CIKMAN & UYGUN (2003)

34. *Pediobius metallicus* (Nees, 1834)
Chromatomyia horticola; *Pisum sativum* [Fabaceae]; CIVELEK & ONDER (1999)
Liriomyza cicerina; *Cicer arietinum* [Fabaceae]; CIVELEK & ONDER (1999)
Chromatomyia horticola; *Cynara scolymus* [Asteraceae]; CIVELEK (2002)
35. *Pnigalio soemius* (Walker, 1839)
Agromyzidae; various plants; ONCÜER (1991)
36. *Ratzeburgiola cristata* (Ratzeburg, 1848)
Turkey; Unknown; ONCÜER (1991)
Liriomyza pascuum (Meigen, 1838); *Euphorbia* sp. [Euphorbiaceae]; New for Agromyzidae (CIVELEK 2004)
37. *Ratzeburgiola incompleta* Boucek, 1971
Turkey; *Phyllocnistis citrella* Stainton, 1856 (Lepidoptera: Gracilaridae); ANONYMOUS (1997)
Liriomyza pascuum; *Euphorbia* sp.; New for Agromyzidae (CIVELEK 2004)
38. *Sympiesis gordius* (Walker, 1839)
Liriomyza trifolii; *Phaseolus vulgaris* [Fabaceae]; CIKMAN & UYGUN (2003)

Family: Pteromalidae

39. *Gastrancistrus flavicornis* (Walker, 1834)
Agromyza apfelbecki Strobl, 1902; *Cynara scolymus* [Asteraceae]; CIVELEK & ONDER (1999)
Phytomyza orobanchia Kaltenbach, 1864; *Orobanche romosa* [Orobanchaceae]; CIVELEK & ONDER (1999)
Phytomyza petoei; *Mentha aquatica* [Labiatae]; CIVELEK & ONDER (1999)
Phytomyza tetrasticha; *Mentha aquatica* [Labiatae]; CIVELEK & ONDER (1999)

Conclusion

This is the first parasitoid checklist of Agromyzidae of Turkey. As the analysis of the checklist shows, the biological diversity of Eulophidae family is richer than the other families. Some species, such as *Diglyphus isaea* and *Neochrysocharis formosa* may be valuable for the biological control of the leafminers.

Chrysocharis pentheus (Walker, 1839) and *Diglyphus pachyneurus* Graham, 1963 were added for the first time to the Turkish parasitoid fauna. Also, *Ratzeburgiola cristata* and *R. incompleta* were known as parasitoids only of citrus leafminer (*P. citrella*) in Turkey. In this study, these parasitoids were reared from *Euphorbia* sp. leaves infested with *Liriomyza pascuum* (new host records for *Liriomyza* parasitoids).

The authors hope this first checklist will promote fundamental studies of the fauna, taxonomy and biology of parasitoids of leafminers of Turkey.

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