Short communication
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Mass swarm of a grass fly in Keszthely, Hungary

Egy gabonalégy tömeges rajzása Keszthelyen

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ABSTRACT

This study aimed to identify the small flies which occurred in disturbingly high numbers covering the upper floors' windows of the Georgikon Campus of the Hungarian University of Agriculture and Life Sciences in the early fall of 2021. During the on-site visit, numerous specimens were collected for later identification. As a result of the species determinations, *Thaumatomyia notata* (Meigen, 1830) was identified. According to the employees, the mass autumn appearance of flies in that high building has been repeatedly seen over the past decades. *Thaumatomyia notata* is, in fact, a valuable species, of which larvae are primarily found in the soil as a predator of *Pemphigus* spp. root aphids.

Keywords: grass flies, outbreak, tall building, *Thaumatomyia notata*

ABSZTRAKT

A vizsgálatok célja, a 2021 kora őszén, a MATE keszthelyi Georgikon Campus kilenc emeletes épületének felső emeleti ablakait zavaróan magas egyedszámban ellepő apró legyek azonosítása volt. A helyszíni szemle során számos példányt gyűjtöttünk, későbbi határozás céljából. A határozások eredményeként a *Thaumatomyia notata* (Meigen, 1830) fajt azonosítottuk. Az épületben dolgozók elmondása alapján, az elmúlt évtizedek során, már több ízben is tapasztalták az épület felső emeletein az apró legyek tömeges őszi megjelenését. A *Thaumatomyia notata* valójában hasznos faj, melynek lárvái a talajban gyökértetvekként károsító *Pemphigus* spp. predátorai.

Kulcsszavak: gabonalégy, tömeges rajzás, magas épület, *Thaumatomyia notata*

INTRODUCTION

Within the family of frit flies (grass flies) (Chloropidae), the larvae are mostly phytophagous, developing within the shoots of young grasses. Some species are specialised in feeding on materials of animal origin (Nartshuk, 1972, 2014). The biology of *Thaumatomyia* species was first studied in detail by Parker (1918), who was the first to find that the larvae live and feed in the colonies of *Pemphigus betae* (Doane, 1900) residing in the soil. However, some authors who found *Thaumatomyia* larvae on the roots of various cultivated plants have mistakenly identified them as pests (Frew, 1923; Goldewaagen, 1926). Assumptions that the larvae are saprophagous and develop in bird nests' debris have also been proven wrong. Therefore, further studies have revealed its biology (Knowlton and Janes, 1931; Balachowsky and Mesnil, 1935; Dunn, 1960; Yarkulov, 1972, 1975, 2019). The larvae feed on root aphids, especially *Pemphigus bursarius* (L., 1758). Aczél (1940), in southern Hungary, reported that these species were predators of *P. bursarius* on lettuce roots.

The genus *Thaumatomyia* includes 45 species. Ten species are known in Europe (Nartshuk, 2012), and mass

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occurrence is known in the case of only one species, *Th. notata*. Only two publications reported the mass occurrence of the Non-Arctic species *Thaumatomyia annulata* (Walker, 1849) (Sabrosky, 1940; Sikes, 2008).

Th. notata is a widespread species from adjacent parts of the Palearctic, Eastern and Afrotropic regions. The species occurs almost everywhere in the Palearctic, except in the northern part, where the Holarctic *Thaumatomyia trifasciata* (Zetterstedt, 1848) lives. Depending on the latitude, *Th. notata* develops 3–4 generations a year and overwinters as an adult. Adults feed on various sugary fluids such as nectar, preferring cereals, alfalfa, sugar beet, umbellifers, flowering forage herbs, and faeces of leaf beetle (Chrysomelidae) larvae (Pschorn–Walcher, 1956). According to Yarkulov (2019), the larvae feed on 27 species of root aphids in Uzbekistan. The activity of the larvae is an essential factor in controlling root aphids like the sugar-beet root aphid *Pemphigus fuscicornis* (Koch, 1857) and the bean root aphid *Smynthurodes betae* (Westwood, 1849) in sugar beet crops (Yarkulov, 2019).

Only a few Hungarian publications deal with indifferent and helpful Chloropidae species. Moreover, no publication in Hungary has reported on the mass swarm of the yellow swarming fly. Therefore, the main goal of this study aimed to determine the fly species and report its mass occurrence. Furthermore, it gives an outlook on other countries' cases and reveals the possible factors in the background of its outbreaks.

MATERIALS AND METHODS

Fly specimens were collected four times during on-site inspections in the Georgikon Campus of the Hungarian University of Agriculture and Life Sciences, Keszthely, Hungary (46° 44' 59.6292'' N; 17° 14' 24.8568'' E) on the 6th, 8th, 10th and 15th of September 2021. The average temperature during the collections was 21.17 °C, and the average relative humidity was 48.52%.

Some specimens were kept alive, while others were stored in 70% ethanol in plastic containers. Trjapitzin's (1982) and Nartshuk's (1987) keys were used for identification in the laboratory in October 2021. A Zeiss discovery stereo microscope with an 8–100X magnification equipped with a Zeiss Axiocam digital camera was used. The main morphological characteristics of the three tagmas used during the identification were as follows.

The head of the 1.9-2.6 mm long flies in the dorsal view is about two times as broad as long. The frons in the dorsal view at eye level is nearly as long as wide. The frontal triangle is primarily yellow, with a narrow, broad median stripe in front of the ocelli (see red arrow). Its lateral margin is slightly convex, and the genae are very narrow, about one-third as wide as the third antennal segment. The antenna with two basal segments is yellow, and the third segment is usually almost entirely black or dark brown, nearly orbicular, as broad as long, or sometimes slightly broader than long. The interfrontal setulae are arranged in 2–3 rows (see green arrow, Figure 1).

The mesonotum of the thorax always has five black stripes not reaching the scutoscutellar suture. The scutellum has two pairs of rather distinct setae, inner lateral scutellar seta longer than the length of scutellar hairs. The thoracic pleura has black maculae on the meso-, sterno- and hypopleuron, and the macula on the sternopleuron is partly or entirely reddish-brown. In contrast, the macula on the pteropleuron is always brown. The mesonotal setae are well developed (Figure 2–3).

The posteroventral margin of the epandrial notch on the abdomen is not demarcated. The posteroventral corner of the epandrium is acutely angled ventrally. The surstylus is oblong with a small blunt process on the inner margin. The cercus is not separated from the epandrium, and the gonites are subequal in length (see blue arrow). The postgonite narrowly incurved on the inner apicolateral margin (Figure 2–3) (Trjapitzin, 1982; Nartshuk, 1987).

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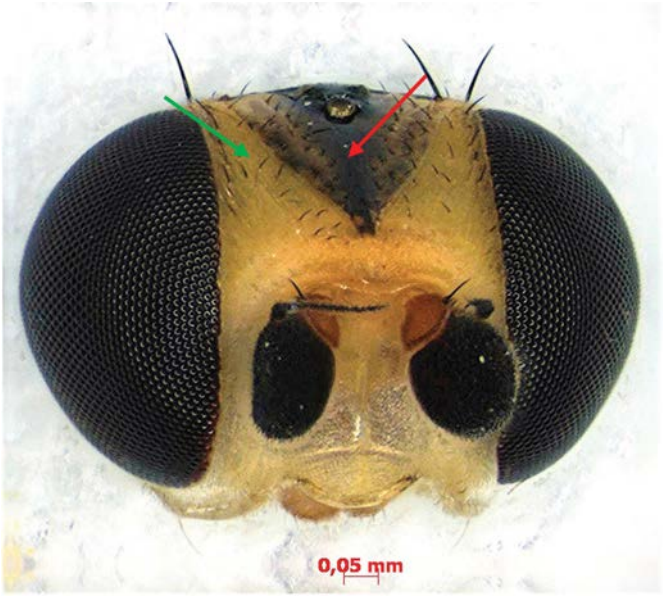

Figure 1. The head of a fly

Figure 2. Male and female flies

RESULTS AND DISCUSSION

As a result of the microscopic determinations of 316 specimens (177 males, 139 females), the yellow swarming fly, *Thaumatomyia notata* (Meigen, 1830), was identified (Figure 1–3). The current paper is Hungary's first report about the mass swarm of this fly species.

The outbreak of *Th. notata* is not a new phenomenon. It was first described by Jenyns (1832) in England, and a year later, Zenker (1833) recorded the mass occurrence of the flies in Germany. Although the earliest records were in England in 1736, Germany in 1807, and Poland in 1812, the flies were not given a scientific name. Nevertheless, publications on the mass occurrence of the fly still appear regularly in the entomological literature (Kotrba and Nartshuk, 2009).

These tiny flies sometimes occupy people's houses during the autumn. This phenomenon occurs only in Europe, with the northernmost record being in Turku, Finland (Haartman, 1950) and the southernmost in Rimini, Italy (Binaghi, 1964). Vast swarms of flies usually appear near tall buildings. In some cases, large swarms of flies appeared near the towers of churches or castles (Kiesenwetter, 1857; Letzner, 1873). It is noteworthy that swarms of flies periodically appear in the same building,

Figure 3. Female fly

like in the case of the university's nine-storey building in Keszthely. Barnes (1933) recorded swarms of flies in the facilities of the Rothamsted Experimental Station in England in 1921–1922 and 1931–1933.

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The flies are passive in houses, usually sitting on the ceiling or windows. However, the number of flies may be enormously high, like when Waga (1848) counted nearly 18 million flies in a room. Hase (1929) recorded the collection of 40 litres of dead flies during one swarm, 360 flies per cubic centimetre. Sabrosky (1940) estimated that about 30 million individuals made up the swarming population.

The flies cannot overwinter in heated houses and die within 10–14 days. However, they can successfully overwinter in natural coverings such as holes, cracks, bird nests, and coniferous cones and can withstand up to -30°C. *Th. notata* was obtained from *Ardea cinerea*, *Buteo buteo*, *Lanius* sp., *Passer domesticus*, *P. montanus* and *P. hispaniolensis* (Donistrop, 1935). Overwintered flies appear in early spring.

According to Nartshuk (2000a), some questions about the biology and ecology of the fly are still unclear: 1) Why do flies form mass swarms? 2) Why do flies break into the same high buildings? 3) Why do flies not appear every year but only intermittently?

An explanation for the first question could be a specific organ in the pregenital part of the flies' abdomen, consisting of two blisters that are usually retracted into the abdominal cavity (Steyskal, 1945; Nartshuk, 2000a, Kotrba, 2009). It is not inconceivable that this organ produces a specific aggregation pheromone in the fall. It may also occur that this pheromone can remain on the walls of buildings for a more extended period, and the flies are attracted to the same places as in previous years. Unfortunately, the histology and physiology of the bladders have not been extensively studied to date.

The intermittent mass outbreak of some agricultural and forest pests is a well-known and long-studied phenomenon. Some authors found that the previous year's warm and dry summer favours the mass occurrence of the fly. For example, Uhlmann (1930) collected data from 54 cases of mass swarms from 1812 to 1930 from literature and concluded that the mass occurrence of the species was recorded in the warm and dry years favourable for grapes. Beck (1990) also highlighted the effects of the previous year's warm summer. The root aphids and their predators react similarly to warm and dry summers. In addition, the lack of rainfall during summer delays the appearance of flies from pupae in the soil. The appearance of flies usually begins after the pupae come into contact with water droplets, typical of many other Chloropidae. As a result, the pupae accumulate in the soil, and the mass emergence of flies after the autumn rains is particularly characteristic (Nartshuk, 2000a).

A definite periodicity is evident in long series of observations, and the outbreaks are repeated almost every 11 years (Nartshuk, 2000b). The gradation observed in 2021 in Keszthely is not unique either, and according to the employees of the building (personal communication, 15 September 2021), it is a recurring phenomenon nearly every decade. A similar recurrence of gradation has been observed in some phytophagous insects (e.g., woolly moths and winter months). These cycles are related to the 11-year processes of solar activity (Eidmann, 1933). The mass occurrences of *Th. notata* usually coincide with the beginning of regular solar activity cycles. These periods are characterised by more frequent eastern and meridional atmospheric circulation when the weather in Europe is warmer and drier (Tyabin, 1957).

CONCLUSIONS

Based on the literature data, this manuscript is the first report in Hungary about the mass swarm of the yellow swarming fly *Thaumatomyia notata*. However, as stated previously by many authors, the reasons for its mass appearance are still unclear. Therefore, further investigations are necessary to verify the abiotic and biotic factors favouring mass swarms, the regular, cyclic nature of the outbreaks and their relation to the cyclic activity of the sun.

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