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Orijinal araştırma (Original article)

Pest status of olive leaf gall midge *Dasineura oleae* (Angelini, 1831), description of *Lasioptera oleicola* Skuhravá sp. new (Diptera: Cecidomyiidae) and effectiveness of parasitoids on their populations in Hatay Turkey

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Summary

During investigations conducted in 2007-2010 in Hatay Province, Turkey, two species of gall midges, *Dasineura oleae* (Angelini, 1831) and *Lasioptera oleicola* Skuhravá sp. new were reared from galls on leaves and shoots of *Olea europaea* L. Average level of infestation on olive leaves and shoots by gall midges was 15.2 % and the highest level 78.2 %. Olive leaves, normally evergreen and outlasting on branches for several years, seriously injured by gall midges fell off and defoliage resulted in loss of ability to product flower buds and fruits in the following year. *Dasineura oleae* causing significant reduction or loss of yield of olive fruits is a serious pest of olive tree and we declare here its pest status. Population levels of gall midges on olive leaves were significantly reduced by 12 species of parasitic Hymenoptera belonging to five families, viz. *Platygaster oleae* Szelenyi, 1940 (Platygastridae); *Eupelmus urozonus* Dalman 1820 (Eupelmidae); *Torymus phillyreae* Ruschka, 1921 (Torymidae); *Mesopolobus mediterraneus* (Mayr, 1903), *Mesopolobus diffinis* (Walker, 1834) and *Mesopolobus aspilus* (Walker, 1835) (Pteromalidae); *Quadrastichus dasineurae* Doganlar, LaSalle, Sertkaya & Doganlar, 2009*, Aprostocetus samandagus* Doğanlar 2011*, Aprostocetus lasiopterus* Doğanlar 2011*, Zeytinus hatayensis* Doğanlar 2011 and additional 2 undescribed species of the genus *Aprostocetus* (Eulophidae). Larvae of these parasitoids kill larvae and pupae of gall midges inside galls. Total level of parasitism amounts 66.2 %. *E. urozonus*, *P. oleae* and *Q. dasineurae* are three main parasitoids reared from galls of *D. oleae* and *L. oleicola* sp. new They are very effective and reduce significantly the populations of *D. oleae* in galls, together for about 70 %, and may be

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evaluated as important supressors of olive leaf gall midges. *Lasioptera oleicola* Skuhravá sp. new is described, its taxonomically important features are illustrated and some biological data are given.

Key words: *Olea europaea,* gall midges, Hymenopter-parasitoids, Turkey

Anahtar sözcükler: *Olea europaea,* gall sinekleri, Hymenopter-parazitoitler, Türkiye

Introduction

The cultivated olive tree, *Olea europaea* L., is an economically very important tree. From one olive tree it is possible to obtain 20-60 kg of olive fruits. Turkey is one of the three top producers of olives in the world. Olive trees are grown in 10 % of the whole area of Turkey and are important also in the Hatay Province where olive orchards cover 17 % of cultivated area.

Four gall midges are associated with olive tree, viz. *Dasineura oleae* (Angelini, 1831), causing galls on olive leaves, *Lasioptera berlesiana* Paoli, 1907, larvae of which are fungus feeder in olive fruits primarily attacked by the fly *Bactrocera oleae* Gmelin, 1790 (Diptera: Tephritidae), *Resseliella oleisuga* (Targioni-Tozzetti, 1886) larvae of which develop under the bark and may cause withering of the twigs and *Asynapta furcifer* Barnes, 1932, a saprophytic species, adults of which were reared from slightly damaged olive fruits. Barnes (1948) summarized the knowledge of olive gall midges in his book “Gall Midges of Economic Importance”.

All these gall midge species occur in the Mediterranean, some of them abundantly (Del Guercio, 1910; Skuhravá, 1986; Skuhravá & Skuhravy, 1994; 1997; Skuhravá et al., 2006, 2007). Galls of *D. oleae* are known from many localities of Turkey (Trotter, 1903; Iyriboz, 1940, 1968, Alkan, 1952; Iren & Ahmet, 1973; Coutin & Katlabi, 1986; Hepdurgun, 1998; Skuhravá et al., 2005, Anonymous, 2008). Darvas et al. (2000) evaluate *D. oleae* as a serious pest in Syria and a causer of damages in other countries of the Mediterranean area. *Dasineura oleae* is generally accepted as the second-rate pest of olive in Turkey (Anonymus, 2008). Al-Tamimi (1997) showed that the olive leaf gall midge is widely distributed in Jordan in all economically olive planted orchards and in some localities it causes serious damage infesting up to 55-62% of leaves. Hrncic (1998) stated it as an important pest of olive in Montenegro (former Yugoslavia).

Larvae of *D. oleae* cause slight, indefinite, elongate swellings on olive leaves. Only one larva develops inside the gall and the whole development from the egg, across the larva, pupa up to adult phase runs inside the gall. Usually only one generation develops per year, but in favourable conditions a second generation may develop. Adults fly from March to the beginning of May are present in nature (Avidov & Harpaz, 1969; Coutin & Katlabi, 1886; Al-Tamimi,

1997; Darvas et al., 2000). Galls of *D. oleae* may occur also on terminal parts of young shoots of olive trees if the density of gall midge population in the area is high.

There are not many works on mortality factors affecting population levels of *D. oleae*. Avidov & Harpaz (1969) stated that *Platygaster* sp. is the larval parasitoid of this pest. Al-Tamimi (1997) considered as the most important the climatic factors, i.e. temperature and relative humidity, and natural enemies, especially the endoparasitoid *Platygaster oleae* Szelenyi, 1940 (Hymenoptera: Platygastridae) and *Aprostocetus* sp. and other two unidentified parasitoids from immature stages of olive leaf gall midge in Amman district. Doğanlar et al. (2009) found *Quadrastichus dasineurae* Doğanlar, LaSalle, Sertkaya & O. Doğanlar (Hymenoptera, Eulophidae) as the larval parasitoid of *D. oleae* in Hatay province. Recently several species of parasitoids were reared from galls of *D. oleae* on leaves and shoots of *O. europea* as larval or pupal parasitoids of the host in Hatay province, Turkey (Doğanlar, 2011).

The aim of our article is to bring information on the occurrence of *D. oleae* and its damage resulting in defoliage and loss of yield of olive fruits in Hatay Province that allow to declare the pest status, and to show the effectiveness of several parasitoid species to reduce the population level of this pest. In the course of the study on insects associated with *O. europaea* in Hatay Province there were reared from leaf galls, together with adults of *D. oleae*, also adults of another gall midge species that belong to the genus *Lasioptera* which is described as a new species in the present article.

Material and Methods

The studies were conducted in twelve localities of Hatay Province in southern Turkey in the years in 2007-2010. Main investigations were made in 2007 and 2010 because the population level of *Dasineura oleae* galls on leaves was very low in the years 2008 and 2009. At each locality three branches with leaves of three trees randomly chosen from olive orchards were taken, all branches were put in plastic bags and brought in the laboratory where the number of leaves with galls and leaves without galls were counted to obtain the infestation level of *D. oleae* at each locality. Olive leaves with galls were placed in glass vials (15 cm length x 1 cm diameter) for rearing purpose. Adults emerged from galls were killed in 96 % ethylalcohol for taxonomic studies. Identification of the hosts of parasitoids was based on gall midge larvae obtained by dissecting the plant materials and the rests of larvae in galls after emergence of adults.

Morphological terminology and identification of gall midges is based on the publication of Skuhravá (1997), identification of parasitoids on the

publication of Doğanlar (2011) and of Doğanlar et al. (2009), determination of pest status in an area on the publication of FAO (1999).

Some of the examined specimens of gall midges are deposited in the collection of the Insect Museum of Plant Protection Department, Agriculture Faculty, Mustafa Kemal University, Antakya, Hatay Turkey. Several adults of *D. oleae* and *Lasioptera sp. new* mounted on microscope slides are deposited in the collection of Marcela Skuhravá in Praha, Czech Republic.

The first two authors are responsible for the collection, field observations and evaluation of effectivity of parasitoids reared from galls of gall midges and the last author for the description of a new species of gall midges, evaluation of results and for declaration of *D. oleae* pest status.

Results and discuscion

Description of new species

Lasioptera oleicola Skuhravá sp. new

(Figure, 1 A-G; Figure, 2 A-F)

Type material: Holotype female: Turkey: Samandag-Hatay, 19.-21.4.2010, reared from leaf galls on *O. europaea* (leg. E. Sertkaya); mounted on microscope slide No. 8341 and deposited in the collection of Marcela Skuhravá, Praha, Czech Republic. Paratypes: 1 female, 3 males, same data as the holotype.

Other examined material: 5 females and 5 males, reared from leaf galls on *O. europaea* from the same locality in April 2007 (leg. M. Doğanlar): dry adults in bad conditions, heavily damaged, without terminal parts of antennae and legs; 11 females and 13 males, Samandag-Hatay, 19.-21.4.2010, reared from leaf galls on *O. europaea*; 7 females, 9 males, Center, Antakya, 18.-27. 4. 2010, reared from leaf galls on *O. europaea* (leg. M. Doğanlar).

Diagnosis: *Lasioptera oleicola* Skuhravá sp. n. is a small gall midge species of body size 1.2-1.8 mm, with large holoptic eyes in both sexes, one pair of four-segmented palpi, antennae with 2+13 to 2+19 segments, flagellomeres very short and sessile in both sexes, toothed claws on all legs and empodium of the same length as claws, ovipositor with a very short terminal part bearing one to four hook-shaped spinae and long hairs. Larvae occur in galls on leaves of *O. europaea*.

Female. (Figure, 1). Body size: 1.5-1.6 mm; wing length: 1.2 mm, wing width 0.6 mm. Head, antennae and thorax dark brown, abdominal tergites brown, legs and remaining parts of abdomen slightly brown. Upper part of abdominal segments, anterior part of the wing and all parts of legs are covered with small dark scales.

Head with large holoptic eyes, eye bridge 5-6 ommatidia wide medially, ommatidia small and densely arranged. Mouthparts of normal size, palpi four-segmented: first segment short and round, the second is longer, the third and fourth longer and slender than the senond segment. Each palpal segment with several long setae.

Antennae with 2+16 to 2+19 segments (N=5). Scape and pedicel obconical, first and second flagellomeres fused, all flagellomeres sessile, without stems. Each flagellomere is densely covered with microtrichia, basally with a whorl of setae, with two rings of sensory thread united with connection, and with several sensorial pores.

Wing with R_5 running very close to costa, uniting with it in the half of the anterior margin of the wing. Other veins are visible only at the basal part. Anterior margin of wings is covered with small scales and setae, wing surface scarcely with small setae.

Legs are very long, slender and covered with hairs and scales; toothed claws on all legs, empodium as long as claws.

Abdomen with tergits 1-7 entire, tergit 8 is divided into a pair of longitudinal, strongly sclerotized sclerits of characteristic shape. Ovipositor is cylindrical, elongate and far protrusible, ending with large superior lamella (fused cerci) and with small inferior lamella. Terminal part of superior lamella is very short and is densely covered with microtrichia and long setae, with one to four hook-shaped spinae dorsally before tip and laterally with about twenty short strong setae. The holotype female has ovipositor with one hook-shaped spina (Figure 1 G), other females under study have two, three and four hook-shaped spinae.

Male. (Figure 2). Body size 1.2-1.8 mm; wing length 1.0 mm, wing width 0.5 mm. Antennae with 2+13 to 2+15 segments (N=3). Flagellomeres a little longer than their width and each distally with a very short stem. Otherwise morphological characters as in female.

Male genitalia: gonocoxits slender, about three times longer than their width, completely setulose and with several long setae; gonostyli slender, slightly broaden at the base and tip. Cerci emarginated, with deep and narrow incision, hypoproct entire and rounded, mediobasal lobe sheating aedeagus longer than hypoproct and cerci, aedeagus as long as mediobasal lobe and and rounded at the tip.

Biology: *Lasioptera oleicola* Skuhravá sp. new is associated with the host plant *O. europaea*. Adults were reared from leaf galls together with adults of *D. oleae*. Larvae of *L. oleicola* sp. new live probably as inquilines in galls caused by larvae *D. oleae*. Further study of the relationships of these two gall midge

species is needed to elucidate this question. Only one generation of *L. oleicola* sp. new develops per year similarly as it is by *D. oleae*. Larvae of *L. oleicola sp. new* develop and hibernate in the galls on olive leaves where they pupate in the spring. They do not spin a cocoon. Adults emerge in April of the following year.

Etymology: The specific name *oleicola* is derived from the name of its host tree *Olea* and the latin verb *colo*, it means to inhabit.

Distribution: As far as we know this species was found only in Turkey at Vakıflı, Samandağ and Center of Antakya, Hatay Province.

Remarks: Six other species of the genus *Lasioptera* are known from Turkey (Skuhravá et al., 2005). Four of them are gall causers on various host plant species and two are inquilines. Larvae of *Lasioptera populnea wachtl* are inquilines in galls of *Contarinia populi* Rubsaamen on leaves of *Populus tremula* and larvae of *Lasioptera berlesiana* Pooli are fungus feeders in olive fruits primarily attacked by the fly *Bactrocera oleae* (Diptera: Tephritidae). Solinas (1967) observed that newly hatched larvae of *Lasioptera berlesiana* prey on the eggs of *B. oleae* and are predators and later they feed on the mycelium in galleris caused by *Bactrocera* larvae in olive fruits.

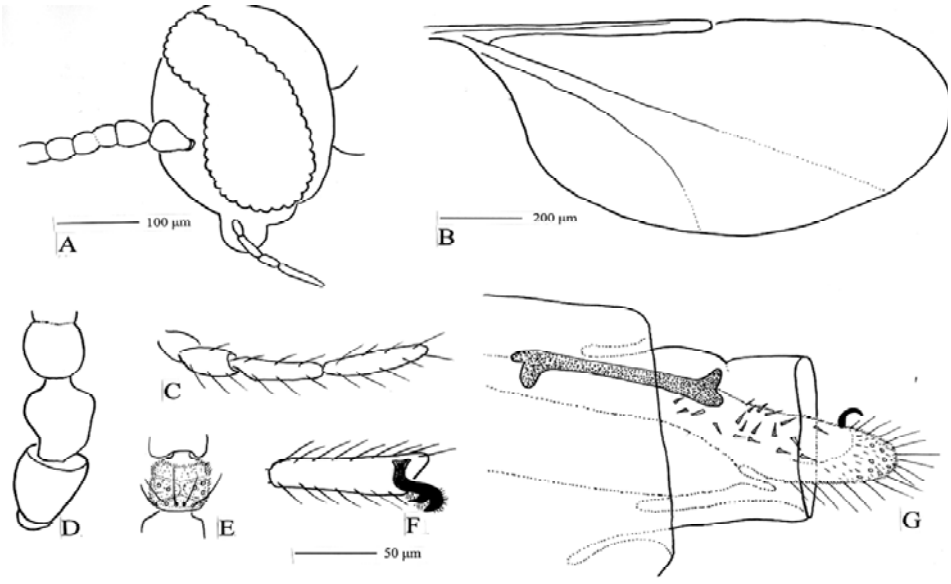

Figure 1. *Lasioptera oleicola* Skuhravá sp. new, Holotype female: A – head in lateral view, B – wing, C – palpus, D – scape, pedicel and the first flagellomere, E – fifth flagellomere, F – fifth tarsomere with claw and empodium, G – terminal part of ovipositor, lateral view. Scale below: 50 µm for D – G (Original).

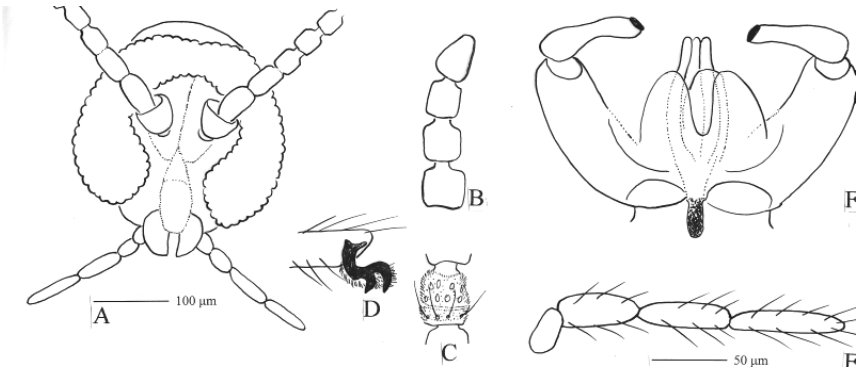

Figure 2. *Lasioptera oleicola* Skuhravá sp. new, male: A – head in frontal view, B – terminal part of antenna, C – fifth flagellomere, D – terminal part of the fifth tarsomere with claw and empodium, E – palpus, F - male genitalia, dorsal view. Scale below: 50 µm for B – E (Original).

Lasioptera is a large genus of the family Cecidomyiidae that includes 50 species in the Palaearctic Region. Most species occur in Europe, thirteen species in eastern Palaearct and four species in middle Asia (Kazakhstan) (Skuhravá, 1986, 2006; Skuhravá & Skuhravý, 2010). Majority of species induce swellings on stems or larvae develop inside stems without making galls. Few species cause leaf galls or are inqulines in galls of other gall midges or insects and three species are associated with fruits. Galls are usually associated with fungal mycelia (so called ambrosia galls). *Lasioptera yadocariae* is a successor inhabiting empty galls of some gall midges after their emergence (Yukawa & Haitsuka, 1994).

Usually one *Lasioptera* species is associated with one host plant species, few species are known to be associated with several host plant species of one genus and only exceptionally one *Lasioptera* species is associated with several species belonging to various plant families. On the other hand, there are only few cases when two *Lasioptera* species are bound to the same host plant species. Each occupies a different niche of host plant and is characterized by other features of its biology (Skuhravá & Skuhravý, 1981). Similarly, *L. berlesiana* and *L. oleicola* sp. new are two gall midge species associated with one host plant species, *O. europaea.* Larvae of *L. berlesiana* develop in olive fruits and larvae of *L. oleicola* sp. new in olive leaves.

Species of the genus *Lasioptera* may be distinguished in adult stage mainly by the number of antennal segments, details of some structures in male terminalia and by the shape and number of cuticular appendages on the ovipositor (Yukawa, 1971; Mamaev, 1969; Skuhravá, 1997; Tastás-Duque & Sylvén, 1989). Difficulties lie in the fact that morphological characters of this genus are not stabil and can vary considerably even in a series of specimens originating from a single ancestor.

In the Table 1 we compare several morphological characters and the biology of two gall midges of the genus *Lasioptera* associated with one host plant species, *Olea europaea.*

Table 1. Comparison of morphological characters and biology of *Lasioptera oleicola* Skuhravá sp. new and *Lasioptera berlesiana* Paoli, associated with *Olea europaea*

Morphological characters	*Lasioptera oleicola sp. new*	*Lasioptera berlesiana*
Body size	1.2-1.8 mm	2 mm (Paoli, 1907)
Antenna: number of segments	2+13 to 2+19	22 (Paoli, 1907) 2+20 (Coutin & Katlabi, 1986) 2+20 (Hepdurgun & Önder, 2000)
Ovipositor: number of hook-shaped spinae	1-4	10-12 (Del Guercio, 1910)
Male terminalia:	deep and narrow	deep and slit-shaped
incision of cercus	slightly longer than hypoproct	much longer than hypoproct (Coutin & Katlabi, 1986)
mediobasal lobe		
Biology		(Solinas, 1967, Coutin & Katlabi, 1986)
Attacked plant organ	leaf	fruit
Association with insect species	*Dasineura oleae* (Cecidomyiidae)	*Bactrocera oleae* (Tephritidae)
Association with fungi	not found	*Macrophoma dalmatica (=Sphaeropsis dalmatica)*
Social organization of larvae	solitary	gregarious
Number of generations per year	1 generation	3 – 4 generations (Hepdurgun & Önder, 1999)
Hibernation	in the gall	in the soil
Cocoon in larval stage	not produced	produced
Pupation site	in the gall	in the soil

The adults of *L. oleicola* sp. new differ from the adults of *L. berlesiana* in smaller body size and lower number of antennal segments. Paoli (1907) in his description of *L. berlesiana* gave that adults are 2 mm long and have antennae with 22 segments. In contrast, adults of *L. oleicola* are only 1.2-1.8 mm long. Antennae of *L. berlesiana* consist of 22 segments (Paoli, 1907 Coutin & Katlabi, 1986İ; Hepdurgun & Önder, 2000) whereas antennae of *L. oleicola* sp. new has from 15 to 21 segments. Ovipositor of *L. oleicola* sp. new bears one to four hook-shaped spinae that are situated very near from the tip and covered by several long setae (Figure, 1G, the ovipositor of the holotype female bears only one hook-shaped spine), in contrast to the ovipositor of *L. berlesina* with ten or more hook-shaped spinae which are situated far from the tip as it is depicted in the article of Del Guercio (1910 and Coutin & Katlabi (1986), Figure 51; see the Figure 3 in present article) figured the ovipositor of *L. berlesiana* with five hook-shaped spinae situated far before its end.

Lasioptera oleicola sp. new and *L. berlesiana* differ in the shape of parts of male terminalia. The incision of the cercus of *L. oleicola* sp. new is deep and narrow and the incision of the cercus in *L. berlesiana* is slit-shaped (Coutin &

Katlabi, 1986, Figure 51; see the Figure 4 in present article). The mediobasal lobe of *L. oleicola* is slightly longer than the hypoproct, in contrast to the mediobasal lobe of *L. berlasiana* which is much more longer than the hypoproct (Coutin & Katlabi, 1986, Figure, 51).

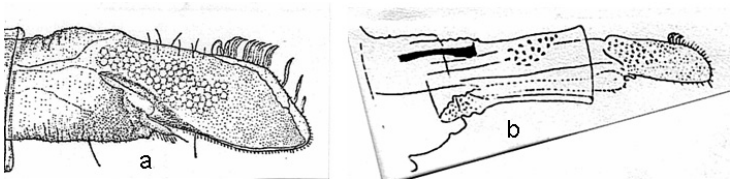

Figure 3. Ovipositor of *Lasioptera berlesiana* Paoli, a. Figure taken from the article of Del Guercio (1910). b. Figure taken from the article of Coutin & Katlabi (1986).

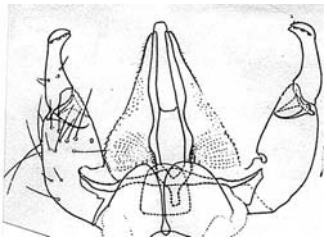

Figure 4. Male genitalia of *Lasioptera berlesiana* Paoli, Figure taken from the article of (Coutin & Katlabi 1986).

We compared morphological characters of adults of *L. oleicola* sp. new reared from leaf galls on *O. europaea* in our experiments in Hatay Province with morphological characters of adults of *L. berlesiana* reared from fruits of *O. europaea* in Izmir in 1999 (that were kindly lent us by Dr. B. Hepdurgun) and also with adults reared from fruits of *O. europaea* by the first author in Dokuzdal (Hatay Province) in 2010 and with morphological characters given by several above mentioned authors.

After examination and reviewing all the morphological characters and their variability of specimens that we had at disposal we may conclude that *L. oleicola* sp. new and *L. berlesiana* are two distinct and distinguishable species of the genus *Lasioptera* which are bound to a single host plant species, *O.europaea*.

Adults of two species belonging to two different genera - *Dasineura oleae* and *Lasioptera oleicola* sp. new- were reared from leaf galls on olive tree, *O. europaea*. It is not quite clear if both species are gall causers inducing galls of similar shape on olive leaves or if the larvae of *L. oleicola* sp. new are inquilines in the leaf galls caused by larvae of *D. oleae* or even predators of its early stages. Any fungal mycelia were found in the galls on olive leaves whereas fungal mycelia are present in olive fruits inhabited by larvae of *L. berlesiana*. Only one generation of *L. oleicola* sp. new develops per year. Larvae hibernate in the galls on olive leaves where they pupate in the spring. They do not spin

cocoons (Figure, 5). On the opposite, several generations of *L. berlesiana* develop per year. In Turkey, Hepdurgun & Önder (1999) observed 3 generations in 1996 and 4 generations in 1997 in Bornova and Urla. Larvae leave attacked olive fruits where they developed, drop to the soil where each larva spins a cocoon. Larvae of *L. berlesiana* protected in cocoons overwinter in the soil where they pupate in the spring (Coutin & Katlabi, 1986).

Figure 5. Female pupa of *Lasioptera oleicola* Skuhravá sp. new without cocoon in gall on leaf of *Olea europaea* (Original).

The place where larvae of both species develop, i.e. the niche or microhabitat, may influence their body size, and, therefore, the number of antennal segments: *L. berlesiana* having during its development sufficient nourishment in the soft and sappy olive fruits have larger body size, in contrast to *Lasioptera oleicola* sp. new which have insufficient nourishment in dry galls on olive leaves which results in smaller body size.

These two *Lasioptera* species are probably sibling or sister species that developed in deep past of the history of the Earth from one ancestor and adapted to different environments of the same host plant, *O. europea*: *Lasioptera berlesiana* found favourable conditions for its development in soft olive fruits damaged by *B. oleae* and *L. oleicola* sp. new found a shelter and source of nourishment in plant tissues inside galls caused by *D. oleae* on leaves of olive trees.

Dasineura oleae (Angelini, 1831)

Corethra oleae Angelini, 1831: 31

Synonym *Cecidomyia oleae* F. Löw, 1885 (junior homonym): in Skuhravá et al., 2007

Synonym *Dasyneura lathierei* Del Guercio, 1910: in Coutin & Katlabi, 1986

Angelini (1831) as the first described this species very shortly under the name *Corethra oleae.* Galls were discovered at Verona in northern Italy. Löw (1885) described adults, larvae and galls under the name *Cecidomyia oleae* on the basis of material found at Rjeka in Croatia. Coutin & Katlabi (1986) found that *D. oleae* and *D. lathierei* are identical species. They gave a detail

description of developmental stages, illustrations of some morphological characters and described biological cycle of this species. Larvae cause slight, indefinite, elongate swellings on the leaves of *O. europaea* and may induce galls also on young branches and inflorescences. A single larva inhabits a gall where it also pupates. One or two generations develop a year. Darvas et al. (2000) evaluate *D. oleae* as a pest of olive tree.

Distribution: Mediterranean. Galls of *D. oleae* were found at many localities in Turkey (Skuhravá et al., 2005).

During investigations 2007-2010 carried out in Hatay Province a total of 370 specimens of two gall midge species, *D. oleae* (Angelini, 1831) and *L. oleicola*, sp. new and 735 specimens of twelve species of parasitic Hymenoptera belonging to five families were reared from 1105 galls developing on leaves of *O.europaea.* Of the total number 1105 specimens reared, the specimens of parasitoids include two third and the specimens of gall midges the remaining third. The parasitoid-host relationship is 2:1 (Table 2 and Table 3).

Table 2. Number of specimens of gall midges (Diptera, Cecidomyiidae) and parasitic Hymenoptera reared from galls on leaves of *Olea europaea* in Hatay Province during years 2007-2010

Taxonomic groups		2007	2008	2009	2010	Total number of specimens and %	
Diptera Cecidomyiidae	*Dasineura oleae*	24	37	28	147	236	21.35%
	Lasioptera oleicola sp. new	39	0	13	82	134	12.12%
Hymenoptera Parasitica		265	128	85	257	735	66.5%
Total		328	165	126	486	1105 = 100%	

It is not quite clear the actual relationship between *D. oleae* and *L. oleicola*: sp. new if larvae of both gall midge species cause similar galls on olive leaves, or if the larvae *D. oleae* are gall-causers and the larvae *L. oleicola* sp. new inquilines developing in galls made by *D. oleae* and feeding together with its larvae by sucking liquid from the walls of the gall, as we have it mentioned in the part devoted to the desription of *L. oleicola*. sp. new In 2007-2009 relative low numbers of *D. oleae* adults emerged from galls in contrast to 2010 when a large number of adults emerged from leaf galls, about five times more than in previous years. The number of adults of *L. oleicola* sp. new was much lower than the number of adults of *D. oleae* in 2007, 2009 and 2010 and no adults of *L. oleicola* sp. new emerged in 2008. Such relationships in the course of several years may give evidence for the inquilinous position of *L. oleicola*. sp. new

During investigations 2007-2010 a total number of 8485 olive leaves collected at 12 localities of Hatay Province were examined and evaluated for the presence or absence of galls caused by gall midges on leaves of olive trees. Of all leaves examined, 1297 (15.2 %) were found with galls of *D. oleae* and

L. oleicola sp. new and 7188 leaves (84.8 %) without galls. In total, the level of infestation of olive leaves by gall midges together at amounts 15.2 % (Table 3).

Number of galls on olive leaves

Usually only one or two galls of *D. oleae* are found on one olive leaf. Galls are small, only about 3-5 mm in size and each includes inside a chamber where a solitary larva of *D. oleae* develops. Although the gall is small, it may cause serious damage on a relative small olive leaf of size 40-50 mm x 8-10 mm (Figure 6).

Figure 6. Branches and flower stalks of *Olea europaea* (Angelini) heavily attacked by olive leaf gall midges (Original).

Galls are usually situated along the main or side veins. Galls developed on the leaf prevent photosynthesis compounds to flow from leaf to the tree. Galls and injured parts of adjacent tissues on the olive leaf harden quickly and get dry. Occurrence of several galls on one leaf may cause precocious fall off the leaves. If many leaves are attacked on a tree it may result in defoliage of many branches or of the whole olive tree. The shortage of assimilation compounds may manifest in the next year in the fact that no flower buds are created on shoots and subsequently no fruits develop (Figures, 7 and 8).

During our investigations in Hatay Province we usually have found only one or two galls per leaf in the localities having low infestation levels, while in localities with high level of infestation in Sebenoba, Yayladağ and Vakıflı, Samandağ we found many leaves with at least three galls and at most eleven galls per leaf.

Figure 7. Galls of olive gall midges on leaves (A) and on terminal parts of branches (B) on olive trees (Original).

Figure 8. Defoliage of normally evergreen olive branches as a result of gall midge attack. A-C. About 80 % of leaves have fallen precociously after attack of gall midges; D. new leaves have grown on branches in the next year but any flowers and fruits occurred on these trees (Original).

Occurrence of olive leaf gall midges in the Hatay Province

Galls of *D. oleae* on leaves of *O. europaea* were found at all localities in the Hatay Province where samples have been taken (Table 3). *Dasineura oleae* occur in altitudinal range from 43 m a.s.l. at Samandağ to 618 m a.s.l. at Dokuzdal, with maximum occurrence in lower situated parts at Sebenoba (162 m), Vakıflı (147 m) and Apaydın (81 m), i.e. in the areas situated not far from the Mediterranean Sea (Table 3).

The occurrence of *D. oleae* was evaluated using the level of infestation, i.e. percentage of leaves with galls of the total number of examined leaves. The average level of infestation was 15.2 % and the highest level of infestation was found on leaves collected at the locality Sebenoba where it reached 78.2 %. Leaves on olive trees of three other localities may be considered as seriously injured, viz. Vakıflı with infestation level 28.9 %, Apaydın with 18.8 % and Samandağ with 8.0 %. In Sebenoba the leaves of olive trees infested in 2009 by gall midges fell off in the February and March of 2010 (Figure 8) and injured olive trees did not give any fruits in 2010. In Vakıflı and Samandağ some of the trees had a low yield of olive fruits because each flower stalk brought only one or two fruits and some others having galls at the base of the stalk remained without fruits in the period from 2007 to 2010. In all localities where the high level of infestation of *D. oleae* was found, the production of olive fruits and the yield was expressively reduced. *Dasineura oleae* is in Hatay Province the economic important species that causes the significant reduction or loss of yield of olive fruits on young trees of the age from five to ten years.

Table 3. Infestation level of *Dasineura oleae* (Angelini) and *Lasioptera oleicola* Skuhravá sp. new on leaves of *Olea europaea* in twelve localities of Hatay Province during the years of 2007-2010

Localities (altitude m.)	Number of examined leaves	Leaves without galls	Leaves with galls	Level of infestation (%)
Samandağ (43 m)	597	549	48	8.0
Apaydın (81 m)	1232	1001	231	18.8
Vakıflı (147 m)	640	455	185	28.9
Yayladağ (562 m)	740	701	39	5.3
Sebenoba (162 m)	767	167	600	78.2
Şenköy (504 m)	992	967	25	2.5
Altınözü (387 m)	704	680	24	3.4
Hacıpaşa (220 m)	500	488	12	2.4
Dokuzdal (618 m)	626	613	13	2.0
Antakya (173 m)	726	630	96	13.2
Hanyolu (430 m)	486	475	11	2.2
Serinyol (204 m)	475	462	13	2.7
Total	**8485**	**7188**	**1297**	**15.2**

Pest status of *Dasineura oleae*

Dasineura oleae causing leaf galls on *O. europaea* is a native species in the Mediterranean and its galls occur abundantly in the whole Mediterranean area from the most western part in Portugal up to eastern part (Syria, Lebanon, Jordan, Israel) (Figure, 9).

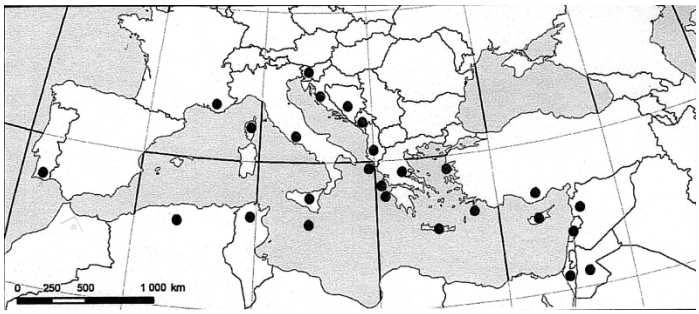

Figure 9. Distribution area of *Dasineura oleae* (Angelini) and its host plant *Olea europaea* in the Mediterranean area (Skuhravá & Skuhravý, 2010).

Galls of *D. oleae* were found in Turkey in all parts where *O. europaea* is grown, i.e. along the coast of the Mediterranean Sea. (Figure, 10).

Figure 10. Occurrence of *Dasineura oleae* (Angelini) in Turkey on the basis of data given in articles of various researchers (Original).

Galls of *D. oleae* were found in all parts of the Hatay Province where the olive trees are grown and samples were taken (Figure, 11). *Dasineura oleae* injures its host plant by forming the gall on the leaf, shoots and flower stalks. Galls reduce the assimilation surface and prevent to fulfill all physiological functions of attacked leaf. All these facts allow us to evaluate the olive leaf gall *D. oleae* as a serious pest of olive tree and to declare its pest status.

We have many data on the biology, occurrence and harmfulness of *D. oleae* in Hatay Province, in Turkey and in the Mediterranean but only few data about these categories with regard to *L. oleicola*. sp. new It is necessary to obtain more data about its biology, occurrence and harmfulness in the future research and to solve the question if it is a gall causer of similar galls as they

are induced by *D. oleae* on olive leaves, or if it is an inquiline inhabiting galls caused by *D. oleae*. Therefore it is not possible at the present time to declare the pest status of *L.oleicola*. sp. new.

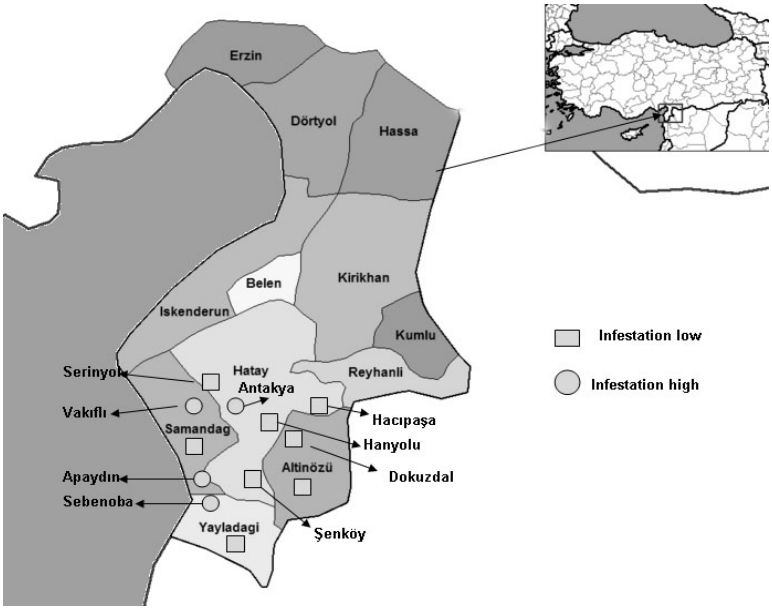

Figure 11. Occurrence of *Dasineura oleae* (Angelini) in Hatay province, Turkey (Original).

Parasitic Hymenoptera and level of parasitism

The following species of parasitic Hymenoptera were reared from galls of *D. oleae* and *L. oleicola* sp. new developing on olive leaves in the area under study: *Platygaster oleae* Szelenyi 1940 (Platygastridae); *Eupelmus urozonus* Dalman 1820 (Eupelmidae); *Torymus phillyreae* Ruschka, 1921 (Torymidae); *Mesopolobus mediterraneus* (Mayr, 1903), *Mesopdoby diffinis* (Walker, 1834) and *Mesopdoby aspilus* (Walker, 1835) (Pteromalidae); *Quadrastichus dasineurae* Doganlar, LaSalle, Sertkaya & Doganlar, 2009*, Aprostocetus samandagus* Doğanlar, 2011*, Aprostocetus lasiopterus* Doğanlar, 2011*, Zeytinus hatayensis* Doğanlar, 2011 and additional two undescribed species of the genus *Aprostocetus* (Eulophidae) (Doğanlar, 2011). The total level of parasitism of 12 parasitoid species amounts 66.2 % (Table 4).

Eupelmus urozonus, *P. oleae* and *Q. dasineurae* are three main parasitoids reared from galls of *D. oleae* and *L. oleicola* sp. new They reduced the populations of the gall midges in galls significantly, together for about 70 %, they are very effective and may be evaluated as important supressors of olive leaf gall midges in the area under study. The parasitism level of other parasitoids varied from 0.5-6.8 % in the regions under study.

In the future it is necessary to solve the problem dealing with both leaf gall midges species: if each of them is gall-causing species or if *D. oleae* is the

gall-causing species and *L. oleicola* sp. new an inquiline developing in galls caused by *D. oleae*. It is also desirable to search for factors influencing the increasing the infestation levels of both gall midge species on olive trees.

Table 4. Number of parasitoid specimens (Hymenoptera Parasitica) reared from galls of *Dasineura oleae* Angelini and *Lasioptera oleicola* Skuhravá sp. new on leaves of *Olea europaea* in four localities of Hatay Province during 2007-2010

Species of parasitoids	Vakıflı, Samandağ				Seben-oba-Y. dağ	Center, Antakya			Hanyolu Antakya	Number of Specimens	%
	2007	2008	2009	2010	2010	2008	2009	2010	2007		
Platygaster oleae	49	19	5	13	-	31	20	40	-	177	16.0
Eupelmus urozonus	126	25	11	90	-	40	18	19	-	329	29.7
Torymus phylleriae	6	-	-	-	-	-	-	-	-	6	0.5
Mesopolobus mediterraneus	1	-	9	8	-	-	-	3	-	21	1.9
Mesopolobus diffinis	5			4	-	-	-	-	-	9	0.8
Mesopolobus aspilus	1		14	3	-	-	-	-	-	18	1.6
Quadrasticus dasineurae	15	9	3	47	-	-	-		-	74	6.6
Zeytinus hatayensis	17	-	-	-	-	4	4	2	-	27	2.4
Anabrostecetus acuminatus	3	-	-	5	-	-	-	-	-	8	0.7
Aprostocetus samandagus	14	-	-	16	-	-	-	-	-	30	2.7
Aprostocetus lasiopterus	24	-	1 -	4	-	-	-	-	-	29	2.6
Aprostocetus spp.	4	-	-	3	-	-	-	-	-	7	0.6
No of parasitoid specimens	265	53	43	193	-	75	42	64	-	735	66.2

Özet

Hatay-Türkiye'de Zeytin Yaprak Siğili, *Dasineura oleae* (Angelini 1831)'nin zararlılık durumu, *Lasioptera oleicola* Skuhravá sp. new (Diptera: Cecidomyiidae)'nın tanımlanması ve bunların popülasyonlarına parazitoitlerin etkisi

Hatay - Türkiye'de 2007-2010 yılları arasında yapılan çalışmada Zeytin ağacı, *Olea europea* L.,'nın sürgün ve yapraklarında bulunan gallerden iki gall sineği, Zeytin yaprak siğili, *Dasineura oleae* (Angelini 1831), ve *Lasioptera oleicola* Skuhravá sp. new, elde edilmiştir. Gal sineklerinin zeytin ağaçlarının yaprak ve sürgünlerinde yaptıkları enfeksiyon düzeyi ortalama % 15.2 ve en yüksek ise % 78.2 olmuştur. Zeytin ağaçlarının yaprakları herdem yeşil olup yıllar boyunca ağaç üzerinde kalmaktadır. Ancak gal

sinekleri tarafından yapraklar zarara uğrayınca dökülmekte ve bunun sonucunda müteakip yılda yüksek düzeyde çiçek gözleri ve dolayısıyla meyve verimi büyük kayıplara uğramaktadır. Bu nedenle Zeytin yaprak siğili oluşturduğu verim kayıpları dolayısıyla önemli bir zararlı olarak görülmektedir. Bu gall sineklerinin poopülasyonlarını engelleyen en önemli ölüm faktörleri olarak Hymenoptera takımına giren 5 familyadan 12 tür larva veya pupa parazitoiti belirlenmiştir. Bu parazitoitler: Platygastridae: *Platygaster oleae* Szelenyi, 1940, Eupelmidae: *Eupelmus urozonus* Dalman, 1820, Torymidae: *Torymus phillyreae* Ruschka 1921, Pteromalidae: *Mesopolobus mediterraneus* (Mayr, 1903), *Mesopolobus diffinis* (Walker. 1834), *Mesopolobus aspilus* (Walker, 1835), Eulophidae: *Quadrastichus dasineurae* Doganlar, Lasalle, Sertkaya & Doganlar, 2009*, Aprostocetus samandagus* Doğanlar, 2011*, Aprostocetus lasiopterus* Doğanlar, 2011*, Zeytinus hatayensis* Doğanlar 2011, ve ayrıca *Aprostocetus* cinsine giren ve henüz teşhisi yapılmamış 2 tür belirlenmiştir. Bu parazitoitlerin larvaları gal sineklerinin galler içinde bulunan larva ve pupalarını öldürmektedirler. Toplam parazitlenme oranı % 66.2'yi bulmaktadır. *D.oleae* ve *Lasioptera oleicola* sp. new gallerinden elde edilen en önemli 3 tür *E. urozonus*, *P. oleae* ve *Q. dasineurae*'dir. Bu türler gal sineklerinin popülâsyonlarını baskı altında tutmakta ve toplam parazitlemenin % 70'e varan bölümü bu türlerce yapılmaktadır. İlerde bu zararlıların üzerinde baskı unsurları olarak kullanılabilecekleri düşünülebilir.

Çalışmada *Lasioptera oleicola* Skuhravá sp. new tanımlanmış, bunun ayırt edici özellikleri ve bazı biyolojik bilgileri verilmiştir.

References

Alkan, B., 1952. Türkiye'nin Zoosesid (Zoocecid)'leri (kökeni hayvansal Bitki urları) üzerinde çalışmalar. **Ankara Üniversitesi Ziraat Fakültesi Yıllığı, (2-3)**: 185-225, **(4):** 259-291.

Al-Tamimi, M. M. A., 1997. Population Trends of Olive Leaf Midge Dasineura oleae Loew (Diptera: Cecidomyiidae) and the Effect of Some Insecticides on the Midge and its Parasites in Amman District. (Thesis or Dissertation), NCARE, Jordan, 77 pp.

Angelini, B., 1831. Degli insetti nocivi all´ulivo nella provincia Veronese. Memoria I. **Memoria Accademia Agricoltura commercio arti, Verona, 12**: 295-323, 325-357.

Anonymous, 2008. Zeytincilik Araştıma Enstitüsü, Bitki Sağlığı, 2.derece önemli zeytin zararlıları.(Web page: http://www.zae.gov.tr/bitkisagligi/iz.asp.) (Data accessed: Mayıs 2008)

Avidov, Z. & Harpaz, I. 1969. Plant Pests of Israel. Israel Universities Press, Jerusalem. 4. Bar-Joseph, M. and Gerson, U. (1977, second edition).

Barnes, H. F., 1948. Gall Midges of Economic Importance. Vol. 3. Gall Midges of Fruit. London, Crosby Lockwood & Son Ltd, 184 pp.

Coutin, R. & H. Katlabi, 1986. Cecidomyiidae. Entomologie oleicole. Arambourg, J. (ed.) COI, Madrid: 95-113.

Darvas, B., M. Skuhravá & A. Andersen, 2000. Agricultural Dipteran Pests of the Palaearctic Region, pp. 565-650. In: PAPP L. & DARVAS B. (editors): *Contributions to a Manual of Palaearctic Diptera*. Vol. 1. General and Applied Dipterology. Science Herald, Budapest, 978 pp.

Del Guercio, G., 1910. Intorno a due nemici nuovi dell´olivo e alle gravi alterazioni che determinano. **Redia, 6** (2): 282-297.

Doğanlar, M., J. LaSalle, E. Sertkaya & O. Doğanlar, 2009. A new species of *Quadrastichus* Girault, 1913 (Hymenoptera: Eulophidae: Tetrastichinae) from Hatay, Turkey. **Turkish Journal of Zoology, 33**: 309-314.

Doğanlar, M., 2011. Parasitoids complex of the olive leaf gall midges, *Dasineura oleae* (Angelini) 1831 and *Lasioptera oleicola* Skuhravá 2011 (Diptera: Cecidomyiidae) in Hatay-Turkey, with descriptions of new genus and species of Tetrastichinae (Hymenoptera: Eulophidae). **Türkiye Entomoloji Dergisi, 35** (2): (in press).

FAO, 1999. Determination of Pest Status in an Area. International Standards for Phytosanitary Measurements. Secretariat of the International Plant Protection Conservation, Food and Agriculture Organization of the United Nations, Rome, (Publication No. 8, November 1998) 17 pp.

Hepdurgun, B., 1998. Zeytin Kızılkurdu [*Lasioptera berlesiana* Paoli (Diptera: Cecidomyiidae)]'nun Tanınması, İzmir İlindeki Yayılışı, Biyolojisi ve Doğal Düşmanları Üzerinde Araştırmalar. E. Ü. Fen Bil. Ens. Doktora Tezi, 105 s.

Hepdurgun, B. & F. Önder, 1999. *Lasioptera berlesiana* Paoli (Diptera: Cecidomyiidae) (Zeytin kizilkurdu)´nin biyolojisi üzerinde arastirmalar (Investigations on the biology of the olive gall midge (*Lasioptera berlesiana* Paoli) (Diptera: Cecidomyiidae). **Türkiye Entomoloji Dergisi, 23** (3): 191-202.

Hepdurgun B. & F. Önder, 2000. *Lasioptera berlesiana* Paoli (Dipt.: Cecidomyiidae) (Zeytin kizilkurdu)´nin taninmasi ve yayilisi üzerinde arastirmalar (Studies on the morphology and distribution of the olive fruit midge (*Lasioptera berlesiana* Paoli) (Dipt.: Cecidomyiidae). **Türkiye Entomoloji Dergisi, 24** (2): 133-142.

Hrncic, S., 1998. A survey of olıve pests ın Montenegro. IV International Symposium on Olive Growing. **ISHS Acta Horticulturae, 586**: 23-28.

İren, Z. & M. K. Ahmet, 1973. Insect pests of Turkey found on deciduous fruits (Meyve zararlıları**). Bitki Koruma Bülteni, Ek yayın, 1**: 35-84.

İyriboz, N., 1940. Zeytin Zararlıları ve Hastalıkları. Karınca Matbaacılık Ticaret Şti, İzmir, 112 pp.

İyriboz, N., 1968. Zeytin Zararlıları ve Hastalıkları. Karınca Matbaacılık ve Ticaret Kollektif Şirketi, İzmir, 122 s.

Löw, F., 1885. Zwei neue Cecidomyia-Arten. **Berliner Entomologische Zeitschift, 29**: 109-112.

Mamaev, B. M., 1969. [26. Family Cecidomyiidae (Itonididae). Pp.: 356-420. In: Bei-Bienko G. Ya. (Editor): Keys to the Insects of the European Part of the USSR. Vol. 5. Diptera and Siphonaptera. Part I. Leningrad.] (In Russian).

Paoli, G., 1907. *Lasioptera berlesiana* Paoli n. sp. Pp. 45-46. In: Materiali per la storia di alcuni insetti dell´olivo. **Redia, 4**: 1-95.

Skuhravá, M., 1986. Family: Cecidomyiidae, pp. 72-297. In: Soós, Á. & L. Papp (editors): Catalogue of Palaearctic Diptera, Vol. 4. Hungarian Academy of Sciences, Budapest, Akadémiai Kiadó and Elsevier, Amsterdam, 441 pp.

Skuhravá, M., 1997. Family Cecidomyiidae, pp. 71-204, with 739 figs. In: PAPP L. & B. DARVAS (Eds): *Contributions to a Manual of Palaearctic Diptera* (*with special reference to flies of economic importance*). Vol. 2. *Nematocera and Lower Brachycera.* Budapest: Science Herald, 592 pp.

Skuhravá, M., 2006a. Species richness of gall midges (Diptera: Cecidomyidae) in the main biogeographic regions of the world. **Acta Societatis Zoologicae Bohemicae, 69**: 327–372.

Skuhravá, M., Ş. Bayram, H. Çam, S. Tezcan & P. Can, 2005. Gall midges (Diptera: Cecidomyiidae) of Turkey. **Türkiye Entomoloji Dergisi, 29** (1): 17-34.

Skuhravá, M. & V. Skuhravý, 1981. Die Gallmücken (Cecidomyiidae, Diptera) des Schilfes (*Phragmites communis* Trin.). **Studie ČSAV,** (3): 1-150.

Skuhravá M. & V. Skuhravý, 1994. Gall midges (Cecidomyiidae, Diptera) of Italy. **Entomologica, Bari, 28**: 45-76.

Skuhravá M. & V. Skuhravý, 1997. Gall midges (Diptera, Cecidomyiidae) of Greece. **Entomologica, Bari, 31**: 13-75.

Skuhravá, M. & V. Skuhravý, 2010. Species richness of gall midges (Diptera, Cecidomyiidae) in Europe (West Palaearctic): biogeography and coevolution with host plants. **Acta Societatis Zoologicae Bohemicae, 73**: 87–156,

Skuhravá, M., V. Skuhravý, J. Blasco-Zumeta & J. Pujade, 2006. Gall midges (Diptera: Cecidomyiidae) of the Iberian Peninsula. 2. Zoogeographical analysis of the gall midge fauna. **Boletin de la Asociation Espanola de Entomologia, 30**: 93-159.

Skuhravá, M., V. Skuhravý & B. Massa, 2007. Gall midges (Diptera Cecidomyiidae) of Sicily. **Naturalista Siciliana, 31**: 215-263.

Solinas, M., 1967. Osservazioni biologiche condotte in Puglia sulla *Prolasioptera berlesiana* Paoli, noc particolare riferimento au rapporti simbioti ci col *Dacus oleae* Gmel. A noc la *Sphaeropsis dalmatica* (Thüm.) Gigante. **Entomologica, 3**: 129-176.

Tastás-Duque, R. & E. Sylvén, 1989. Sensilla and cuticular appendages on the female abdomen of *Lasioptera rubi* (Schrank) (Diptera, Cecidomyiidae). **Acta Zoologica, 70** (3): 163-174.

Trotter, A., 1903. Galle della Penisola Balcanica e Asia minore. **Nuovo Giornale botanico Italiano (Nuova serie), 10**: 1-86.

Yukawa, J., 1971. A revision of the Japanese gall midges (Diptera: Cecidomyiidae). **Memoirs of the Faculty of Agriculture, Kagoshima University, 8** (1): 1-203.

Yukawa, J. & S. Haitsuka, 1994. A new Cecidomyiid successor (Diptera) inhabiting empty midge galls. **Japanese Journal of Entomology, 62**: 709-718.