

First record of *Mycodiplosis coniophaga* (Diptera: Cecidomyiidae) from Syria

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Abstract. Larvae of *Mycodiplosis coniophaga* (Winnertz, 1853) were found in colonies of rust fungus *Phragmidium violaceum* (Schultz) Wint. (Uredinales) on the leaves of *Rubus anatolicus* Focke (Rosaceae) near Zegreen village in Lattakia Province in western Syria during May 2010. It is the first record of *Mycodiplosis coniophaga* in Syria. Egg, larva, pupa and adults are shortly described and illustrated, life cycle, occurrence in Syria and a map of its distribution in Europe are given.

Key words. Taxonomy, distribution, Diptera, Cecidomyiidae, *Mycodiplosis*, Uredinales, Syria, Palaearctic region.

INTRODUCTION

Gall midges (Cecidomyiidae) are the largest family in the order Diptera. Currently there are 6590 species and 812 genera in this family (Gagné & Jaschhof 2017). Of them, 3122 species are known to occur in the Palaearctic Region, and more than 1800 species in 270 genera are known to occur in Europe (Skuhrová 2006). *Mycodiplosis* Rübsaamen, 1895 is a large genus and currently includes 46 species, which occur widespread in various countries of the world.

This family is divided into six subfamilies: Catotrichinae, Lestremiinae, Micromyinae, Winnertzinae, Porricondyliinae and Cecidomyiinae. The last subfamily is the largest: it includes 5100 species and 602 genera (Gagné & Jaschhof 2017). Gall midges may be divided on the basis of feeding habits, into three biological groups. The majority are phytophagous and most of them cause galls on plants, and the larvae of some are zoophagous and mycophagous (Skuhrová et al. 1984).

The mycophagous species *Mycodiplosis coniophaga* was described by Winnertz (1853) under the name of *Cecidomyia coniophaga*. Winnertz (1853) found larvae feeding on rust, *Ceoma minutum* (now: *Phragmidium mucronatum* (Pers.) Schltdl.), on leaves of *Rosa* sp. Later Rübsaamen (1895) established a new genus *Mycodiplosis* for species reared from mycophagous larvae and designated *Cecidomyia coniophaga* as the type species. Kieffer (1913), in his monograph cites 48 species in the genus *Mycodiplosis* at that time. Later Nijveldt (1969) summarizes the knowledge on this species. Holz (1970) lists the species in the genus *Mycodiplosis* in detail and provides a thorough revision of the whole *Mycodiplosis* species group. Skuhrová (1986, 1989) synonymized *Mycodiplosis reaumuri* Kieffer, 1901 with *Mycodiplosis coniophaga* (Winnertz, 1853).

The gall midge fauna in Syria is poorly known. Skuhrová (1986) summarized the scattered information on gall midges occurring in Syria in the *Catalogue of Palaearctic Diptera*. She records the seven species of gall midges known at that time from Syria. A preliminary list of gall midges known to occur in Syria currently includes fourteen species (Skuhrová & Alnakkar,



Fig. 1. The landscape near Zegreen in Lattakia Province, western Syria, where the larvae of *Mycodiplosis coniophaga* (Winnertz, 1853) were discovered in colonies of the rust fungus *Phragmidium violaceum* (Schultz) Wint. on the leaves of *Rubus anatolicus* Focke.

unpubl. data). During our studies on the insect fauna in western Syria in 2010 and subsequently we found several species of gall midges. In this paper we record for the first time the presence of the mycophagous gall midge *Mycodiplosis coniophaga* in Syria. We hope that in the near future the gall midge fauna of Syria will be enriched with new findings obtained during ongoing studies in the western part of Syria (Skuhrová & Alnakkar , unpubl. data).

MATERIAL AND METHODS

Samples of leaves of *Rubus anatolicus* Focke (= *R. sanguineus* Friv.) attacked by rust fungi were collected in the surroundings of the Zegreen Village in the Lattakia Province, western Syria, during 2010. Zegreen village is located about 27 km north of Lattakia, at 35°31'N, 35°47'E, 11 m a. s. l. and an altitude of 50 m a. s. l. (Fig. 1).

Leaves of *Rubus anatolicus* attacked by rust being fed on by larvae of *Mycodiplosis coniophaga* were put in bags and transferred to the laboratory. Samples were kept at room temperature in Petri dishes until the emergence of adults. Emergence of adults in Petri dishes was checked every day and emerged specimens removed. Adults, larvae and pupae were put in vials with 75% ethanol. The external morphology of the specimens was studied using Amplival and Visopan microscopes.

Identification of adults is based on keys by Skuhrová (1997) and Holz (1970), of larvae using the keys by Möhn (1955), of host plants the keys by Davis (1982), of rust fungi the keys by Blumer (1963), Braun (1982) and Brandenburger (1985). Voucher specimens of *Mycodiplosis coniophaga* are deposited in the collection of gall midges of Marcela Skuhrová, Praha, Czech Republic.

RESULTS

Larvae of the gall midge *Mycodiplosis coniophaga* were collected in colonies of rust fungus on the leaves of *Rubus anatolicus* at Zegreen near Lattakia in western Syria in May 2010. It is the first record of this species in Syria.

Mycodiplosis coniofaga (Winnertz, 1853)

MATERIAL EXAMINED. Syria: Zegreen near Lattakia (35°31'N, 35°47'E, 11 m a. s. l.): 1 larva, May 2010; from *Phragmidium violaceum* (Schultz) Winter (the uredinial phase) on leaves of *Rubus anatolicus* Focke. (Rosaceae); 4 males, 4 females, May–September 2010, R. Alnakkar leg., M. Skuhrová identified. All material is deposited in the collection of Cecidomyiidae of Marcela Skuhrová, Praha, Czech Republic.

TAXONOMIC STATUS. *Mycodiplosis coniofaga* belongs to the subfamily Cecidomyiinae, supertribe Cecidomyiidi, tribus Mycodiplosini, genus *Mycodiplosis*.

MORPHOLOGY OF DEVELOPMENTAL STAGES (Fig. 2). Egg: The eggs are very small, cylindrical or oval in shape, 0.1–0.2 mm in diameter, transparent with a smooth surface and slightly pink in colour. They occur on rust pustules either singly or in pairs. Larvae usually hatch from eggs after two to three days.

Larva: The larval development includes three instars, which differ mainly in body length and colour. The first instar larvae are 0.2–0.4 mm long and colourless, later they became slightly orange coloured; the second instar larvae are orange coloured; the third instar larvae are rose-red-orange coloured. Larvae of the third instar (so called mature larvae) are 1.5–1.9 mm long, 0.4–0.5 mm



Fig. 2. The developmental stages of *Mycodiplosis coniofaga* (Winnertz, 1853): a – eggs; b – larva in colony of rust; c – pupa; d – adult.



Fig. 3. Larva of *Mycodiplosis* sp. in colony of the rust *Phragmidium tuberculina* on the leaf of *Rosa* sp. at Yahmour in Tartous governorate, western Syria, in 1998. Photograph by M. Ahmad.

broad, and have on the ventral side of the prothorax a specific organ (spatula sternalis), which has a characteristic shape, and a group of papillae and setae on the terminal part of the abdomen; their arrangement, number and size are important for the identification of this species.

Pupa: Pupae are 1–1.5 mm long, the upper part of body is dark brown and the lower part orange. Pupation takes place on the surface of the leaf near the sori.

Adult: Small fly, body size 1.2–1.9 mm, head black with large holoptic eyes, thorax brown and abdomen yellow-orange coloured; antennae 2+12 segmented, male flagellomeres binodal, each with three whorls of sensilla circumfila, female flagellomeres cylindrical with long necks; palpi four-segmented, wing with a few veins and several spots, legs long. Adults live several days. After mating females lay eggs and then die.

HOST. *Phragmidium violaceum* (Schultz) Wint. (Uredinales). It is a plant pathogen native to Europe, Africa and the Middle East. It primarily infects *Rubus* species (Wilson & Henderson 1966).

HOST PLANT. *Rubus anatolicus* Focke (= *Rubus sanguineus* Friv.) (Rosaceae).

LIFE CYCLE. On the basis of our observations, the females of *Mycodiplosis coniofaga* lay eggs near rust sori on the leaves of *Rosa*. The egg stage lasts 2–3 days, then larvae hatch; the larval stage lasts 15–17 days and pupation up to the emergence of adult 4–6 days. In western Syria the life cycle of *M. coniofaga* usually lasts 21–25 days. During one vegetative season, from two to four generations of *M. coniofaga* may develop.

OCCURRENCE. Larvae of *Mycodiplosis conioiphaga* were first observed in Syria in 2010 during studies in western Syria. In 1998 the larvae of *Mycodiplosis* sp. were observed by the first author (personal communication) at Yahmour village in Tartous governorate in the western part of Syria in colonies of the rust *Phragmidium tuberculina* on the leaves of *Rosa* sp. (Fig. 3). They were not collected and preserved, therefore they could not be identified to species level.



Fig. 4. Map showing the occurrence of *Mycodiplosis conioiphaga* (Winnertz, 1853) (black circles) in countries in Europe, Syria and Egypt on the basis of published data.

DISTRIBUTION. *Mycodiplosis conioophaga* is a Palaearctic species with its centrum of occurrence in Europe; it secondarily occurs also in the Holarctic. Skuhrová (1986) summarizes the occurrence of *M. conioophaga* in countries in Palaearctic Region. At that time, it was known only from Sweden, United Kingdom, the Netherlands, Germany and Austria. At present *M. conioophaga* is known to occur in fourteen countries in Europe, one in North Africa (Egypt) and one in western Asia (Syria) (Fig. 4). Data on occurrence of *M. conioophaga* are given in the following articles: United Kingdom (Harris 1976), France (Skuhrová et al. 2010), the Netherlands (Roskam & Carbonnelle 2015), Denmark (Haarder et al. 2016), Sweden (Wahlgren 1944), Germany (Holz 1970), Poland (Skuhrová et al. 2008), Czech Republic and Slovakia (Skuhrová 2009), Austria (Skuhrová & Skuhrový 2009), Hungary (Skuhrová & Skuhrový 1999), northern Italy (Skuhrová & Skuhrový 2010), Serbia (Simova-Tošić et al. 2000), Bulgaria (Skuhrová et al. 1991), Egypt (Skuhrová et al. 2014), and Syria (present article). Gagné & Jaschhof (2017) give occurrence of *M. conioophaga* in USA (New York, New Hampshire, New Jersey) and Mexico.

DISCUSSION

The results indicate that the larvae of *Mycodiplosis conioophaga* feed on uridiospores of *Phragmidium violaceum* on *Rubus anatolicus* Focke. Holz (1970) in his study on gall midges of the *Mycodiplosis* group stated that the larvae of *M. conioophaga* may feed on species of various genera of rust fungi. Kluth et al. (2001) reported larvae feeding on spores of *Puccinia punctiformis* (F. Strauss) Rohl. Other studies on the genus *Mycodiplosis* indicated that the larvae may feed on rust and powdery mildew (Gagné 1994, Blumer 1967). Nelsen (2013) reported that adults feed on *Cocoa* flowers and white ants. Yukawa et al. (2018), on the basis of a genetic analysis, reported that *Mycodiplosis conioophaga* is a “super polyphagous species” feeding on four species of one genus of Ascomycetes and 62 species of 12 genera of Basidiomycetes on at least 30 plant families.

Our observations of the development of *M. conioophaga* in the laboratory indicate that larvae pupate on the surface of a leaf near to sori, near a midrib and on lateral leaf veins. Berkenkamp (1969) reports that the larvae pupate on the lower surface of leaves in greenhouses, while Powell (1971) reports that they pupate in the soil and not on the surface of leaves, which is contrary to our findings.

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