

The gall midges (Diptera: Cecidomyiidae) of Armenia. 2. New records of occurrence

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Abstract. In the course of studies of the fauna of gall midges in Armenia from 2012 to 2020, 28 species of phytophagous gall midges were found at 25 localities of nine marzes (provinces) situated in the central, western, northern and southern parts of Armenia. They are new members of the gall midge fauna of Armenia. The gall midges are associated with 22 species of host plants belonging to 14 plant families. Ten gall midge species cause galls on trees and shrubs and 18 species cause galls on herbaceous plants. The largest number of gall midge species is associated with the plant family Fagaceae. Usually only one species of gall midges is associated with one host plant species. Two species of gall midges are associated with *Bryonia alba* and *Quercus macranthera*, and three species of gall midges with *Fagus orientalis*. The gall midges *Dasineura pyri* (Bouché, 1847) and *Mikiola orientalis* (Kieffer, 1908) occurring in larger amount are evaluated as pests. From the point of view of geographical occurrence, 14 species of gall midges are mainly of Euro-Asian distribution, eight species European, three species Euro-Siberian and three species of the Asian distribution. The present known fauna of gall midges of Armenia is composed of 124 species. An annotated list of species of gall midges and a list of host plants and associated with gall midges are given. Galls of 17 species of gall midges on their host plants are shown in colour photos.

Key words. Faunistics, zoogeography, biogeography, distribution, plant-animal interactions, economic importance, Diptera, Cecidomyiidae, Armenia, Palearctic Region.

INTRODUCTION

In 2011, ninety-six species of gall midges were known from Armenia (Mirumian 2011). In the course of the following ten years the intensive investigations of gall midge fauna in Armenia were carried out which resulted in the findings of galls of 28 species of gall midges and in the discovery and description of a new gall midge species – *Janetiella convolvuli* Mirumian et Skuhravá, 2017.

In this paper we summarize records on gall midges of Armenia obtained during investigations in the central, western, northern and southern parts of Armenia in 2012–2020 and evaluate the gall midge species from the zoogeographical and economical points of view.

MATERIAL AND METHODS

The occurrence and distribution of gall midges have been studied by collecting galls containing larvae from host plants at each locality. The method of collecting is described in detail by Mamaev (1968). Identification of galls was based on the species of host plant and morphological analysis of plant damage (gall shape and morphology and their localization on plant parts). Galls gathered from nature were transferred to a laboratory, immersed into dry heat sterilized sand and the adults that emerged were collected and fixed in 70% ethanol. Permanent microscope slides of adults were made (according to Kolomoec et al. 1989) and morphology of the adult insects was studied under a microscope for identification purposes. Microscope slides of gall midges and a herbarium of dried host plants with galls are kept in the collection of the Laboratory of Entomology and Soil Zoology of the Scientific Centre of Zoology and Hydroecology, Armenian National Academy

of Sciences in Yerevan. The gall midges were identified using the keys by Mamaev (1969) and Mamaeva & Mamaev (1981). The taxonomy of gall midges follows that of Skuhrava (1986), Gagné (2004), and Gagné & Jaschhof (2021), and of the host plants that of Tahtadžân & Fedorov (1972).

The investigations were carried out at the following nine localities of Armenia at altitudes from 800 m up to 2220 m a. s. l. (Fig. 1); the locality numbers below correspond with those in Fig. 1.

Ararat Province, 800–900 m a. s. l.; semi-desert climate and landscape, with the exception of artificially irrigated agrocoenoses. In this area there are usually very hot summers with air temperature in July 40–45 °C and relatively mild winters with a prevalence of temperatures above 0 °C (localities 10, 11, 19, 22, and 25).

Aragatsotn Province, 1,000–2,000 m a. s. l.; area of mountainous steppe. The climate of localities depends on the altitude, some localities are semi-desert (localities 18 and 21).

Armavir Province, 800–900 m a. s. l.; the summer are very hot (air temperature on July 40–45 °C) and winters relatively mild with a prevalence of temperature above 0 °C (localities 13, 20, and 24).

Gegharkunik Province, 1,700–2,200 m a. s. l.; it includes the lake Sevan. Mountainous steppe with mesophytic vegetation. Summers are mild and winters long, cold and snowy (localities 1, 4, 6, and 9).

Kotayk Province, 1,400–2,000 m a. s. l.; mountainous steppe with mesophilic and xero-mesophytic vegetation. Densely populated area situated near to the capital Yerevan and rich in resorts and satellite towns (localities 2, 3, 8, 12, and 14).



Fig.1. Map of Armenia with the localities where the gall midges have been recorded in 2012–2020. Legend: 1 – Martuni, 2 – Kamaris, 3 – Kakhsi, 4 – Lchashen, 5 – Akner, 6 – Semionovka, 7 – Dilijan, 8 – Tsaghkadzor, 9 – Sevan, 10 – Vedi, 11 – Noramarg, 12 – Aghavnadzor, 13 – Mrgashat, 14 – Hrazdan, 15 – Sochut, 16 – Teghut, 17 – Dilijan Reserve, 18 – Mount Aragats, 19 – Goravan, 20 – Ushakert, 21 – Byurakan, 22 – Khor Virap, 23 – Nubarashen, 24 – Sardarapat, 25 – Bartsrashen.

Table 1. List of host plants attacked by gall midges

host plant species	gall midge species
<i>Acer trautwetteri</i> Medw.	<i>Dasineura rubella</i> (Kieffer, 1896)
<i>Alyssum desertorum</i> L.	Cecidomyiidae sp. 1
<i>Atraphaxis spinosa</i> L.	<i>Polygonomyia atraphaxiflorae</i> (Fedotova, 1984)
<i>Artemisia fragrans</i> Willd.	<i>Rhopalomyia hispanica</i> Tavares, 1904, <i>R. navasi</i> Tavares, 1904
<i>Artemisia scoparia</i> Waldst.	<i>Rhopalomyia tubifex</i> (Bouché, 1847)
<i>Bassia prostrata</i> L.	<i>Kochiomyia kochiae</i> (Kieffer, 1909)
<i>Bryonia alba</i> L.	<i>Jaapiella bryoniae</i> (Bouché, 1847), <i>J. parvula</i> (Liebel, 1899)
<i>Campanula</i> sp.	<i>Contarinia campanulae</i> (Kieffer, 1895)
<i>Cephalaria gigantea</i> L.	<i>Cephalaromyia capituli</i> Skuhrová et Karimpour, 2017
<i>Epilobium</i> sp.	Cecidomyiidae sp. 4
<i>Fagus orientalis</i> L.	<i>Hartigiola annulipes</i> (Hartig, 1839), <i>Mikiola orientalis</i> (Kieffer, 1908), <i>Oligotrophus</i> sp.
<i>Halothamnus glaucus</i> (Bieb.)	Cecidomyiidae sp. 3
<i>Chenopodium vulvaria</i> L.	Cecidomyiidae sp. 2
<i>Inula</i> sp.	<i>Contarinia inulicola</i> (Stelter, 1965)
<i>Lathyrus rosea</i> L.	<i>Dasineura lathyri</i> (Kieffer, 1909)
<i>Origanum vulgare</i> L.	<i>Blastomyia origani</i> (Tavares, 1902)
<i>Pyrus</i> sp.	<i>Dasineura pyri</i> (Bouché, 1847)
<i>Quercus macranthera</i> Stev.	<i>Macrodiplosis pustularis</i> (Bremi, 1847), <i>M. roboris</i> (Hardy, 1854)
<i>Salix alba</i> L.	<i>Iteomyia capreae</i> (Winnertz, 1853)
<i>Salix excelsa</i> Gmel.	<i>Dasineura auritae</i> (Rübsaamen, 1915)
<i>Stachys atherollyph</i> C.	<i>Ametrodiplosis crassinerva</i> (Kieffer, 1901), <i>Wachtliella stachydis</i> (Bremi, 1847)
<i>Thymus kotchyanus</i> Boiss. et Hohen.	<i>Bayeriola thymicola</i> (Kieffer, 1888)

Lori Province, 1,000–1,700 m a. s. l.; mountainous forest, fields, abundant mesophilic vegetation. Mild climate with long summer (localities 15 and 16).

Syunik Province, 600–2,000 m a. s. l.; dry climate, mountainous steppe, mountainous forests (locality 5).

Tavush Province, 700–1,200 m a. s. l.; mountainous forests, meadows, abundant mesophilic vegetation (localities 7 and 17).

Yerevan Province, 800–1400 m a. s. l.; waste ground (semi-desert parts) near to populated city areas (locality 23).

The gall midges occurring in Armenia are classified in four zoogeographical types based on geographic distribution (Skuhrová & Skuhrový 2020): (1) the Euro-Asian species occurring in Europe, reaching to the Mediterranean Sea and western Asia, Turkey, Armenia, and Kazakhstan; (2) the European species which have their centers of distribution in Europe and reach up to the territory of Armenia; (3) the Euro-Siberian species occurring abundantly in Europe and extending at least to western Siberia, some species may reach up to the Far East; and (4) the Asian species which occur only in Asia.

RESULTS

In the following part we present an annotated list of 28 species of gall midges recorded in Armenia between 2012–2020 and a list of host plant species with associated gall midge species (Table 1). The following data are given for each species: the species name, author and year of description, short description of the biology, description of the gall, host plant species and plant family, names of localities where galls were found and the type of geographic distribution.

Ametrodiplosis crassinerva (Kieffer, 1901)

Larvae develop in deformed flowers of *Stachys atherollyph* C. (Lamiaceae). Two or three generations develop per year.

LOCALITY. Gegharkunik Prov., Martuni (1870 m a. s. l.).

DISTRIBUTION. Euro-Asian.

***Bayeriola thymicola* (Kieffer, 1888)**

Red coloured larvae develop in rosette woolly galls at the top of the shoots of *Thymus kotchyanus* Boiss. et Hohen. (Lamiaceae). Two generations develop per year.

LOCALITIES. Kotayk Prov., Kamaris (1525 m a. s. l.), Kakhsi (1550 m a. s. l.).

DISTRIBUTION. Euro-Asian.

***Blastomyia origani* (Tavares, 1902)**

White larvae develop in galls on *Origanum vulgare* L. (Lamiaceae) (Fig. 2). The gall is composed of closed leaves covered with white hairs. Two or three generations develop per year.

LOCALITIES. Gegharkunik Prov., Lchashen (1930 m a. s. l.); Syunik Prov., Akner (1700 m a. s. l.).

DISTRIBUTION. European.

***Cephalaromyia capituli* Skuhravá et Karimpour, 2017**

Orange larvae develop between hairs in blackened, lignified heads on *Cephalaria gigantea* L. (Caprifoliaceae).

LOCALITIES. Gegharkunik Prov., Semionovka (2100 m a. s. l.); Tavush Prov., Dilijan environs (1220 m a. s. l.).

DISTRIBUTION. Euro-Asian (Skuhravá & Karimpour 2017).

***Contarinia campanulae* (Kieffer, 1895)**

Orange larvae develop in swollen, truncated buds on *Campanula* sp. (Campanulaceae).

LOCALITY. Kotayk Prov., Tsaghkadzor (1825 m a. s. l.).

DISTRIBUTION. Euro-Asian.

***Contarinia inulicola* (Stelter, 1965)**

Orange larvae develop in the fusiform galls of the shoot tops on *Inula* sp. (Asteraceae) (Fig. 3).

LOCALITY. Gegharkunik Prov., Sevan (1900 m a. s. l.).

DISTRIBUTION. European.

***Dasineura auritae* (Rübsaamen, 1915)**

Yellow larvae cause galls on the marginal part of leaves on *Salix excelsa* S. G. Gmel. (Salicaceae) (Fig. 4). Only one larva develops in each gall. Two generations develop per year. Larvae of the summer generation pupate in the galls, larvae of the hibernating generation pupate in the soil.

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Figs 2–7. The galls of gall midges found in Armenia. 2 – Galls of *Blastomyia origani* (Tavares, 1902) on the leaves of *Origanum vulgare*. 3 – Galls of *Contarinia inulicola* (Stelter, 1965) on the shoot tops of *Inula* sp. 4 – Galls of *Dasineura auritae* (Rübsaamen, 1915) on the leaf of *Salix excelsa*. 5 – Galls of *Dasineura lathyri* (Kieffer, 1909) on the leaf of *Lathyrus rosea*. 6 – Galls of *Dasineura rubella* (Kieffer, 1896) on leaf of *Acer trautwetteri*. 7 – Cylindrical galls of *Hartigiola annulipes* (Hartig, 1839) on the leaf of *Fagus orientalis*.



LOCALITIES. Ararat Prov., Vedi (900 m a. s. l.), Noramarg (829 m a. s. l.).

DISTRIBUTION. Euro-Asian.

***Dasineura lathyri* (Kieffer, 1909)**

White larvae develop in swollen galls at the edges of the leaf blade of the *Lathyrus rosea* L. (Fabaceae) (Fig. 5).

LOCALITIES. Gegharkunik Prov., Semionovka (2100 m a. s. l.); Kotayk Prov., Aghavnadzor (1840 m a. s. l.).

DISTRIBUTION. Euro-Asian.

***Dasineura pyri* (Bouché, 1847)**

Orange larvae develop in curled and rolled leaf margins of *Pyrus* sp. (Rosaceae). Several generations develop per year.

LOCALITY. Armavir Prov., Mrgashat (848 m a. s. l.) in private households.

DISTRIBUTION. It is a European species widely spread in Europe and introduced into the North America and New Zealand. Sometimes it is a serious pest on pear, especially on young trees.

***Dasineura rubella* (Kieffer, 1896)**

White-coloured larvae develop in wrinkled folds between leaf veins of the highland maple *Acer trautwetteri* Medw. ex Trautv. (Aceraceae) (Fig. 6). The pupation of larvae occurs in the soil.

LOCALITY. Kotayk Prov., Hrazdan (1762 m a. s. l.).

DISTRIBUTION. Euro-Siberian.

***Hartigiola annulipes* (Hartig, 1839)**

SYNONYM. *Phegobia tornatella* Bremi, 1847

Larvae develop in brownish, cylindrical galls located along the midrib of a leaf on the beech *Fagus orientalis* L. (Fagaceae) (Fig. 7). Its galls are similar to the galls of *Hartigiola annulipes* (Hartig, 1839) but they are without hairs.

LOCALITIES. Lori Prov., Sochut (1450 m a. s. l.), Teghut (1550 m a. s. l.); Tavush Prov., Dilijan Reserve (1220 m a. s. l.).

DISTRIBUTION. Euro-Asian.

***Iteomyia capreae* (Winnertz, 1853)**

Orange larvae develop one by one in multi-chambered rounded or irregularly shaped galls visible on both sides of the leaf on *Salix alba* L. (Salicaceae). Fully grown larvae leave galls and pupate in the soil.

LOCALITY. Kotayk Prov., Hrazdan (1762 m a. s. l.).

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Figs 8–13. The galls of gall midges found in Armenia. 8 – Bud galls of *Kochiomyia kochiae* (Kieffer, 1909) on *Bassia prostrata*. 9 – Rounded galls of *Mikiola orientalis* (Kieffer, 1908) on the leaf of *Fagus orientalis*. 10 – Galls of *Oligotrophus* sp. on the leaf of *Fagus orientalis*. 11 – Flower buds galls of *Polygonomyia atraphaxiflorae* (Fedotova, 1984) on the shoots of *Atraphaxis spinosa*. 12 – Galls of *Rhopalomyia hispanica* Tavares, 1904 on the stem of *Artemisia fragrans*. 13 – Large galls of *Rhopalomyia navasi* Tavares, 1904 on the stems of *Artemisia fragrans*.



DISTRIBUTION. *Iteomyia capreae* is a Euro-Siberian species, known to occur in many countries of Europe and also in Asia – in Turkey, Georgia and Iran.

***Jaapiella bryoniae* (Bouché, 1847)**

The larvae develop in fruit galls on the white bryony *Bryonia alba* L. (Cucurbitaceae), which become enlarged and deformed. The pupation occurs in the soil. Two or three generations develop per year.

LOCALITY. Aragatsotn Prov., slopes of Mount Aragats (2005 m a. s. l.).

DISTRIBUTION. European.

***Jaapiella parvula* (Liebel, 1899)**

The larvae develop between the sepals in the deformed blackened flowers of the white bryony *Bryonia alba* L. (Cucurbitaceae).

LOCALITY. Aragatsotn Prov., slopes of Mount Aragats (2005 m a. s. l.).

DISTRIBUTION. European.

***Kochiomyia kochiae* (Kieffer, 1909)**

Orange larvae cause globular bud galls on *Bassia prostrata* (*Kochia prostrata* L.) (Chenopodiaceae; Fig. 8). Only one generation develops per year.

LOCALITIES. Ararat Prov., Goravan (920 m a. s. l.); Armavir Prov., Ushakert (900 m a. s. l.).

DISTRIBUTION. Euro-Asian.

***Macrodiplosis pustularis* (Bremi, 1847)**

SYNONYM. *Macrodiplosis dryobia* (Low, 1877)

White larvae cause galls on leaves of *Quercus macranthera* Stev. (Fagaceae). The marginal leaf lobe is folded downwards. Only one generation develops per year. Full grown larvae leave galls, fall to the ground and hibernate in the soil. Gagne (2004) established the name *Macrodiplosis pustularis* as the valid name for this species because Bremi (1847) was the first who gave the name and description of this species.

LOCALITY. Kotayk Prov., Aghavnadzor (1840 m a. s. l.).

DISTRIBUTION. European.

***Macrodiplosis roboris* (Hardy, 1854)**

SYNONYM. *Macrodiplosis volvens* (Kieffer, 1895)

Orange larvae cause galls in the form of narrow dense ridges on a leaf blade of the oak *Quercus macranthera* Stev. (Fagaceae). Only one generation develops per year. Full grown larvae leave galls, fall to the ground and hibernate in the soil.

LOCALITIES. Kotayk Prov., Aghavnadzor (1840 m a. s. l.); Aragatsotn Prov., Byurakan (1450 m a. s. l.).

DISTRIBUTION. European.



Figs 14–18. The galls of gall midges found in Armenia. 14 – Galls of *Rhopalomya tubifex* (Bouché, 1847) on *Artemisia scoparia*. 15 – Galls of Cecidomyiidae sp. 1 on the leaf of *Alyssum desertorum*. 16 – Galls of Cecidomyiidae sp. 2 on rolled-up edges of the leaf and bud of *Chenopodium vulvaria*. 17 – Bud-shaped scaly galls Cecidomyiidae sp. 3 on *Halothamnus glaucus*. 18 – Galls Cecidomyiidae sp. 4 on the leaf of *Epilobium* sp.

***Mikiola orientalis* (Kieffer, 1908)**

Whitish larvae develop in galls on the eastern beech *Fagus orientalis* L. (Fagaceae; Fig. 9). The gall has ovoid shape, thin walls and is rounded at the apex. The galls are situated on the upper side of the leaf blade.

LOCALITIES. Lori Marz: Teghut, 1550 m a. s. l., Sochut, 1450 m a. s. l., Tavush Marz: Dilijan reserve.

DISTRIBUTION. Asian. The galls of *M. orientalis* were found only in Turkey and in Georgia.

***Oligotrophus* sp. (bundle-like beech gall midge)**

Larvae cause galls on leaves of oriental beech *Fagus orientalis* L. (Fagaceae) (Fig. 10). The gall has a form of a bundle of golden-bright, silky hairs along the midrib, rounded and pubescent. Inside the gall there is one chamber, where one whitish-cream larva develops. Only one generation develop per year.

LOCALITIES. Lori Prov., Teghut (1550 m a. s. l.), Sochut (1450 m a. s. l.); Tavush Prov., Dilijan Reserve (1220 m a. s. l.).

DISTRIBUTION. Asian.

***Polygonomyia atraphaxiflorae* (Fedotova, 1984)**

Many orange larvae develop in deformed swollen flower buds of *Atraphaxis spinosa* L. (Polygonaceae) (Fig. 11). The fully grown larvae leave galls and pupate in the soil. One generation develops per year. Adults emerge at the beginning of June of the following year.

LOCALITY. Ararat Prov., Khor Virap, Khosrov Reserve.

DISTRIBUTION. Asian. This species is known only from Kazakhstan (northern Balkhash) where the galls were found on *Atraphaxis laetevirens* L. (Fedotova 1991).

***Rhopalomyia hispanica* Tavares, 1904**

Orange larvae develop in brownish-gray galls that resemble dust clumps on the stems of *Artemisia fragrans* Willd. (Asteraceae) (Fig. 12).

LOCALITIES. Yerevan Prov., Nubarashen (980 m a. s. l.); Armavir Prov., Sardarapat (900 m a. s. l.), Mrgashat (848 m a. s. l.).

DISTRIBUTION. Euro-Asian. The galls of *Rhopalomyia hispanica* were found only in Spain and Iran.

***Rhopalomyia navasi* Tavares, 1904**

Orange larvae develop in large, fluffy, whitish galls on stems of wormwood *Artemisia fragrans* Willd. and *A. campestris* L. (Asteraceae) (Fig. 13). Galls are situated on the stem sides. Several chambers occur inside one gall.

LOCALITIES. Ararat Prov., Bartsrashen (980 m a. s. l.); Armavir prov., Sardarapat (900 m a. s. l.), Ushakert (900 m a. s. l.).

DISTRIBUTION. Euro-Asian. Iran (Moeinadini et al. 2017).

***Rhopalomyia tubifex* (Bouché, 1847)**

Orange larvae develop in rounded galls, single or collected in several bunches, there are also found galls in the form of leaf clusters at the base of shoots on *Artemisia scoparia* Waldst. et Kit. (Asteraceae) (Fig. 14).

LOCALITY. Ararat Prov., Bardzrashen (980 m a. s. l.).

DISTRIBUTION. Euro-Siberian, sub-Mediterranean.

***Wachtliella stachydis* (Brems, 1847)**

Pink-coloured larvae develop in compacted galls on *Stachys atherolix* C. (Lamiaceae). The gall is composed of apical leaves, which bend to form a wrinkled cavity. Fully grown larvae leave galls and pupate in the soil.

LOCALITY. Gegharkunik Prov., Martuni (1870 m a. s. l.).

DISTRIBUTION. European.

Cecidomyiidae sp. 1

Orange larvae develop in the rolled-up edges of the leaf blade on *Alyssum desertorum* L. (Brassicaceae) (Fig. 15). Fully grown larvae leave galls and pupate in the soil.

LOCALITIES. Ararat Prov., Goravan (920 m a. s. l.); Yerevan Prov., Nubarashen (980 m a. s. l.).

Cecidomyiidae sp. 2

Orange larvae develop in galls on the stinking goosefoot *Chenopodium vulvaria* L. (Chenopodiaceae) (Fig. 16). The gall is formed of rolled-up pubescent edges of the leaf blade, as well as in enlarged buds. Larvae pupate in the soil.

LOCALITY. Ararat Prov., Goravan (920 m a. s. l.).

Cecidomyiidae sp. 3

Orange larvae develop in bud-shaped scaly galls at the shoot edges of *Halothamnus glaucus* (M. Bieb.) Bot. str. (Chenopodiaceae) (Fig. 17). Larvae pupate in galls. Only one generation develops per year. Adults emerge at the beginning of June.

LOCALITY. Yerevan Prov., Nubarashen (980 m a. s. l.).

Cecidomyiidae sp. 4

Orange larvae develop in galls on stems of *Epilobium* sp. (Onagraceae) (Fig. 18). The gall is composed of deformed leaves which are thickened and slightly pubescent, or in galls at the base of the leaf blade on plant stems.

LOCALITY. Yerevan Prov., Nubarashen (980 m a. s. l.).

DISCUSSION

The fauna of gall midges of Armenia is relatively rich. In 2011 it involved 96 species (Mirumian 2011), after additions of 28 species of gall midges which were obtained during investigations carried out in 2012–2020, the present known fauna of gall midges of Armenia includes 124 species. It is quite as numerous as the gall midge fauna of Georgia which involves 123 species of gall midges (Skuhravá et al. 2013) and the gall midge fauna of Turkey which includes 118 species of gall midges (Skuhravá 2016). The fauna of Armenia is more numerous as the known gall midge fauna of Iran where only 61 species of gall midges were recorded (Skuhravá et al. 2014). The gall midge fauna of Azerbaijan, where no investigations of gall midges have been done, involves only

four species of gall midges, namely *Winnertzia rubricola* Mamaev, 1963, *Careopalpis harenosa* Möhn, 1971, *Stefaniola fructua* Möhn, 1971, and *S. procera* Möhn, 1971, which are given in the catalog of Gagné & Jaschhof (2021). None of these species were discovered during our investigations in Armenia. Of 28 species of gall midges the galls of which were discovered in Armenia in 2012–2020, nine species occur in Turkey, seven species occur in Georgia and four species in Iran.

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