



FIRST RECORDS OF ANTHOMYIIDAE (DIPTERA) FROM NAGORNO-KARABAKH, ARMENIA

NONNA M GRIGORYAN^{1*}, MARK Y KALASHYAN²,
VAHRAM T HAYRAPETYAN³ AND KARINE V BALAYAN⁴

^{1,4}Artsakh Scientific Center; ³Artsakh Republic Nature Protection Committee Artsakh State University; Stepanakert 375000, Nagorno-Karabakh; ²Scientific Center of Zoology and Hydroecology NAS RA, Yerevan 0014, Republic of Armenia

*Email: nonna.grigoryan.88@mail.ru (corresponding author); ORCID ID 0000-0001-8079-8574

ABSTRACT

The root maggot flies are important pests of cultivated and non-cultivated plant species. This study on the invertebrate fauna of Nagorno-Karabakh was focused on the new leaf miners belonging to the Anthomyiidae. *Pegomya bicolor* (Wiedemann, 1817) and *P. betae* (Curtis, 1847) are documented for the first time in Nagorno-Karabakh, Armenia; *P. bicolor* was found on the leaves of *Rumex confertus* (Willd.), while *P. betae* infested the leaves of *Beta vulgaris* L., and *Chenopodium album* (L.). Thus, two species of the genus *Pegomya* cause serious damage to fodder and agricultural crops, causing 55 to 90% damage. Details of species description, ecology of larva and pupa, as well as the damage are included.

Key words: Anthomyiidae, *Pegomya*, *Pegomya bicolor*, *P. betae*, Nagorno-Karabakh, leaf-miner, fauna, root-maggot fly, *Rumex confertus*, *Beta vulgaris*, *Chenopodium album* (L.)

The Anthomyiidae are a large and diverse family of Muscoidea flies with 1560 described species (Joneidi et al., 2017). Anthomyiidae was derived from Greek anthos (flower) plus myia (a fly). Some species are commonly called “root-maggots”, as the larvae are found in the stems and roots of various plants. *Pegomya* is the most economically important genus of flies in the family Anthomyiidae (Diptera). One of the distinguishing features of the genus is the 2-3 anterodorsal and posterodorsal bristles on hind tibiae present in both sexes, and the absence of a complete or partial row of distinct posterior setulae on hind tibiae in males (Frost, 1924; Synder, 1957). *P. betae* is widely distributed species particular in the temperate parts of Europe (Curtis, 1847; Stein, 1906). *P. bicolor* is widespread leaf-mining pests in the Palearctic region on several species of Polygonaceae (Karimpour, Razmi, 2009; Suwa, 2013). The aim of the work is to discover new pests from the Nagorno-Karabakh fauna, describe their morphological, ecological features, mine types, discover host plants, as well as to assess damage degree of the plants.

MATERIALS AND METHODS

This study was carried out from 2022-2023 within the framework of the scs21-002 scientific program which was supported by MESCS AR. It was collected during the research project "Leaf-miners (Diptera:

Agromyzidae) as a pests of agricultural plants. The latest biological pest controls" scientific program. The damaged leaves with larvae inside were transported to the laboratory of the Artsakh Scientific Center, and kept at 75± 5 RH, 27± 1°C in glass containers filled with moist sand. Excess moisture, which as the drops settles on the containers' walls, was removed by filter paper placed on the surface of the sand. Adults were fixed in 75% ethyl alcohol. External morphological features study was carried out using the ADSM302 and Optika B-290 digital binocular microscopes. The extensiveness was determined by the number of damaged plants (%) and the intensity by the number of damaged leaves (%) on per plant. Data collection and statistical analysis made by the methods accepted for the family (Hering, 1951; Lakin, 1990; Capinera, 2001). For the species identification the larvae and males' abdomen were kept in 10% KOH for about 12 hrs. The article presents all species' quantitative data, collecting dates and GPS data. Abbreviations used: acr – acrostichal bristle, dc - dorsocentral bristle, ad – anterodorsal, av – anteroventral, pd – posterodorsal, pv – posteroventral.

RESULTS AND DISCUSSION

The species of *Pegomya* documented for the first time in the Nagorno-Karabakh fauna, causes serious injuries and reduces the plants' growth. The taxonomic details are as follows.

1. *Pegomya bicolor* (Wiedemann, 1817)

Material examined: 1♂, 2♀, *Rumex confertus* Willd. (Polygonaceae), vlg. Nngi/Martuni, Bovurkhan Monastery (39°47'20.89"N 46°51'15.63"E), 25-VI-2022; 4♂, 5♀, vlg. Patara/Askeran, (39°55'18"N 46°39'43"E), 24-IV-2023; 3♂, 4♀, vlg. Herher/Martuni, (39°42'11"N 46°57'49"E), 06-VI-2023; 2♂, 4♀, c. Stepanakert, (39°48'55"N 46°45'7"E), 04-VI-2023.

2. *Pegomya betae* (Curtis, 1847)

Material examined: 1♂, 1♀, *Beta vulgaris* L. (Amaranthaceae), vlg. Ivanyan/Askeran (39°54'45.99"N 46°47'28.19"E), 26-VII-2022; 1♂, 3♀, vlg. Gishi/Martuni (39°46'31"N 47°01'13"E), 22-VI-2023; 12♂, 5♀, *Chenopodium album* L. (Amaranthaceae), c. Stepanakert, (39°48'55"N 46°45'7"E), 02-VI-2023.

Adults of both species appear in April-May. Females lay eggs on the underside of the leaf blade. At the first instar the larvae form linear mines, which are then turn into broad blotch mines (Fig. 1). Larvae eat the

entire mesophyll without damaging the leaf epidermis. 4-6 larvae per leaf are sufficient to reduce the leaf's photosynthetic surface and lead to complete drying of the plants. Larvae frass in blotch mines look like small scattered piles. Due to the insufficient amount of mesophyll, the larvae are able to move from one leaf to another. The larvae can be distinguished by the cephalic skeletons which are mentioned in the revisions of Dušek (1969-1970) and d'Aguilar and Missonier (1962) (Fig. 2). The intensity of plants infection is 55-60%, the extensiveness is 80-90%. With an abundance of food, larval development lasts 8-10 days ($27 \pm 1^\circ\text{C}$). Pupate in the soil. The pupa is dark red-brown; each posterior spiracle has 3 bulbs. Pupae development lasts 15-17 days ($29 \pm 1^\circ\text{C}$); length of pupa is 5.04 ± 0.01 mm.

Adults are large, body length varies from 5.2 (♂) mm to 5.4 (♀) mm. Male head holoptic, eyes closely approximated dorsally. Female head dichoptic, eyes widely separated dorsally (Fig. 3). In both species, the antennae of the 3rd segment are black. The basal

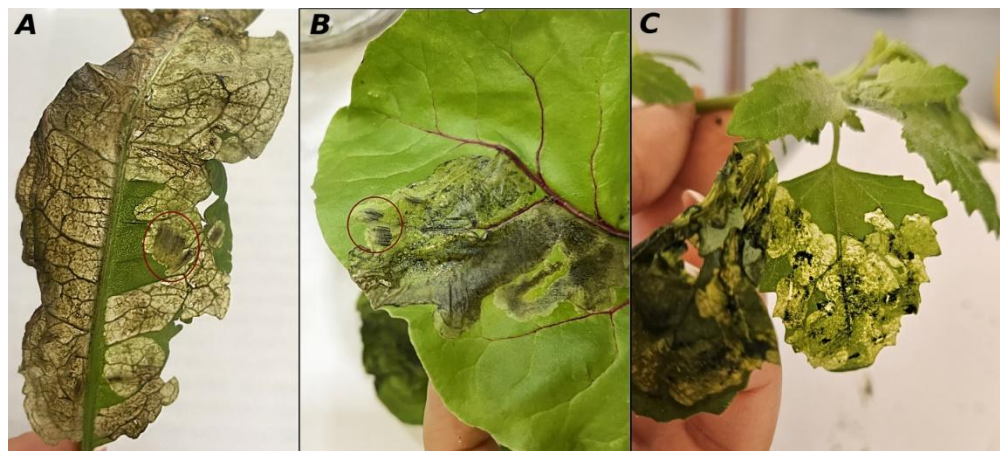


Fig. 1. Blotch mines on: A. *Rumex confertus*; B. *Beta vulgaris*; C. *Chenopodium album*

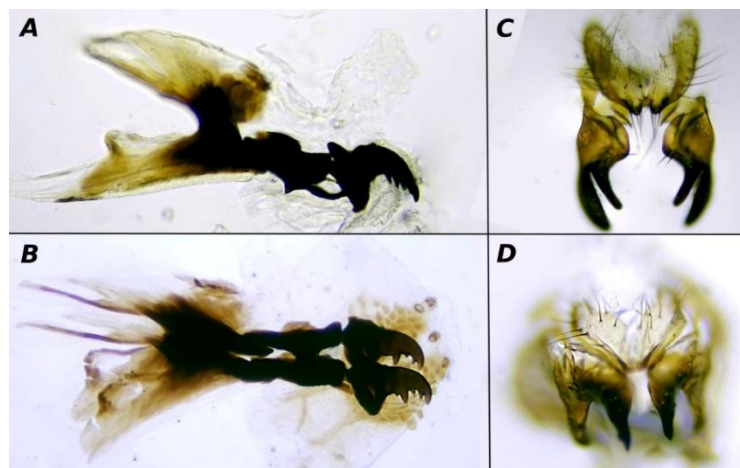


Fig. 2. Cephalic skeleton, cercal plate and surstyli: A, C. *P. bicolor*; B, D. *P. betae*

segments of the antennae and palpi of *P. bicolor* are extensively or wholly black, while those of *P. betae* are yellow or dark orange. Arista with very short pubescence. Thorax completely grey with a difference in shade. *P. bicolor* bristles with black stripes at base that are absent in *P. betae* (Fig. 3). Rows of acr setae arranged in two rows inserted closer to each other than to 2+3 dc rows. Prealar bristle very short, never as long as notopleural bristles, notopleuron with only 2 bristles. Anepisternum grey with posterior anepisternal bristles, and fine, short, well developed setae beginning at upper margin and running diagonally. Katepisternum is also grey with stout and fine bristles. Halteres of both species are yellow. Abdomen of *P. bicolor* is orange, while that of *P. betae* is yellowish grey. The species' cercal plate and surstylus as in Fig. 2 C, D.

Wing venation: A1 reaches wing margin (as least as a crease-like fold); R4+5 and M1 parallel-sided (Fig. 4). Costal vein (C) with short spinules. Wing length of *P. bicolor* is 4.4 (♂) - 5.0 (♀) mm, *P. betae* - 4.5 (♂)

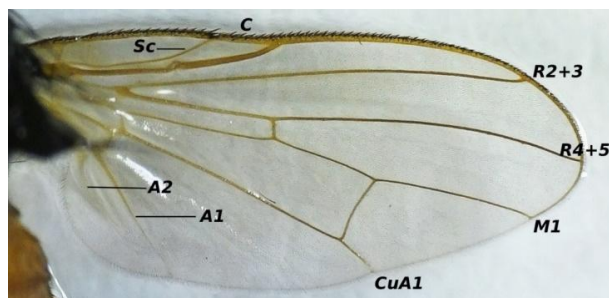


Fig. 4. Wing structure

- 5.3 (♀) mm. Legs. Fore femur of both species with black strips on anterior side and with rows of av (two sides) and ad bristles. Mid and hind femur are orange, all tibiae orange, tarsi black; *P. betae*: Hind femur with regular row of medium sized 8 (9) ad bristles, 5+2 av bristles, 1pd on distal half, pv 2 (distal). Hind tibia with 1 ad on central part, 4 av, 2 long pv bristles. Mid femur with 3 long av bristles, 1 (2) ad on the distal half, 6 (7) pv delicate setae on the apical half. Mid tibia with 2 ad bristles on the central part, 1 pd on distal half; *P. bicolor*: Hind femur - 4+1 ad, 8 (9)+2 av, 1 pd, 2 pv. Hind tibia - 1 ad, 2 av, 3 pd. Mid-femur - 1 ad (distal), 2 av (distal), 2 av (apex), 1 pd (distal). Mid-tibia - 1 ad (distal), 1 pd (distal), 1 pv (distal). Morphometrics reveal sexual dimorphism (Table 1). This is evidenced by the superiority of female body ($p < 0.90$) and wing length ($p > 0.99$), which are 0.2 and 0.6 mm (*P. bicolor*), 0.1 and 0.8 mm (*P. betae*), respectively; coefficient of variation is quite pronounced (6.3-13.0%); wing length in both sexes is more variable compared to the body length. Wing length variability in *P. bicolor* males is 13.0%, in *P. betae* females CV = 10.7%.

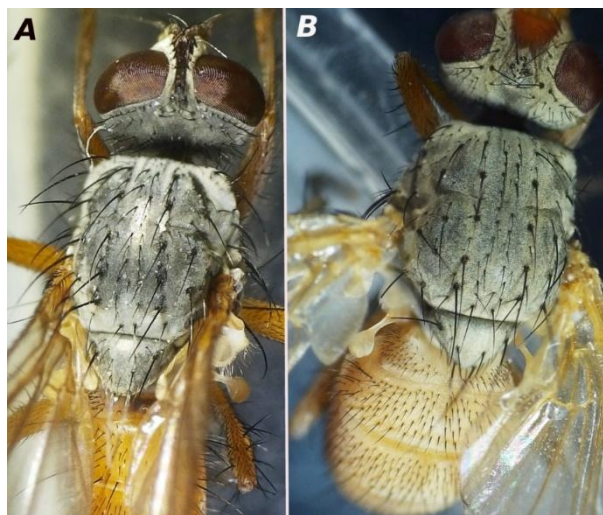


Fig. 3. Habitus: A. *P. bicolor* (♂); B. *P. betae* (♀)

AUTHOR CONTRIBUTION STATEMENT

NMG and MYK conducted experiments and wrote the manuscript. VTH analyzed data. KVB identified the plant species.

Table 1. Morphometrics of *Pegomya* spp.

Species	Parameter	Gender	Sample size	Mean length, mm	Mean error	Standard deviation	Coefficient of variation, %	t _{st}
<i>P. bicolor</i>	Body length	♂	10	5.2	0.2	0.5	9.1	p < 0.90
		♀	15	5.4	0.1	0.4	6.8	
	Wing length	♂	10	4.4	0.2	0.6	13.0	p > 0.99
		♀	15	5.0	0.1	0.5	10.5	
<i>P. betae</i>	Body length	♂	14	5.2	0.1	0.4	8.5	p < 0.90
		♀	9	5.3	0.2	0.5	8.8	
	Wing length	♂	14	4.5	0.1	0.3	6.3	p > 0.99
		♀	9	5.3	0.2	0.6	10.7	

CONFLICT OF INTEREST

No conflict of interest.

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