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A Study on the Chalcidoid (Hymenoptera: Chalcidoidea) Parasitoids of Leafminers (Diptera: Agromyzidae) in Ankara Province*

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Abstract: The objective of this study was to determine parasitoids attacking leafminers (Agromyzidae: Diptera) in Ankara province. Seven parasitoids species belonging to the Eulophidae (Chalcidoidea) were found. These species were *Diglyphus iseae* (Walker), *D. chabrias* (Walker), *Neochyrsocharis formosa* (Westwood), *N. arvensis* Graham, *Pediobius acantha* (Walker), *Chrysocharis* sp. and *Hemiptarsenus* sp. Of these, *D. isaea, N. formosa* and *N. arvensis* were found to be the most common parasitoids of leafminers. *Liriomyza trifolii* (Burgess), *Chromatomyia horticola* (Goureau) and *Phytomyza lappae* Goureau putatively appeared to be the host species. However, parasitoids were only reared from the first two species. The last species from which no parasitoid was reared is a new record for Turkish fauna.

Key Words: Parasitoid, Chalcidoidea, Hymenoptera, Leafminer, Diptera

Ankara İli Galerisinekleri (Diptera: Agromyzidae) Chalcidoid (Hymenoptera: Chalcidoidea) Parasitoidleri Üzerinde Bir Çalışma

Özet: Ankara ili galerisineklerinin parasitoidlerini belirlemek amacıyla yapılan bu çalışmada Eulophidae (Chalcidoidea) familyasına ait yedi tür tespit edilmiştir. Bu türler *Diglyphus iseae*(Walker), *D. chabrias* (Walker), *Neochyrsocharis formosa* (Westwood), *N. arvensis* Graham, *Pediobius acantha* (Walker), *Chrysocharis sp* ve *Hemiptarsenus sp* dir. Bu türlerden *D. isaea, N formosa* ve *N. arvensis* en fazla rastlanan türler olarak belirlenmiştir. Başlangıçta, *Liriomyza trifolii* (Burgess), *Chromatomyia horticola* (Goureau) ve *Phytomyza lappae* Goureau konak türler olarak kabul edilmiştir. Ancak, bunlardan sadece ilk iki türde parasitoid çıkışı olmuştur. Parasitoid çıkışı gözlenmeyen son tür Türkiye için yeni kayıttır.

Anahtar Sözcükler: Parasitoit, Chalcidoidea, Hymenoptera, Galerisineği, Diptera

Introduction

Members of the Agromyzidae are pests of economic importance on several vegetable and ornamental plants growing around the world. The adults are commonly found on vegetation, whereas most larvae are leafminers. These species make serpentine mines usually in the leaves, though they sometimes gather on the stems of vegetables. They also cause damage to grain crops and wild plants. Considerable damage are caused by the larvae. The larvae feed within the leaves of the host plant and this feeding can severely reduce yields and/or kills the plants at high fly density (Spencer and Steyskal, 1986). In addition, viral and fungal diseases can be transported from one plant to another by adult flies (Civelek and Önder, 1999).

Agromyzid leafminers are known to have rich natural enemy communities. Several studies have been conducted on the natural enemies of the Agromyzidae in various countries (Stegmaier, 1966; Spencer, 1973; Al Azawi, 1971; LaSalle and Parrella, 1991; Murphy and LaSalle, 1999; Sivapragasam et al., 1999). However, there have only been a few studies on the natural enemies of the Agromyzidae in Turkey (Civelek and Önder, 1999; Yabaş and Ulubilir, 1992; Uygun et al., 1995).

According to previous records, all natural enemies of agromyzids are members of the Hymenoptera. These parasitoids belong to the Chalcidoidea, Ichneumonidea and Cynipodea (Hymenoptera). Of these, chalcidoid parasitoids are reported to constitute the most dominant group (Murphy and LaSalle, 1999).

In recent years, the population size of pest species has increased dramatically and have been recognised as a very important pest group in Turkey (Uygun et al., 1995). Agromyzidae populations were sampled in Ankara province in order to determine their parasitoids, and the abundance and potential use of such parasitoids in biological control programs.

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Materials and Methods

Leafminer-infested leaves from cultivated vegetables (bean, tomato, squash and mullein) were collected between March and October 2001 in order to determine the presence of agromyzid leafminers and their parasitoids in Ankara province (Central Ankara, Akyurt, Elmadağ, Evren, Hasanoğlan, Kalecik, Kazan, Polatlı, Sincan and Şereflikoçhisar). Leafminer-infested leaves were taken to the laboratory for the emergence of pests and parasitoids. The laboratory temperature was about 25-30 ºC and the relative humidity was between 60 and 70%. A small piece of leaf containing the larvae was cut and placed in a small glass vial and then closed with a cotton ball covered with muslin. They were daily checked for the emergence of leafminers and parasitoids and relevant notes were recorded. After the completion of emergence, all reared pest and parasitoid specimens were identified.

The specimens are kept in the collection of the Department of Biology, Cumhuriyet University, Sivas. Leafminer-infested leaves were partly collected by Elif Sakaltaş. The emerged leafminers were identified by Dr. Hasan S. Civelek (Muğla University).

Results and Discussion

Seven parasitoid species were reared from agromyzid larvae. The identified parasitoid species, their percentages and host species are given in the Table.

As seen in the Table, *Diglyphus isaea* and *Neochrysocharis arvensis* and *N. formosa* were recorded as the most common parasitoids. Hence, these species were considered to be the most important natural enemies of the Agromyzidae in Ankara province. The morphological, ecological and distribution information of these seven species are provided below.

Diglyphus iseae (Walker)

This species is extremely close morphologically to *D. intermedius*, but can be distinguished by the basal ring of metallic color on the hind tibia extends 0.75 the length of the tibia. Notauli incomplete, forewing basal cell densely setose, stigmal vein and postmarginal vein subequal in length. Hind tibia predominantly metallic colored.

Host range: Many species of Agromyzidae and also Lyonetiidae and Tephritidae (Lepidoptera) (Ciampolini, 1952; Gordh and Hendrickson, 1979; Minkenberg and Lenteren, 1986; Zhu et al., 2000). This species has previously been reported to be a parasitoid on some species of Agromyzidae in Turkey (Civelek and Önder, 1999; Uygun et al., 1995; Doğanlar, 1985).

This species has been reared from *Liriomyza trifolii* and *Chromatomyia horticola* in the present study.

Distribution: Widespread in Palearctic regions, and also Afrotropical, Australian, Pacific, Nearctic, and Oriental regions.

Diglyphus chabrias (Walker)

This species is extremely close morphologically to *D. poppoe* but can be distinguished by the scapus with metallic sheen and by the scutellum equal in length and width or slightly wider. Funicle not longer or barely longer than wide. Scapus with metallic sheen and scutellum equal in length and width. Body usually greenish.

Host range: Unknown species of Agromyzidae and *Liriomyza trifolii* (Gordh and Hendrikcson, 1979; Ignaciio, 1999; Boucek and Askew, 1968; Tryapisyn and Kostyukov, 1987).

Table. Parasitoid species, their hosts and percentage of emergence from the host species.

Parasitoid species	Number of individuals	Percentage of parasitoids	Agromyzidae species (Host)	Host plants of Agromyzidae species
Diglyphus iseae	108	44	*L. trifolii* and *C. horticola*	Bean, Tomato, Squash
Diglyphus chabrias	14	5.6	*L. trifolii* and *C. horticola*	Bean, Tomato, Squash
Neochrysocharis arvensis	92	37.2	*L. trifolii* and *C. horticola*	Bean, Tomato, Squash
Neochrysocharis formosa	27	10.2	*L. trifolii*	Bean, Tomato
Pediobius acantha	4	1.6	Unknown species	Mullein
Chrysocharis sp	1	0.4	Unknown species	Squash
Hemiptarsenus sp	1	0.4	*L. trifolii*	Bean

This species has been reared from *L. trifolii* and *C. horticola* in the present study.

Distribution: Widespread in Palearctic region, and also Grent Britain, Norway, Germany, Hungary and England.

This parasitoid species is reared from *C. horticola* for the first time and is also a new record for Turkish fauna.

Neochrysocharis arvensis Graham

This species is extremely close to *N. formosa* but can be distinguished by the structure and color of the dorsum and the sides of scutellum more sinuate anteriorly. Thorasic dorsum with weaker reticulation, brighter color and distinctly vaulted, notaular depression indistinct and much wider posteriorly; postmarginal vein usually as long as stigmal vein, occasionally shorter.

Host range: Unknown species of Agromyzidae (Gordh and Hendrikcson, 1979).

This species has been reared from *L. trifolii* and *C. horticola*.

Distribution: Finland, Great Britain, Greece, Sweden, Yugoslavia.

This parasitoid species is reared from *L. trifolii* and *C. horticola* for the first time and is also a new record for Turkish fauna.

Neochrysocharis formosa (Westwood)

This species has been also treated in the literature under the names of *Achrysocharella formosa, Derostenus variipes, A. variipes*, *D. fullawayi, Chrysontomyia formosoa* and *N. trifoli* (LaSalle and Parrella, 1991; Uygun et al., 1995; Boucek and Askew, 1968; Hansson, 1990). This species is extremely close morphologically to *N. arvensis* but can be distinguished by features on upper part of the thorax. Thoracic dorsum usually with strong and dense reticulation, with relatively dull colors, sides of scutellum straight, notaular depressions narrow and distinct throughout; postmarginal vein 0.5-1.0 times as long as stigmal vein.

Host range: Several species of Lepidoptera, Diptera, Hymenoptera and Coleoptera. This species mostly prefers Agromyzidae species as hosts. In particular, it is thought of as an important control agent for populations of *L. trifolii* and *L. sativa* (Murphy and LaSalle, 1999; Sivapragrasam et al., 1999; Hansson, 1990; Lema and Poe, 1978).

This species has previously been recorded from *Phytomyza horticola* (Agromyzidae) from Turkey (Uygun et al., 1995) and it has been reared from *L. trifolii* in the present study.

Distribution: Widespread distribution in West Palearctic, also in Nearctic region, Africa and Europe.

Pediobius acantha (Walker)

This species is extremely close morphologically to *P. epigonus* but can be distinguished by the bluish-black face of the female; 1st segment of funicle usually thicker than antennal pedicel. In addition, 2nd segment of club is narrower than 1st segment and usually with shorter apical spine.

Host range: Primary sometimes secondary, solitary endoparasites of larvae and pupae of mining forms of Lepidoptera and Diptera. Particularly agromyzid genus *Phytomyza, Liriomyza* and *Dizygomyza* (Boucek and Askew, 1968; Tryapisyn and Kostyukov, 1987; Boucek, 1965).

This species has been reared from an unidentified species of Agromyzidae on *Verbascum* in the present study

Distribution: Europe, Asia, North America.

This species has previously been reported from *Phytomyza horticola* and *Liriomyza cicerina* in Turkey (Civelek and Önder, 1999; Uygun et al., 1995; Doğanlar, 1985).

In addition, *Chyrsocharis* sp. and *Hemiptarsenus* sp. have been reared from unidentified species of Agromyzidae and *L. trifolii*. Identification efforts failed at the specific level because of the insufficient number of specimens available. However, several species of *Chyrsocharis* and *Hemiptarsenus* have been reported as important agromyzid parasitoids and the percentage of these parasitoids belonging to *Chyrsocharis* and *Hemiptarsenus* have been reported to be up to 60% in some regions (Civelek and Önder, 1999; LaSalle and Parrella, 1991; Murphy and LaSalle, 1999; Sivapragrasam et al., 1999; Uygun et al., 1995).

D. iseae has been recorded as the most common species and this finding is in accord with the report by Uygun et al. (1995) on the East Mediterranean. Although the occurrence of *N. formosa* was approximately 10% in Ankara province, it has been reported to be the most common parasitoid with rates of over 50% in Peninsular

Malaysia (Sivapragasam et al., 1999). There is no record of high level population size of *N. arvensis*, the other common parasitoid found in Ankara province.

D. iseae, N. arvensis and *N. formosa* are considered to be important parasitoids of agromyzid flies, as seen in the Table. A rate of emergence higher than 10% among all parasitoids is reported to be significant and they are considered to be potential biological control agents (Murphy and LaSalle, 1999). The relatively higher parasitism level may suggest that parasitoids could be an important mortality factor in the population dynamics of leafminer populations. However, in addition to high parasitoid levels, several important factors have to be taken into account in order to increase success rates in biological control programs. These factors include distribution, climate and host specificity. More detailed studies considering these factors are required in order to explore the potential use of agromyzid parasitoids for biological control programs.

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