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## **Eight New records of gall midges (Diptera: Cecidomyiidae) from Iran**

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### **Abstract**

Eight gall midge species were identified as new records for the fauna of Iran from the Golestan province: gall inducing species *Rabdophaga rosaria* (LOEW, 1850), *Rabdophaga nervorum* (KIEFFER, 1895), *Iteomyia capreae* (WINNERTZ, 1853), and zoophagous species *Lestodiplosis heterobiae* (BARNES, 1928), associated with *Salix* (Salicaceae); *Dasineura irregularis* (BREMI, 1847) with *Acer pseudoplatanus* (Aceraceae); *Zygiobia carpini* (LÖW, 1874) with *Carpinus betulus* (Betulaceae); mycophagous species *Mycodiplosis plasmoparae* (RÜBSAAMEN, 1906); and *Camptodiplosis boleti* (KIEFFER, 1901), from the soil.

Key words: New record, Cecidomyiidae, Fauna, Iran.

### **Zusammenfassung**

Acht Gallmückenarten wurden als neue Funde für die Fauna des Iran aus der Provinz Golestan festgestellt. Gallen bildende Arten: *Rabdophaga rosaria* (LOEW, 1850), *Rabdophaga nervorum* (KIEFFER, 1895), *Iteomyia capreae* (WINNERTZ, 1853), und zoophage Arten *Lestodiplosis heterobiae* (BARNES, 1928), auf *Salix* (Salicaceae);

*Dasineura irregularis* (BREMI, 1847) auf *Acer pseudoplatanus* (Aceraceae); *Zygiobia carpini* (LOEW, 1874) auf *Carpinus betulus* (Betulaceae); mycophage Arten *Mycodiplosis plasmoparae* (RÜBSAAMEN, 1906); und *Camptodiplosis boleti* (KIEFFER, 1901), vom Boden.

## Introduction

The family Cecidomyiidae is the biggest group of insects in the order Diptera. The family presently contains 6203 known species and 736 genera (GAGNÉ & JASCHHOF 2014). Altogether 3113 species in 344 genera occur in the Palaearctic region of which more than 1800 species in 270 genera occur in Europe (SKUHRAVÁ 2006). The family is composed of six subfamilies: Catotrichinae, Lestremiinae, Micromyinae, Winnertziinae, Porricondyliinae, and Cecidomyiinae. The first five subfamilies comprise about one-fourth of the species, all are fungivores. The largest subfamily, the Cecidomyiinae, including 565 genera and 4819 known species (GAGNÉ & JASCHHOF 2014). The Cecidomyiidae include phytophagous, zoophagous or mycophagous species. Phytophagous larvae of these midges induce the formation of galls on various plants and zoophagous larvae are predators of aphids, scale insects and mites. Adults are usually small flies (0.5–3.0 mm), rarely up to 8 mm. The head bears large holoptic eyes in both sexes. Antennae consist of 6 to 40, usually 12 or 14, flagellomeres, covered with microtrichia and whorls of long setae and circumfila plus other sensoria. Wing veins are reduced in number, usually with only three or four long veins present. Legs are usually long and the first tarsomere (metatarsus) is much shorter than the second tarsomere, except in Lestremiinae where it is longer. On the basis of larval feeding habits, gall midges may be divided into three biological groups: phytophagous, mycophagous (including saprophagous), zoophagous and the biology of about 2% remains unknown. (SKUHRAVÁ 1986, 1997a, SKUHRAVÁ et al. 1984).

Reviewing taxonomic related literature in Iran (e.g., HASHEMI KHABIR et al. 2011; KARIMPOUR & SKUHRAVÁ 2012; SADEGHI et al. 2012; JOGHATAIE et al. 2013; HONARMAND et al. in press) showed that the knowledge of Iranian gall midges is still limited. This research was carried out in Ali Abad Katool region in Golestan Province, in North-eastern Iran where no previous faunistic study of gall midges has been carried out.

## Material and Methods

This study was conducted during growth season of 2013. The occurrence and distribution of gall midges have been studied by collecting galls containing larvae from host plants at each locality. The host plants and midge-induced galls were put in separate small plastic bags and brought to the laboratory. Some species of host plants and midge-induced galls kept in rearing cages until the emergence of adult midges. Also some galls with larvae were put into vials filled with 75% alcohol for morphological studies. In the meantime, some adult specimens were collected with a hand net. The adult specimens were mounted on microscopic slides using Hoyer's Medium which were then placed in an oven at 60 °C for 48 hours until they had cleared enough for morphological studies. Species were identified by the fourth author. Identification of galls is based on the keys of HOUARD

(1908-1909) and BUHR (1964-1965), of larvae on MÖHN (1955), of adults on SKUHRAVÁ (1997a). Nomenclature follows GAGNÉ & JASCHHOF (2014). Voucher specimens are deposited in the collection of Plant Protection Department, Ferdowsi University of Mashhad, Iran, and in the collection of Marcela Skuhrová in Prague, Czech Republic.

## Result

*Rabdophaga rosaria* (LOEW, 1850), *Rabdophaga nervorum* (KIEFFER, 1895), *Lestodiplosis heterobiae* (BARNES, 1928), *Iteomyia capreae* (WINNERTZ, 1853), *Dasineura irregularis* (BREMI, 1847), *Zygiobia carpini* (LÖW, 1874), *Mycodiplosis plasmoparae* (RÜBSAAMEN, 1906), and *Camptodiplosis boleti* (KIEFFER, 1901) are reported in the Golestan province in North-eastern of Iran for the first time. All species belong to various tribes of the subfamily Cecidomyiinae.

### ***Rabdophaga rosaria* (LOEW, 1850) (Fig. 1)**

*Cecidomyia rosaria* LOEW, 1850

**A d u l t** : palpus consisting of 4 segments, antenna with 2+18 up 2+20 segments, each flagellar segment of male, except terminal one or two, consisting of a relatively long distal stem and a distal stem and a cylindrical basal enlargement; female flagellar segment consisting of a very short distal stem and a cylindrical basal enlargement. Claw of leg with a distinct proximal tooth. Wing with costa interrupted at junction with  $R_5$ ;  $R_1$  reaches before the middle of the anterior wing margin;  $R_5$  slightly curved, joining costa before the wing apex. Legs long and slender, claws simple, claws as long as empodia. Male genitalia: cerci rather deeply incised by a V-shaped emargination, forming a pair of lobes. Ovipositor not chitinized (NIJVELDT & YUKAWA 1982).

**M a t u r e l a r v a** : orange-red; spatula distally incised by a U-shaped emargination, forming a pair of narrow triangular lobes; basal part of sternal spatula roughly rectangular in shape, not strongly chitinized; inner pleural papillae without seta on pro thorax, with short setae on meso- and metathorax; sternal papillae all without seta; anterior ventral papillae without seta (NIJVELDT & YUKAWA 1982).

**P u p a** : apical spine undeveloped, gently rounded apically; prothoracic horn relatively short; stigmatal protuberances short, present on second to sixth abdominal segments (NIJVELDT & YUKAWA 1982).

**M a t e r i a l e x a m i n e d** : several galls on terminal buds collected from *Salix caprea* L. (Salicaceae), Ali Abad Katool (36°54'N - 54°53'E) in Golestan province of Iran, 140 m.a.s.l., 10 Sep. 2013, coll. Ali Gol.

**B i o l o g y** : A single orange red larva causes a large rosette leaf gall on terminal or lateral buds of *Salix alba* L. and related species of *Salix* (Salicaceae). Only one generation develops a year. Pupation takes place in the gall (SKUHRAVÁ & SKUHRAVÝ 2012).

**D i s t r i b u t i o n** : Euro-Siberian (Skuhrová, 1986).

***Rabdophaga nervorum* (KIEFFER, 1895) (Fig. 2)**

*Dichelomyia nervorum* KIEFFER, 1895

**A d u l t** : antenna consisting of 2+13 up 2+14 segments, palpus of 4 segments. Claw of leg with a distinct proximal tooth. Wing with costa interrupted at junction with R<sub>5</sub>; R<sub>1</sub> reaches before the middle of the anterior wing margin; R<sub>5</sub> slightly curved, joining costa before the wing apex. Legs long and slender, claws simple, claws as long as empodia (STELTER 1993).

**M a t e r i a l e x a m i n e d** : This species was identified based on the characteristic features of galls on leaf of plant host, *Salix caprea* L. (Salicaceae), Ali Abad Katool (36°54'N - 54°53'E) in Golestan province of Iran, 140 m.a.s.l., 13 Sep. 2013, coll. Ali Gol.

**B i o l o g y** : Red-yellow larva develops in spindle-shaped swelling of the midvein on the leaf of *Salix caprea* L. and *S. aurita* L. (Salicaceae). Each swelling contains only one larva. It pupates in the gall. One generation develops per year (SKUHRVÁ et al. 2014).

**D i s t r i b u t i o n** : European, found in 10 countries (SKUHRVÁ, databasis).

***Dasineura irregularis* (BREMI, 1847) (Fig. 3)**

*Cecidomyia irregularis* BREMI, 1847

*Cecidomyia acercrispans* KIEFFER, 1888

**A d u l t** : antenna with 2+13 segments in both sexes, flagellomeres in male with stems, in female without stems, circumfila simple; palpi four segmented; R<sub>5</sub> joining costa before wing apex and curved anteriorly, cu forked; tarsal claws with tooth, empodium about as long as the claws; male genitalia with mediobasal gonocoxite lobes that gradually taper from base to apex and are nearly as long as the aedeagus. Superior lamella of female genitalia simple, ovipositor retractile and tapering and cerci of female fused (SKUHRVÁ 1997a).

**M a t u r e l a r v a** : white larva with well-developed bilobed spatula and a pair of small two-segmented antennae. BREMI (1847) described very briefly a larva, later Kieffer (1888) gave a detailed description of a male, female, larva and gall.

**M a t e r i a l e x a m i n e d** : several galls on leaves, collected from *Acer pseudoplatanus* L. (Aceraceae), Ali Abad Katool (36°54'N - 54°53'E) in Golestan province of Iran, 140 m.a.s.l., 26 Aug. 2013, coll. Ali Gol.

**B i o l o g y** : White larvae cause galls from leaves of *Acer pseudoplatanus* L. (Aceraceae). The leaves are wrinkled, curled and rolled upwards and their veins are hypertrophied and slightly swollen. Two generations develop per year. Pupation takes place in the soil. *D. irregularis* may be locally and occasionally a major pest of young maple trees grown in forest nurseries or in hedges (SKUHRVÁ & ROQUES, 2000, SKUHRVÁ et al. 2013).

**D i s t r i b u t i o n** : European, known to occur in many countries (SKUHRVÁ, 1986), recently found in Armenia and Georgia (MIRUMIAN 2011, SKUHRVÁ et al. 2013).

***Zygiobia carpini* (LÖW, 1874) (Fig. 4)**

*Cecidomyia carpini* LÖW, 1874

**A d u l t** : antenna with 2+12 segments; palpus consisting of 4 segments; R<sub>1</sub> reaches

before the middle of the anterior wing margin,  $R_5$  meeting with costa at apex of wing. Male flagellomeres with definite necks; a protrusible ovipositor; female eighth abdominal tergite as long or longer than seventh and tending to divide longitudinally; and male genitalia with mediobasal gonocoxite lobes that gradually taper from base to apex and are nearly as long as the aedeagus (STELTER 1992).

**Material examined:** several galls on leaves collected from *Carpinus betulus* L. (Betulaceae), Ali Abad Katool (36°54'N - 54°53'E) in Golestan province of Iran, 140 m.a.s.l., 26 Sep. 2013, coll. Ali Gol.

**Biology:** White larvae produce small swellings along the median vein and side veins of the leaves of *Carpinus betulus* L. (Corylaceae). Each swelling contains one larva. In autumn the larvae leave galls and hibernate in the soil. One generation develops per year (SKUHRAVÁ et al., 2013).

**Distribution:** European, known to occur in many countries, recently found in Asia: Turkey, Armenia and Georgia (SKUHRAVÁ et al. 2005, SKUHRAVÁ et al. 2013, MIRUMIAN 2011).

### ***Iteomyia capreae* (WINNERTZ, 1853) (Fig. 5)**

*Cecidomyia capreae* WINNERTZ, 1853

**Adult:** palpus consisting of 2 segments; antenna with 2+12 segments in both sexes; each flagellar segment of male, except terminal one, consisting of a rather long distal stem and a cylindrical basal enlargement; female flagellar segment consisting of a very short distal stem and a cylindrical basal enlargement; claws of all legs without tooth; empodium nearly as long as claw;  $R_5$  meeting with costa a little beyond wing apex. Male genitalia: cerci incised by a V-shaped emargination forming a pair of rather large lobes; subanal plate nearly as long as and distinctly narrower than cerci, short, with a pectinated claw apically; inner angle of gonocoxite ventrally developed into a setose lobe which is provided with many protuberances distally; aedeagus nearly parallel sided medially, weakly rounded and curved upward distally. Ovipositor rather long, not chitinized; terminal lobe short, entire (NIJVELDT & YUKAWA, 1982).

**Mature larva:** orange-red colored. Cervical papillae without seta; six dorsal papillae present, each with a seta; two dorsal papillae of eighth abdominal segment and two pleural papillae, each with a seta; stigma normal in number and position; eight terminal papillae present, each with a seta; sternal spatula absent; lateral papillae reduced in number; only two outer lateral papillae present, each with a seta; sternal papillae without seta; inner pleural papillae without seta on prothorax, with a seta on meso- and metathorax; four anterior ventral papillae without seta; two posterior ventral papillae and two ventral papillae of eighth abdominal segment each with a seta; anal papillae without seta (NIJVELDT & YUKAWA 1982).

**Pupa:** apical spine short; upper and lower frontal spines absent; a pair of lower facial papillae present, without seta; one of three pairs of lateral facial papillae with a seta; prothoracic horn long, pointed apically; stigma short, pointed apically, present on second to sixth abdominal segments; each abdominal segment with many short spines dorsally and ventrally (NIJVELDT & YUKAWA 1982).

**Material examined:** This species was identified based on the characteristic features of galls on leaf of plant host, *Salix caprea* L. (Saliaceae), Ali Abad Katool (36°54'N - 54°53'E) in Golestan province of Iran, 140 m.a.s.l., 13 Sep. 2013, coll. Ali Gol.

**Biology:** First white, then orange, at maturity red larvae produce small hemispherical galls on the leaves of *Salix caprea* L., *S. aurita* L. and its hybrids and relatives (Salicaceae). The circular opening is on the lower surface of the leaf. Each gall includes one larva. When full-grown, larvae leave galls, drop to the soil where they hibernate. One generation develops per year (SKUHRAVÁ et al. 2014).

**Distribution:** Euro-Siberian, known to occur in many countries of Europe, in Asia: Turkey, Georgia (SKUHRAVÁ 1986, SKUHRAVÁ 1997b, with a map of distribution area, SKUHRAVÁ et al. 2013).

### ***Mycodiplosis plasmoparae* RÜBSAAMEN, 1906**

**Adult:** antenna with 2 + 12 segments, antennal segments of female elongate, cylindrical, with relatively short neck and simple circumfila; palp 4-segmented; wings with R1 joining costa in the basal third, R<sub>5</sub> curved distally and joining costa beyond apex of wing, distinct cross-vein Rs usually present; legs with all claws toothed, claw evenly and shallowly curved; male genitalia with the inferior lamella deeply lobed, superior lamella relatively large, broadly and triangularly emarginate, aedeagus long, internal angle of basal clasp segment forming a setal lobe, and distal clasp segment long and narrow; ovipositor short, not retractile, terminal lobes well develop (HARRIS 1966).

**Mature larva:** yellowish-red, with sternal spatula; integument ornamented with raised patterns of small warts and spines; 4 pairs of terminal papillae, 2 pairs bearing normal and 2 pairs bearing reduced or modified setae. Posterior ventral papillae without seta, terminal papillae in two transverse rows, the superior row of four papillae with long seta, the inferior row with four cone-shaped papillae (ROSKAM 1979).

**Material examined:** 1♂, reared from old galls on *Carpinus betulus* L. (Betulaceae), Ali Abad Katool (36°54'N - 54°53'E) in Golestan province of Iran, 140 m.a.s.l., 25 Aug. 2013, coll. Ali Gol.

**Biology:** yellowish red or orange larvae are often found feeding on rusts and mildews on a wide range of flowering plants, including many crops. They appear to browse superficially on the mycelium and spores and are unlikely to have any effect in limiting the diseases (HARRIS 1966).

**Distribution:** UK, the Netherlands, Germany, Czechoslovakia, Russia (European part), Sweden (SKUHRAVÁ 1986).

### ***Camptodiplosis boleti* (KIEFFER, 1901)**

*Mycodiplosis poriae* RÜBSAAMEN, 1912

**Adult:** antenna with 2+12 segments; R1 reaches before the middle of the anterior wing margin, R<sub>5</sub> meeting with costa at apex of wing.

**Material examined:** 1♂ reared from the soil sample, Ali Abad Katool (36°54'N - 54°53'E) in Golestan province of Iran, 140 m.a.s.l., 4 Oct. 2013, coll. Ali Gol.

**Biology:** Larvae are mycophagous. They develop in various species of fungi. KIEFFER (1901) found a single female ovipositing on *Boletus confluens* (now correctly *Albatrellus confluens* (Albatrellaceae) (HOLZ 1970, SKUHRAVÁ et al. 2014).

**Distribution:** Germany, Lithuania, UK, France, Czech Republic, Slovak Republic, Russia (SKUHRAVÁ 1986, SKUHRAVÁ 2004, YAKOVLEV 1994).

### ***Lestodiplosis heterobiae* BARNES, 1928**

**Adult:** antenna 2 + 12, segments in female with nodes markedly constricted and more smoothly rounded; palp 4 segmented; eyes normal, holoptic, ommatidia relatively large; male antennal segments binodose, with a single set of circumfilar loops on the basal and 2 on the distal node; female antennal segments with relatively long necks, circumfilar simple, forming relatively short low loops; wing with  $R_5$  not markedly curved distally and joining the costa slightly before the wing apex; partial cross-vein  $R_s$  usually present; wing lamella often patterned; tarsal claws simple on all legs; male genitalia with long aedeagus, entire inferior lamella and shorter, roundly bilobed superior lamella, basal clasp segment with inner angle expanded and setose, distal clasp segment relatively narrow and recurved; ovipositor simple, not markedly retractile (HARRIS 1966).

**Maturation Larva:** with well developed head-capsule and particularly long antennae; sternal spatula generally absent; dorsal, pleural and posterior ventral papillae all bearing setae and four pairs of terminal papillae bearing setae, some of which may be modified to form long, narrow, truncate processes; pseudopods often present on ventral surface of thoracic and abdominal segments (HARRIS 1968).

**Material examined:** 1♀ reared from the galls of *Rabdophaga rosaria* on *Salix caprea* L. (Saliaceae), Ali Abad Katool (36°54'N - 54°53'E) in Golestan province of Iran, 140 m.a.s.l., 10 Sep. 2013, coll. Ali Gol.

**Biology:** Larvae were described by Barnes (1928) as predators of larvae of *Rabdophaga heterobia* (LOEW, 1850) and reared from galls on and *Salix triandra* L. (= *Salix amygdalina* L.) (Salicaceae) in England.

**Distribution:** UK, the Netherlands (SKUHRAVÁ 1986).

## **Discussion**

Of the eight species of gall midges presented here, five species are phytophagous, one is predator and two species are mycophagous. Given that the majority of gall midges are phytophagous, so it was expected that most of the species found to be phytophagous. SKUHRAVÁ & SKUHRAVÝ (2010) gave that in Europe 64 species of gall midges are associated with the plant family Saliaceae and the majority of them - 50 species - are associated with the genus *Salix*. In the course of our research, four species of gall midges were collected from the genus *Salix* in Iran. Because willows (*Salix*) are in north-eastern part of Iran relatively abundant trees, it could be expected that with more intensive research more species of gall midges will be found. In the present study we added eight new records to gall midges fauna of Iran. The species number of gall midges of Iran has increased, together with species recorded in North-western Iran, to fifty six species (SKUHRAVÁ et al. in preparation).

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**Fig. 1:** *Rabdophaga rosaria* (LOEW, 1850); large rosette leaf gall on terminal buds on branch of *Salix* sp.



**Fig. 2:** *Rabdophaga nervorum* (KIEFFER, 1895); spindle-shaped swelling on the midvein of leaf of *Salix* sp.



**Fig. 3** *Dasineura irregularis* (BREMI, 1847); galls on *Acer pseudoplatanus*: attacked leaves are wrinkled, curled and rolled upwards, with hypertrophied and slightly swollen veins.



**Fig. 4:** *Zygiobia carpini* (LÖW, 1874); gall on the leaf of *Carpinus betulus*: small swellings along the median vein and side veins.



**Fig. 5:** *Iteomyia capreae* (WINNERTZ, 1853); small hemispherical galls on the leaves of *Salix* sp.

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