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Gall midges (Diptera: Cecidomyiidae) of Georgia

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Abstract. The gall midge fauna of Georgia is composed of 123 species belonging to 47 genera. Of them 12 species are identified to the genus level: two species to *Asphondylia* Loew, 1850, two species to *Contarinia* Rondani, 1860, two species to *Dasineura* Rondani, 1840, one species to *Ephedromyia* Marikovskij, 1953, one species to *Mikiola* Kieffer, 1896, and one species to *Spurgia* Gagné, 1990. 82 gall midge species are new members of the gall midge fauna of Georgia; their galls were found by H. J. Buhr at 30 localities in central and eastern Georgia in the years 2004–2013. An annotated list of all species of gall midges and a list of host plants and associated with gall midges are given. Galls of 60 species of gall midges on their host plants are shown in colour photos. The gall midge fauna of Georgia is relatively rich and similar in composition and species numbers with that of Armenia; both countries are shared by 40 common species. Zoogeographical analysis: 38% are European, 22% Eurosiberian, 18% Euro-Asian, 5% Holarctic and 2% alien species. *Contarinia desertorum* Marikovskij, 1961, causing galls on *Alhagi pseudoalhagi* (Bieb.) Desv., *Psectrosema barbatum* (Marikovskij, 1961) and *P. turkmenicum* Mamaev et Becknazharova, 1983, associated with *Tamarix* L., *Spiromyia cystiphorae* (Fedotova, 1985) and *Tavolgomyia karelini* (Fedotova, 1982) with *Spiraea hypericifolia* L. are Turanian species originating from Central Asia. *Mikiola orientalis* Kieffer, 1908 and *Mikiola* sp. causing galls on leaves of *Fagus orientalis* Lipsky, *Rabdophaga gemmicolata* Gagné, 2004, causing galls on *Salix triandra* L. and *Sophoromyia armeniaca* Mamaev et Mirumian, 1989, inducing galls on leaflets of *Glycyrrhiza glabra* L., are Caucasian species. *Janetiella frankumi* Harris, 2003, inducing galls on stems of *Rosa spinosissima* L., is a rare species, firstly recorded after its description. *Contarinia loti* (De Geer, 1776), causing galls on *Lotus pedunculatus* Cav., was found at the highest situated locality of Georgia, at Kazbegi, at an altitude of 2191 m a. s. l.. In Georgia two alien species were recorded: *Dasineura gleditchiae* (Osten Sacken, 1886), causing galls on leaflets of *Gleditsia triacanthos* L., and *Obolodiplosis robiniae* (Haldeman, 1847), inducing galls on leaflets of *Robinia pseudoacacia* L. Both species originate from Neartics. Relation to host plants: gall midges are associated with 102 plant species which belong to 40 plant families; of them 30% are trees and shrubs and 70% herbaceous plants. Most gall midge species (15) are associated with Fabaceae. Usually only one species of gall midges is associated with one host plant species. Each of three tree, *Betula litwinowii* Doluch, *Fraxinus excelsior* L. and *Fagus sylvatica* L., host three gall midge species.

Key words. Diptera, Cecidomyiidae, faunistics, zoogeography, distribution, plant-animal interactions, Georgia, Palaearctic Region.

INTRODUCTION

The family Cecidomyiidae is one of the most species rich families of Diptera: 6131 species in 783 genera occur in the world (Gagné 2010). Of them, 3113 species in 344 genera were described in the Palaearctic Region of which more than 1800 species in 270 genera occur in Europe (Skuhravá 2006). Only larvae of the subfamily Cecidomyiinae are able to induce galls on host plants, larvae of other subfamilies are mycophagous and saprophagous. Majority of gall midge species are important components of biotops in the nature. However, some gall midges are serious pests of cultivated plants and forest trees, and several species are used in the biological control of pests and weeds (Skuhravá et al. 1984).

Gall midges are the richest group of gall-inducing arthropods in Europe and in the world. Phytophagous larvae of gall midges cause galls on all organs of host plants: on stems or twigs, on terminal or axial leaf buds, flower buds, leaves, flowers, fruits and roots. Larvae of some species may develop in flower buds or flowers or in stems without making galls. Some larvae may live as inquilines in galls caused by other gall midges or insects. Gall midges are usually specificly associated with their host plants. Usually they are monophagous, few gall midges are oligophagous and only several species are polyphagous. The shape of a gall on the organ of the host plant is usually so characteristic that it is possible to identify the gall causer with large probability to species level. In all cases it is necessary to verify such preliminary identification by the subsequent identification of larvae, pupae or reared adults (Skuhravá & Skuhravý 2010a).

Gall midges in Georgia, situated in the region of Caucasus Mountains, at the crossroads of Western Asia and Eastern Europe, were poorly studied. In the past there only few data on the presence of several gall midge species were recorded in the literature, no list of gall midges of this area has been elaborated and nobody have carried out a systematic research of galls in this area.

During the years 2004–2013 Hans Jürgen Buhr, the son of the famous German cecidologist Herbert Buhr (1902–1968), undertook several research trips to Georgia to search for galls on plants caused by insects and other arthropods with the aim to photograph them. He gathered a large collection of colour photographs of plant galls (not only from Georgia but also from other countries of Europe) and placed them on the Internet (H. J. Buhr: *Fotogalerie Pflanzengallen*). Among them there are also many galls of gall midges which have not been known to occur in Georgia up to present time. In this paper we present results of investigations of Hans Jürgen Buhr gathered during years 2004–2013, together with knowledge on gall midges of Georgia summarized by us. All these data we evaluate together from various points of view.

HISTORY

Until now, the fauna of gall midges of Georgia was little known. Some species of gall midges were recorded usually by chance by several researchers, mainly as pests in the agriculture. Shengelija (1941) and Vanin (1941) gave several species of gall midges caused galls in Georgia, Gusev & Rimskij-Korsakov (1951) several gall midge species developing on trees and shrubs that were recorded in territory of Caucasus and Shchhegolev (1955) two species injuring agricultural plants. Marikovskij (1956) described the first gall midge species found directly in Georgia (in the surroundings of Batumi) as *Tribremia aphidophaga* (now correctly: *Aphidoletes aphidimyza*). Mamaeva & Mamaev (1981) summarized knowledge on dipteran pests injurious to agricultural plants in European part of Russia and gave sixteen species of gall midges occurring in Caucasus which are considered to occur also in Georgia. These species are given also in the book of Kolomoec et al. (1989). Skuhravá (1986) summarized scattered data on the occurrence of gall midges in Georgia and gave 30 species in the Catalog of Palaearctic Diptera.

In 2004 H. J. Buhr made the first trip to Georgia to search for plant galls and to obtain their photographs. During the years 2004–2012 he have travelled mainly in the central and eastern Georgia, found galls caused by many arthropods including more than 40 gall midges species and made colour photos of each gall that he found. On the basis of these photos it is possible in majority of cases to identify a causer of the gall. He found also galls of several undescribed species of gall midges. In 2013, during one-month lasting trip directed to search mainly for galls of gall midges, he was very successful and found galls of about 70 gall midge species.

MATERIAL AND METHODS

The occurrence of gall midges have been studied at localities by collecting galls on host plants. After taking a photograph of the gall, each host plant with galls was put into a separate polyethylen bag and transferred to the laboratory to look for larvae. A part of larvae that left galls was placed in small glasses with humid soil for rearing adults and a part of larvae was put into vials with 75% ethanol. These were later mounted on microscope slides for identification. A part of host plants with galls was placed between filter papers for herbarium items. Microscope slides of larvae and adult gall midges and a herbarium of dried host plants with galls are kept in the collection of Marcela Skuhravá in Prague, Czech Republic.

Photographs of galls were taken by Hans Jürgen Buhr either at the locality where he found them or in the laboratory.

Identification of galls is based on keys of Buhr (1965), Houard (1908–1909, 1913, 1922–1923), Skuhravá (2011), of larvae on Möhn (1955) and Mamaev & Krivosheina (1965), of adults on Skuhravá (1997a). Identification of host plants is based on Tutin et al. (1964–1980). Occurrence of gall midge species was evaluated from the zoogeographical point of view using data of Skuhravá (1987, 1994a, b, 1997b).

We use the English version of names of localities in Georgia as they are given in the Wikipedia (2013) and in the map of Georgia published by the Tourism Development Foundation of Georgia (without giving the date of publishing).

Study area

Georgia is situated in the Caucasus region of Eurasia, at the border of Western Asia and Southeastern Europe. It occupies 69,700 km^2. It is bounded to the west by the Black Sea, to the north by Russia, to the south by Turkey and Armenia and to the east by Azerbaijan (Fig. 1). The highest mountain is the Mount Shkhara 5,201 m a. s. l. Forests cover round 40% of the territory. The north part of the country is built by the mountains complex of High Caucasus with the highest point in the eastern part, the Mount Mqinvartsveri (Kazbegi), 5033 m a. s. l.

Georgia has many rivers. The largest river is the Mtkvari (Kura). The climate is affected by mediterranean and subtropical influences from the west and continental dry air from Central Asia. Tbilisi, the capital of Georgia, is located in the South Caucasus in Eastern Georgia at altitudes from 380 to 770 m a. s. l. and is surrounded by mountains on three sides. In Tbilisi is located the National Botanical Garden of Georgia, formerly the Tbilisi Botanical Garden. It is situated in the Tsavkisis-Tskali Gorge on the southern foothills of the Sololaki Range. It occupies the area of 161 hectares and has a collection of over 4,500 taxonomic groups of plants.

From the biogeographical point of view, Georgia is a part of the Caucasus-Iranian Highlands Province of the Palaearctic region (Udvardy 1975).

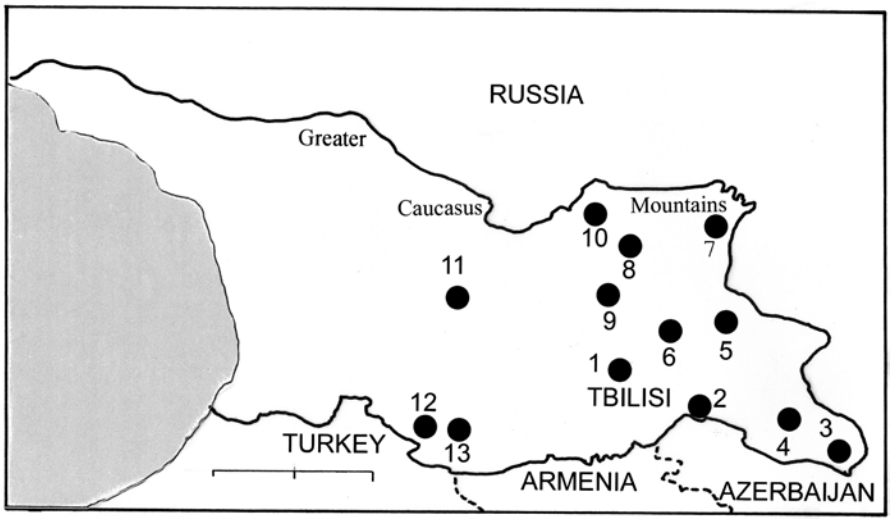


Fig. 1. Georgia with adjacent countries and with main localities where Hans Jürgen Buhr collected galls of gall midges in the years 2004–2013: 1 – Tbilisi, 2 – David Gareja, 3 – Vashlovani National Park, 4 – Dedoplitskaro, 5 – Monastyr Nekresi, 6 – Gombori, 7 – Omalo, 8 – Korscha, 9 – Ananuri, 10 – Stepantsminda, formerly Kazbegi, 11 – Rikoti Pass, 12 – Vardzia, 13 – Akhalkalaki.

Localities examined in 2004–2013

In the following part we bring a short information on the geographic position and altitude of localities where galls were found. The position of 13 localities where galls were collected in 2013 are shown in Fig. 1.

Akhalkalaki, 1707 m a. s. l., a small city in southern Georgia, on the edge of the Javakheti Volcanic Plateau, located about 30 km from the border with Turkey (13).

Ananuri, 1000 m a. s. l., a castle complex on the Aragvi River about 70 km from Tbilisi (9).

Archoty near **Akhiyeli**, 3000 m a. s. l., a site in Khevsureti (Chewsuretien), in north of Georgia, about 10 km from the border with Russia.

Avchala (**Avtschala**), 440 m a. s. l., at present a northern suburb of Tbilisi, formerly an independent village, incorporated within Tbilisi in 1962. It lies on the left bank of the Mtkvari River (Kura River).

Bakuriani, 1700 m a. s. l, a village on the northern slope of the Trialeti Range in the Lesser Caucasus. It is a home to the Alpine Botanical Garden of the Georgian Academy of Sciences.

Borjomi-Kharagauli National Park, 1200–2000 m a. s. l., a park in central Georgia, in the Lesser Caucasus, southwest to Tbilisi. It is one of the largest national parks in Europe, founded in 1995. Its particular uniqueness is diversity of geographical and ecological zones, landscapes, historical monuments and rich flora and fauna.

David Gareja, 750 m a. s. l., a rock-hewn Georgian Orthodox monastery complex located in the Kakheti region of south-eastern Georgia, on the half-desert slopes of Mount Gareja (2).

Dedoplistskaro, 800 m a. s. l., a town in the Kakheti region in the Shiraki Lowlands in eastern Georgia (4).

Dshuta, 2300 m a. s. l., Roshka Pass, in eastern Georgia, in Khevsureti (Chewsuretien).

Gergeti, **a** village in the Greater Caucasus on the right bank of the river Chkheri River (Terek), at an elevation of 2170 m a. s. l., under the Mount Kazbegi, with the famous Gergeti Trinity Church.

Gombori (Tsiv-Gombori), a mountain range in Georgian section of Greater Caucasus mountains. It is located in the province of Kakheti, eastern Georgia, and stretches to the distance of 107 km, with the highest mountain at 1991 m a. s. l. (6).

Kazbegi see Stepantsminda.

Korscha, 2200 m a. s. l., a small locality in Khevsureti (Chewsuretien) (8).

Lagodechi National Park, 1430–1966 m a. s. l., situated at the foot of the Greater Caucasus Mountains, in the Lagodekhi municipality. Lagodekhi Nature Reserve, established in 1911, is noted for a large variety of tree species.

Monastyr Nekresi, 410 m a. s. l., in the Nekresi, a historic town in Kakheti, eastern Georgia, near the village Shilda (5).

Ninigori, 330 m a. s. l., a little village 8 km west of Lagodekhi in eastern Georgia (Kakhetien).

Omalo, 2500 m a. s. l., a principal village in the historical region of Tusheti, the historic region in northeast Georgia, located on the northern slopes of the Greater Caucasus Mountains. The only access road is through the Abano pass at elevation of 2850 m a. s. l. (7).

Racha (also **Ratcha**, Radsha), a highland area in western Georgia, located in the upper Rioni river valley and rounded by the Greater Caucasus mountains.

Roschka, 3000 m a. s. l., a village in the Greater Caucasus, in Khevsureti.

Rikoti Pass, 996 m a. s. l., a mountain pass in the southern portion of the Likhi Range, a spur of the Greater Caucasus which divides Georgia into its western and eastern parts (11).

Saguramo Range, an east-west mountain range in Eastern Georgia in the Greater Caucasus, located immediately to the north of the city of Tbibisi, with the highest mountain Mt. Saguramo, 1392 m a. s. l. It is situated in a moderately humid subtropical zone. The slopes are covered mainly with deciduous forests with *Carpinus*, *Quercus* and *Acer*, at lower elevations with *Fagus orientalis*.

Shatili (**Schatili**), 1400 m a. s. l., a highland in eastern Georgia, in Khevsureti (Chewsuretien) and a village near the border with Chechnya. It is located on the northern slope of the Greater Caucasus mountains.

Stepantsminda, formerly **Kazbegi**, 1740 m a. s. l., a small town in the Mtskheta-Mtianeti region, in north-eastern Georgia in the Greater Caucasus, along the banks of the Thergi River. The town is dominated by large mountains on all sides. The most notable mountain of the region, Mount Kazbek, lies immediately to the west of the town (10).

Tabatskuri Lake, a lake in the Lesser Caucasus, 2100 m a. s. l.

Tbilisi, 380–770 m a. s. l., the capital of Georgia, located in the South Caucasus, in Eastern Georgia on the both sides of the river Mtkvari (Kura). It is surrounded by mountains on three sides (1). Galls were collected at several localities in this town and its surroundings:

– **National Botanical Garden of Georgia**, formerly the **Tbilisi Botanical Garden** is located in Tbilisi and is situated in the Tsavkisis-Tskali Gorge on the southern foothills of the Sololaki Range, 500–700 m a. s. l. It occupies the area of 161 hectares and possesses a collection of over 4500 taxonomic groups of plants.

– **Castle Hill Narikala**, 500 m a. s. l., an ancient fortress consisting of two walled sections on a steep hill between the sulphur baths and the botanical garden.

– **Hill slopes in eastern part of the town**, 500–700 m a. s. l.

– **Manglisi**, 1200 m a. s. l., a small village about 56 km west of Tbilisi, on the southern slopes of the Trialeti Range, in the Algeti River valley.

Udabno, 700 m a. s. l., a last village on a way to David Gareja Monastery, at the boundary between Georgia and Azerbaijan. It is located on the slopes of Mount Gareja, in Kakheti Province.

Vardzia, 1200 m a. s. l., a cave monastery site in southern Georgia, excavated from the slopes of the Erusheti Mountain on the left bank of the Mtkvari River (12).

Vashlovani National Park, 50–350 m a. s. l., a national park located in the eastern part of Georgia, established in 1935 to preserve its unique shallow forests, in 2003 expanded to 84.80 km², with an area of 251.14 km². The area is characterized by its dry climate. It is notable for its unique, bad-land-like areas of desert and semi-desert steppe vegetation and arid and deciduous forests. It's also home to the great cliffs-of-the-canyons, known in the area as the "Sharp Walls", and the magnificent Alazani flood plains and forests (3).

RESULTS

At present the gall midge fauna of Georgia includes 123 species; of them 82 are new records. Galls of these species were discovered during research in 2004–2013 at 30 localities in central and eastern Georgia. In the following part we present an annotated list of all gall midge species recorded in Georgia and a list of host plant species with associated gall midge species (Table 1). Then we evaluate all data obtained in Georgia from the zoogeographical point of view.

Annotated list of gall midge species

The following data are given for each species: species name, author and date of description, synonyms (if any), short description of the gall, host plant species and family, occurrence at localities in Georgia, date of collection, references and distribution in the Palaearctic region. An asterisk (*) before the species name indicates the first record for Georgia.

****Acericecis campestre*** Harris, 2004

Larvae develop in a small depression (dimple or pit-gall) on the lower side of the leaf of *Acer campestre* L. (Aceraceae). Yellow spots on leaves remain after larvae left galls. They hibernate in the soil.
Occurrence. Kakheti, Monastyr Nekresi.
Distribution. European.

Ametrodiplosis medialis Mamaev, 1961

Larvae develop as inquilines in galls caused by *Dasineura crataegi* (Winnertz, 1853) on *Crataegus laevigata* (Poiret) DC (= *C. oxyacantha* L.) (Rosaceae).
Occurrence. Caucasus.
Reference. Mamaev (1961), Skuhravá (1986).
Distribution. European.

****Anisostephus betulinus*** (Kieffer, 1889)

Larvae cause parenchymous galls on leaves of *Betula litwinowii* Doluch (Betulaceae). Only one generation develops a year. Overwintering in the soil.
Occurrence. Kazbegi, 13 July 2005.
Distribution. European up to Caucasus, Kazakhstan.

Aphidoletes aphidimyza (Rondani, 1847)

Tribremia aphidophaga Marikovskij, 1956. Type locality: Batumi.

Slightly orange coloured larvae are predators of many species of aphids (Hemiptera: Aphididae) on various host plants. They are used for biological control of aphids.
References. Marikovskij (1956), Skuhravá (1986).

Distribution. Holarctic.

****Asphondylia baudysi*** Vimmer, 1937

Solitary orange coloured larva cause swelling on pods of *Coronilla varia* L. (Fabaceae). One larva develops in the gall.
Occurrence. Avchala, 16 July 2004.
Distribution. European up to Armenia.

****Asphondylia scrophulariae*** Schiner, 1856

Orange coloured larvae cause flower bud galls on *Scrophularia grossheimii* Schischk (Scrophulariaceae; Fig. 2).
Occurrence. Kazbegi, 1301 m, 26 June 2008, Korscha, 23 June 2013.
Distribution. Mediterranean.

****Asphondylia verbasci*** (Vallot, 1827)

Orange coloured larvae cause flower bud galls on *Verbascum* sp. (Scrophulariaceae).
Occurrence. Tbilisi (Saguramo), 3 August 2005.
Distribution. Submediterranean, Turanian.

****Asphondylia*** sp.

Larvae cause swellings on pods of *Securigera securidaca* (L.) Degen et Dörfer (= *Coronilla parvifolia* Willd.) (Fabaceae).
Occurrence. Tbilisi, steppe, 863 m, 6 June 2006.
Distribution. Euro-Asian, Caucasian.

****Asphondylia*** sp.

Larvae cause swellings on pods of *Zygophyllum fabago* L. (Zygophyllaceae).
Occurrence. Tbilisi (OT Vake, Nikolai Church), 13 July 2004.
Distribution. Turanian.

****Atraphaxiola bogutensis*** Fedotova, 1986

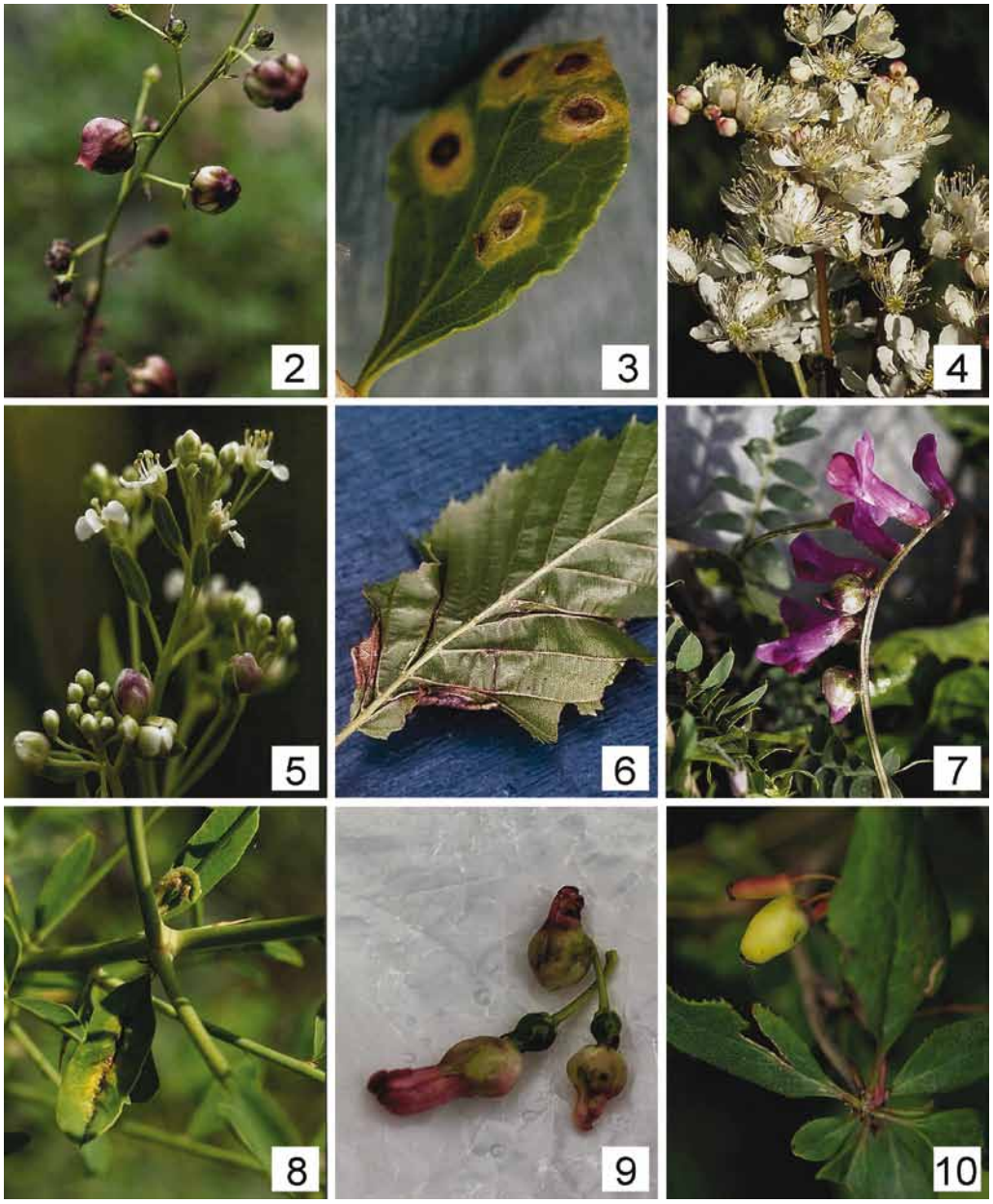
Pink-orange larvae cause parenchymous galls on leaves of *Atraphaxis caucasica* (Hoffm.) Pavlov (Polygonaceae; Fig. 3). Only one larva develop in each gall. Larvae do not have a spatula sternalis on the sternal side of the prothoracic segment which is usually present in gall midge larvae. This species was found on the host plant *Atraphaxis virgata* in the Tian-Shan Mountains in southern Kazakhstan and described by Fedotova (1986b).
Occurrence. Georgia: Tbilisi, 27 May 2013.
Distribution. Euro-Asian, Kazakhstan.

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

Red larvae produce terminal or axillary rosette galls on *Thymus serpyllum* L. a *T. chamaedrys* Fr. (Lamiaceae).
Occurrence. Georgia: Dshuta, 18 July 2004.
Distribution. European, up to north Africa.

****Bremiola hedysarii*** Fedotova, 1986

Larvae cause folded leaflets on *Hedysarum hedysaroides* (L.) Schinz & Thell. (Syn. *Hedysarum caucasicum* M. Bieb.) (Fabaceae). This species was described by Fedotova (1986a) from *Hedysarum* sp. from Talasskij Alatau Mountains in Kazakhstan.



Figs 2–10. Galls of gall midges found in Georgia. 2 – Flower bud galls of *Asphondylia scrophulariae* on *Scrophularia variegata*. 3 – Galls of *Atraphaxiola bogutensis* on leaf of *Atraphaxis caucasica*. 4 – Flower bud galls of *Contarinia anthobia* on *Crataegus monogyna*. 5 – Flower bud galls of *Contarinia cardariae* on *Lepidium draba* (=*Cardaria draba*). 6 – Galls of *Contarinia carpini* on leaf of *Carpinus caucasica*. 7 – Flower bud galls of *Contarinia craccae* on *Vicia purpurea*. 8 – Folded leaflets of *Alhagi pseudoalhagi* induced by *Contarinia desertorum*. 9 – Flower bud galls of *Contarinia lonicerearum* on *Lonicera orientalis*. 10 – Swollen fruit of *Berberis vulgaris* caused by *Contarinia* sp.

Occurrence. Kazbegi: Truso Valley, 14 July 2005, Avchala.
Distribution. Euro-Asian, Kazakhstan.

****Contarinia anthobia*** (Löw, 1877)

Yellow larvae live in swollen flower buds of *Crataegus monogyna* Jacq. and *C. laevigata* (Poiret) DC (Rosaceae; Fig. 4). Occurrence: Georgia: Tbilisi, 15 June 2013. Distribution: European.

****Contarinia cardariae*** Fedotova, 1994 (not *Contarinia lepidii* as it was previously identified)

Yellow larvae cause swollen flower buds of *Lepidium draba* L. (Syn. *Cardaria draba* (L.) Desv.) (Brassicaceae; Fig. 5).
Occurrence. Avchala, 31 May 2013.
Distribution. Euro-Asian, Caucasian. – The host plant *Lepidium draba* is native to western Asia and eastern Europe and is an invasive species in North America, introduced by contaminated seeds in the early 1900s.

****Contarinia carpini*** Kieffer, 1897

White larvae produce galls on leaves of *Carpinus caucasica* Grosch (Corylaceae; Fig. 6). Leaf part along side vein is swollen and forms a fold with a chamber where larvae develop. One generation develop per year.
Occurrence. Schatili Mutzo, 28 July 2004, Korscha, 24 June 2013.
Distribution. European.

Contarinia coryli (Kaltenbach, 1859)
Diplosis corylina Löw, 1878

White larvae, usually three or four in number, live in catkins of *Corylus avellana* L. (Corylaceae) and cause swellings. One generation develops per year. Larvae hibernate in the soil.
Reference. Mamaeva & Mamaev (1981).
Distribution. Eurosiberian, up to China.

Contarinia cotini Kieffer, 1901

White larvae cause swollen flower buds of *Cotinus coggygria* Scop. (= *Rhus cotinus*) (Anacardiaceae).
Reference. Gusev & Rimskij-Korsakov (1951).
Distribution. South-European.

****Contarinia craccae*** (Loew, 1850)
Contarinia craccae Kieffer, 1897

Yellowish orange larvae develop in swollen flower buds of *Vicia tenuifolia* Roth. and other *Vicia* species (Fabaceae; Fig. 7). Two generations develop per year. Larvae hibernate in the soil.
Occurrence. Dshuta, 18 July 2004, Stepantsminda, 8 June 2013 (on *Vicia purpurea* Steven).
Distribution. Eurosiberian, Kazakhstan.

****Contarinia cybelae*** Gagné, 1972
Contarinia coryli Kieffer, 1909

White larvae live in folded leaves of *Corylus avellana* L. (Corylaceae).
Occurrence. Korscha, 24 June 2013.
Distribution. European.

****Contarinia desertorum*** Marikovskij, 1961

Whitish larvae cause pod-like galls on the midrib of folded leaflets on *Alhagi pseudalhagi* (Bieb.) Desv. (Chenopodiaceae; Fig. 8). This species was described by Marikovskij (1961). He reared adults from galls on *Alhagi pseudoalhagi* found in desert in Kzyl-Orda Region in southern Kazakhstan. Galls were found also in Armenia by Mirumian (2011).
Occurrence. Vashlovani Natural Park, 3 June 2013.
Distribution. Euro-Asian, Turanian.

****Contarinia lonicerearum*** (Löw, 1877)

Larvae cause flower bud galls on *Lonicera xylosteum* L. and other *Lonicera*-species (Caprifoliaceae; Fig. 9).
Occurrence. Korscha, 24 June 2013 (on *Lonicera orientalis* Lam.).
Distribution. European.

****Contarinia loti*** (De Geer, 1776)

Yellow larvae live in flower buds of *Lotus corniculatus* L. (Fabaceae). Attacked buds are swollen and remain shut. Two or more generations develop per year. Larvae pupate in the soil.
Occurrence. Kazbegi, 2191 m a. s. l., 06 August 2008 (on *Lotus pedunculatus* Cav.).
Distribution: European.

Contarinia medicaginis Kieffer, 1895

Yellow larvae induce galls on flower buds of *Medicago sativa* L. and *M. falcata* L. (Fabaceae). Two or more generations develop per year. Larvae pupate in the soil. In central, southern and southeastern Europe it is a serious pest of lucerne (Darvas et al. 2000).
References. Shchhegolev (1955), Mamaeva & Mamaev (1981), Skuhravá (1986), Kolomoets et al. (1989).
Distribution. Eurosiberian (Holarctic); Kazakhstan.

Contarinia nasturtii (Kieffer, 1888)

Lemon-yellow larvae cause several types of damage: they live in swollen flower buds that remain closed, in crincled and crumpled heart leaves and in swollen young shoots on host plants of the family Brassicaceae, namely and *Brassica* (cultivated forms) and *Raphanus sativus*. Several generations develop per year. Pupation takes place in the soil. It is a pest of cabbage (Darvas et al. 2000).
Reference. Mamaeva & Mamaev (1981).
Distribution. European, occurring up to Turkey and Kazakhstan; immigrant in Canada.

****Contarinia petioli*** (Kieffer, 1898)

Harmandia petioli Kieffer, 1898
Syndiplosis winnertzi Rübsaamen, 1910

Orange coloured larvae cause globular galls on leaf petioles on *Populus tremula* L. (Salicaceae). One generation develops per year. Larvae hibernate in the soil.
Occurrence. Tbilisi, Avchala, 30 May 2013.
Distribution. Eurosiberian.

****Contarinia steini*** (Karsch, 1881)

Whitish-yellow larvae live in swollen flower buds of *Silene pratensis* (Rafn.) Godr. (= *Silene alba* Mill., *Melandrium album* Mill.) (Caryophyllaceae).

Occurrence. Tbilisi (Botanical Garden), 19 June 2008 (*Silene* sp.).
Distribution. Eurosiberian.

Contarinia tritici (Kirby, 1798)

Lemon or golden yellow gregarious larvae develop in spikelets of *Triticum vulgare* L. (Poaceae). It is an inconspicuous and often overlooked, but serious pest of wheat. One generation develops per year but it may develop a numerically small partial second generation. *C. tritici* is a serious pest of wheat in Europe (Darvas et al. 2000).
References. Mamaeva & Mamaev (1981), Skuhravá (1986), Kolomoets et al. (1989).
Distribution. Holarctic, cosmopolitan.

****Contarinia vera*** Fedotova, 1997

Larvae cause galls at vegetative tip of *Galium verum* L. (Rubiaceae). The gall is composed of many small leaves.
Occurrence. Dshuta, 18 July 2004, Tbilisi, 26 May 2013, Stepantsminda, 7 June 2013.
Distribution. Euro-Asian, Turanian.

****Contarinia zygophylli*** Debski, 1918

Larvae cause swollen flower buds of *Zygophyllum fabago* L. (Zygophyllaceae).
Occurrence. Tbilisi (Botanical Garden), 12 July 2004, Tbilisi (Castle), 3 July 2010, Tbilisi (Tower Hill), 25 May 2013.
Distribution. Euro-Asian, Caucasian.

****Contarinia* sp.**

Pale-yellow larvae develop in swollen barrel-like fruits of *Berberis vulgaris* L. (Berberidaceae; Fig. 10). Larvae leave galls and pupate in the soil.
Occurrence. Ananuri, 6 June 2013. This species was discovered in Armenia by Mirumian (2011).
Distribution. Euro-Asian, Caucasian.

****Contarinia* sp.**

Larvae cause flower bud gall on *Hesperis matronalis* L. and *Hesperis voronovii* (N. Busch) (it is probably a synonym of *Hesperis matronalis* L. subsp. *voronovii*) (Brassicaceae; Fig. 11).
Occurrence. Caucasus: Ananuri, 25 June 2007, Korscha, 23 June 2013.
Distribution. Euro-Asian, Caucasian.

Coquillettomyia dentata Felt, 1908

Picrodiplosis caricis Möhn, 1955

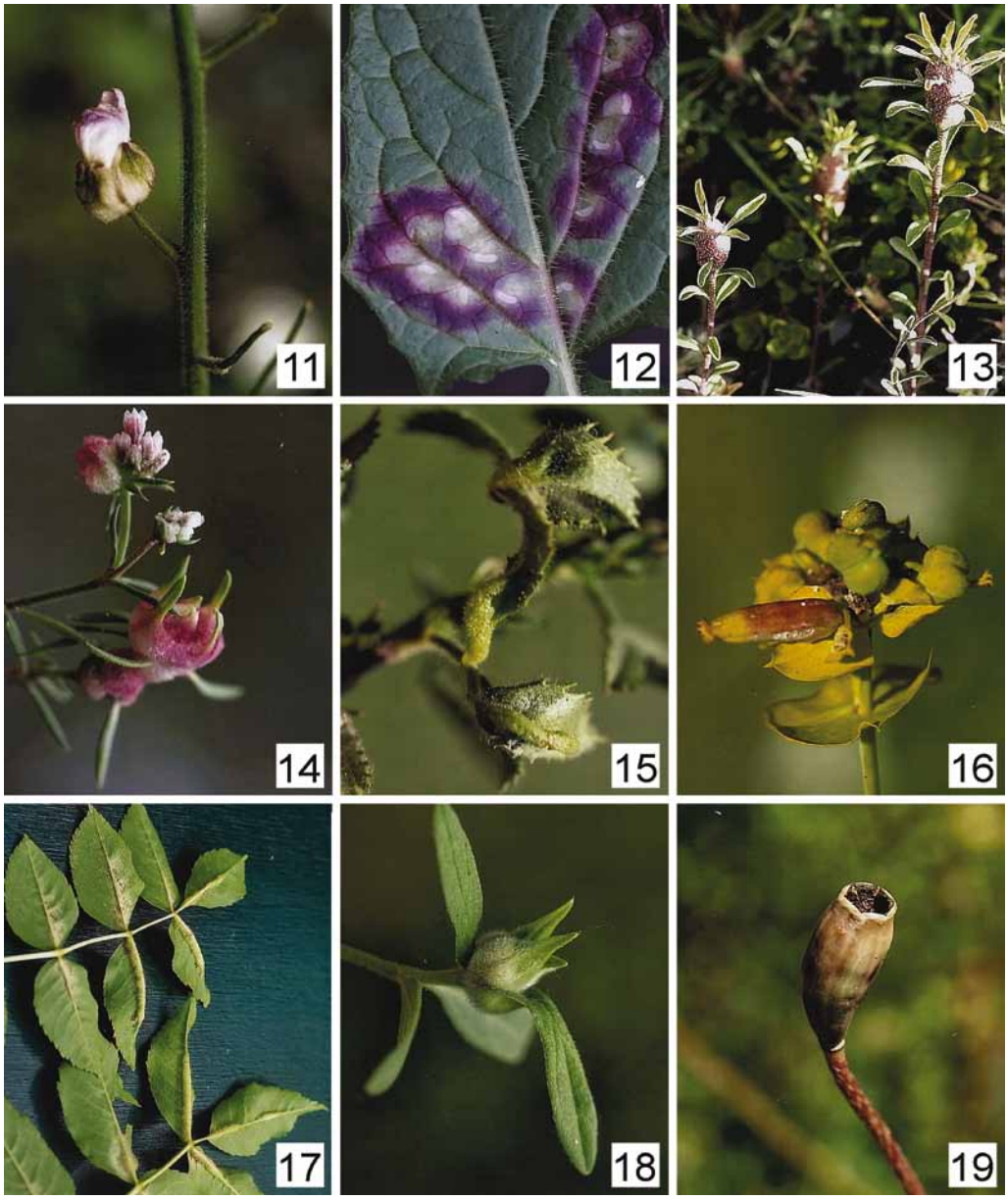
Biology unknown, adults were caught.
References. Mamaev (1972, 1973), Skuhravá (1986).
Distribution. Holarctic.

Coquillettomyia extensa Mamaev, 1973

Biology unknown, adults were caught.
References. Mamaev (1972, 1973), Skuhravá (1986).
Distribution. Holarctic.

Coquillettomyia lobata Felt, 1907

Biology unknown, adults were caught.



Figs 11–19. Galls of gall midges found in Georgia. 11 – Flower bud gall on *Hesperis voronovii* caused by *Contarinia* sp. 12 – Parenchymous galls of *Cystiphora sonchi* on leaf of *Sonchus* sp. 13 – Swellings on stems of *Alyssum* sp. caused by *Dasineura alyssi*. 14 – Spongy galls on stem of *Asperula pontica* caused by *Dasineura asperulae*. 15 – Folded leaflets of *Ononis pusilla* caused by *Dasineura columnae*. 16 – Deformed fruit of *Euphorbia boisseriana* caused by *Dasineura euphorbiarum*. 17 – Swellings on midvein of lealets of *Fraxinus excelsior* caused by *Dasineura fraxini*. 18 – Leaf bud gall on *Aegonychon* (*Lithospermum*) *purpureo-caeruleum* caused by *Dasineura lithospermi*. 19 – Deformed seed capsule of *Papaver rhoeas* including larvae of *Dasineura papaveris*.

References. Mamaev (1972, 1973), Skuhravá (1986).
Distribution. Holarctic.

Cystiphora sonchi (Vallot, 1827)

Cecidomyia sonchi Bremi, 1847
Cecidomyia sonchi Löw, 1875

Yellow-whitish larvae cause pustule galls on the leaves of *Sonchus oleraceus* L. and *S. arvensis* L. (Asteraceae; Fig. 12). Two or more generations develop per year. A part of larvae pupates in galls, a part in the soil. Larvae hibernate in the soil.
Occurrence. Archoty, 21 July 2004, Lagodechi, 28 July 2005, Korscha, 24 June 2013.
Distribution. Eurosiberian, Kazakhstan, introduced in Canada for biological control.

Dasineura acrophila (Winnertz, 1853)

White larvae live gregariously and produce galls on leaflets of *Fraxinus excelsior* L. (Oleaceae). Attacked leaflet is folded upwards along mid-vein, each part becomes thickened and both parts form together a large cavity in which larvae develop. Usually all leaflets on young shoots are attacked. Only one generation develops per year. Larvae hibernate in the soil.
Occurrence. Tbilisi, Botanical Garden, 28 May 2013.
Distribution. European.

Dasineura alyssi (Kieffer, 1901)
Larvae cause fusiform swellings on stems of *Alyssum alyssoides* (L.) L. (=*A. calycinum* L.) (Brassicaceae) (Fig. 13).
Occurrence. Stepantsminda (Kazbegi), 8 June 2013.
Distribution. European.

Dasineura asperulae (Löw, 1875)

Orange red larvae produce spongy galls on stems of *Asperula tinctoria* L. and *A. cynanchica* L. (Rubiaceae; Fig. 14).
Occurrence. Truso Valley, 14 July 2005, Stepantsminda, 10 June 2013 (on *Asperula pontica* Boiss.).
Distribution. Euro-Asian, Kazakhstan.

Dasineura bayeri (Rübsaamen, 1914)

Larvae produce densely haired galls at the vegetative tips of *Sisymbrium loeselii* L. (Brassicaceae).
Occurrence. Tbilisi, 442 m a. s. l.., 12 June 2006.
Distribution. Euro-Asian.

Dasineura capsulae (Kieffer, 1901)

This species was described from *Euphorbia cyparissias* L. (Euphorbiaceae).
In Georgia similar galls were found on *Euphorbia boisieriana* (Woronow) Prokh. It is not clear if both species are identical.
Occurrence. Tbilisi, Avchala, 30 July 2005.
Distribution. European, occurring up to Africa.

Dasineura columnae (Kieffer, 1909)

Reddish larvae cause galls on *Ononis pusilla* L. (=*O. columnae* All.) (Fabaceae; Fig. 15). The leaflets are pod-like folded, slightly hypertrophied.

Occurrence. Georgia: Dedoplitskaro, Mount Elias, 4 June 2013.
Distribution. European.

Dasineura crataegi (Winnertz, 1853)

First whitish, later yellow and last red-yellowish larvae produce terminal rosette leaf galls on *Crataegus laevigata* (Poiret) DC. (= *C. oxyacantha* L.) and *C. monogyna* Jacq. (Rosaceae).
Reference. Mamaeva & Mamaev (1981).
Distribution. European, up to Turkey.

****Dasineura euphorbiarum*** (Kieffer, 1909)

Larvae develop in fruits of *Euphorbia boisseriana* (Woronow) Prokh. (Euphorbiaceae; Fig. 16). Kieffer (1909) described *Dasineura euphorbiarum* from the fruits of *Euphorbia cyparissias* L. Fedotova 2000 did not gave any species associated with fruits of *Euphorbia*. We use Kieffer's name for the species developing in fruits of *Euphorbia boisseriana.*
Occurrence. Avchala, 30 May 2013.
Distribution. Euro-Asian.

****Dasineura fraxinea*** (Kieffer, 1907)

White larvae produce pustule galls on the leaflets of *Fraxinus excelsior* L. (Oleaceae). Only one larva develops in the gall. One generation develops per year. Larvae hibernate in the soil. It is evaluated as a minor pest (Skuhravá & Roques 2000).
Occurrence. Tbilisi, 16 June 2013.
Distribution. European, up to Caucasus.

****Dasineura fraxini*** (Bremi, 1847)

Orange larvae cause swellings of the mid-vein on the leaflets of *Fraxinus excelsior* L. (Oleaceae; Fig. 17). Usually one generation, rarely two generations develop per year. Larvae hibernate and pupate in the soil. It is evaluated as a minor pest (Skuhravá & Roques 2000). References: Skuhravá (1986), Kolomoets et al. (1989).
Occurrence. Tbilisi (Botanical Garden), 512 m a. s. l., 19 June 2008, 28 May 2013.
Distribution. European, occurring up to Caucasus and North Africa.

****Dasineura geranii*** (Kieffer, 1907)

Larvae develop gregariously in flower buds and fruits of *Geranium pratense* L. (Geraniaceae).
Occurrence. Archoty, 22 July 2004.
Distribution. Euro-Siberian.

****Dasineura gleditchiae*** (Osten Sacken, 1886)

Larvae develop gregariously in folded leaflets of *Gleditsia triacanthos* L. (Fabaceae).
Occurrence. Lagodechi, 1 August 2004, Radsha (Orbeli Valley), 3 July 2008, Akhalkalaki, 14 June 2013.
Distribution. Nearctic, introduced into Europe and evaluated as alien species.

****Dasineura hyperici*** (Bremi, 1847)

Orange-yellow larvae cause leaf bud galls on *Hypericum perforatum* L. and other species (Hypericaceae).
Occurrence. Dshuta, 18 July 2004.
Distribution. European.

*__Dasineura irregularis__ (Bremi, 1847)

Cecidomyia acercrispans Kieffer, 1888

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 (Skuhravá & Roques 2000).
Occurrence. Korscha, 24 June 2013.
Distribution. European.

__Dasineura kiefferi__ (Marchal, 1896)

Larvae cause swollen flower buds of *Hedera helix* L. (Araliaceae).
Reference. Gusev & Rimskij-Korsakov (1951): Caucasus.
Distribution. European.

*__Dasineura lithospermi__ (Loew, 1850)

Reddish larvae cause rosette leaf galls on *Aegonychon purpureocaeruleum* (L.) Holub. (= *Lithospermum purpureocaeruleum* L.) (Boraginaceae; Fig. 18).
Occurrence. Avchala, 16 July 2004, 20 June 2013, 31 June 2013.
Distribution. Eurosiberian, spread up to Kazakhstan.

__Dasineura mali__ (Kieffer, 1904)

At first white, later red larvae develop in rolled leaf margins of *Malus sylvestris* Mill. (Rosaceae). Infested leaves drop prematurely. Two or more generations develop per year. One part of larvae pupates in galls, other part drops to the ground and pupate in the soil. It is a serious pest of young apple trees and scions in orchards and in nurseries (Darvas et al. 2000).
References. Mamaeva & Mamaev (1981), Skuhravá (1986), Kolomoets et al. (1989).
Distribution. Eurosiberian, Holarctic, immigrant in North America, Argentina and New Zealand.

*__Dasineura oxyacanthae__ (Rübsaamen, 1914)

Red larvae live in swollen flower buds of of *Crataegus laevigata* (Poiret) DC (*C. oxyacantha* L.) and *C. monogyna* (Rosaceae). One generation develops per year.
Occurrence. Tbilisi, 15 June 2013.
Distribution. European.

*__Dasineura papaveris__ (Winnertz, 1853)

Reddish yellow larvae develop in the seed capsules of *Papaver rhoeas* L. and *P. dubium* L. (Papaveraceae; Fig. 19).
Occurrence. Akhalkalaki, 14 June 2013.
Distribution. Euro-Asian, up to Israel and Kazakhstan.

__Dasineura rosae__ (Bremi, 1847)

Cecidomyia rosarum Hardy, 1850
Wachtliella rosarum (Hardy, 1850): auctorum

Orange coloured larvae cause galls on leaflets of *Rosa canina* L. and other species of *Rosa* (Rosaceae). The attacked leaflet is folded along the midvein and swollen forming a chamber where larvae develop. Several generations develop per year. Full-grown larvae leave galls, fall to the soil where they pupate.

Occurrence. Archoty, 22 July 2004, Borj.-Kharagauli National Park, 19 July 2005 (on *Rosa spinossissima* L.; Fig. 20), Korscha, 25 June 2013, Omalo, 18 June 2013.
Reference. Mamaeva & Mamaev (1981).
Distribution. Euro-Asian, Kazakhstan.

****Dasineura sampaina*** (Tavares, 1902)

Larvae cause artichoke galls at vegetative tip or side leaf buds of *Linum austriacum* L. (Linaceae; Fig. 21). The gall is formed of broadened leaves.
Occurrence. Avchala, 30 May 2013.
Distribution. Mediterranean and Submediterranean.

****Dasineura serotina*** (Winnertz, 1853)

White larvae cause leaf bud galls on *Hypericum perforatum* L. (Hypericaceae; Fig. 22).
Occurrence. Tbilisi, 28 May 2013.
Distribution. European.

****Dasineura symphyti*** (Rübsaamen, 1891)

White larvae develop in swollen flower buds of *Symphytum asperum* Lepech (Boraginaceae).
Occurrence. Archoty, 21 July 2004.
Distribution. European.

****Dasineura thomasi*** (Kieffer, 1909)

Dasyneura thomasi Rübsaamen, 1912

Red larvae cause rolled leaf margin of *Campanula cochleariifolia* Lam. (= *C. pusilla* Haenke) (Campanulaceae). This species was described by Kieffer (1909) on the basis of galls found in the Alps.
Occurrence. Tabatskuri Lake, 11 July 2005 (on *Campanula tridentata* Schreb.).
Distribution. European.

****Dasineura tiliae*** (Schrank, 1803)

Cecidomyia tiliamvolvens Rübsaamen, 1889

Red-yellow or orange coloured larvae cause galls on leaves of *Tilia platyphyllos* Scop. and *T. cordata* Mill. (Tiliaceae). The gall is formed of rolled leaf margin that is freshy and swollen. One generation develops per year. Larvae hibernate in the soil.
Occurrence. Tbilisi (Botanical Garden), 16 June 2013 (on *Tilia begoniifolia* Steven; Fig. 23).
Distribution. Eurosiberian.

Dasineura trifolii (Löw, 1874)

Reddish-yellow larvae live in pod-like folded leaflets of *Trifolium repens* L. (Fabaceae) and other *Trifolium*-species (Fig. 24). Several generations develop per year. Larvae of summer generations pupate in the galls in white cocoon. In autumn larvae leave galls and hibernate in the soil.
Occurrence. Caucasus (Sno-Valley), 28 June 2007, Stepantsminda, 8 June 2013 (*Trifolium canescens* Willd.).
Reference. Mamaeva & Mamaev (1981).
Distribution. Eurosiberian, immigrant in USA.

****Dasineura urticae*** (Perris, 1840)

Whitish-orange larvae cause irregular galls on leaves, stems and flower stalks of *Urtica dioica* L. (Urticaceae; Fig. 25). The gall is rounded, unilocular with a mouth-like opening on the upper surface of the leaf. Two or more generations develop per year. Larvae pupate in the soil.
Occurrence. Schatili – Mutzo, 28 July 2004, Korscha, 23 June 2013.
Distribution. Eurosiberian, Kazakhstan, Turanian.

Dasineura valerianae (Kieffer, 1909)

Larvae cause galls in form of rooled leaf margins on of *Valeriana alliariifolia* Adams (Valerianaceae). Kieffer (1909) gave name to this gall that was found by Rübsaamen (1895) in Caucasus.
References. Rübsaamen (1895), Mamaeva & Mamaev (1981), Skuhravá (1986).
Distribution. European, Caucasian.

****Dasineura viciae*** (Kieffer, 1888)

White larvae live gregariously in pod-like folded and hypertrophied leaflets of *Vicia sepium* L., *V. angustifolia* L. and *V. sativa* L. (Fabaceae). Two or three generations develop per year. Larvae pupate in the soil.
Occurrence. Roschka, 25 July 2004 (on *Vicia sepium* L.), Kazbegi (on *V. sosnowskyi* Ektvim.).
Distribution. Eurosiberian, Kazakhstan.

****Dasineura*** sp. 1.

Several white larvae produce galls on young leaves at the shoot tips of *Corylus avellana* L. (Corylaceae; Fig. 26). Attacked leaf is folded upwards, densely haired, and the midvein and bases of lateral veins are thickened.
Occurrence. Korscha, 24 June 2013.
Distribution. Caucasus. – Similar galls caused by an undescibed species of gall midge on other host plant – *Corylus americana* – were observed in North America (Gagné 1989).

****Dasineura*** sp. 2.

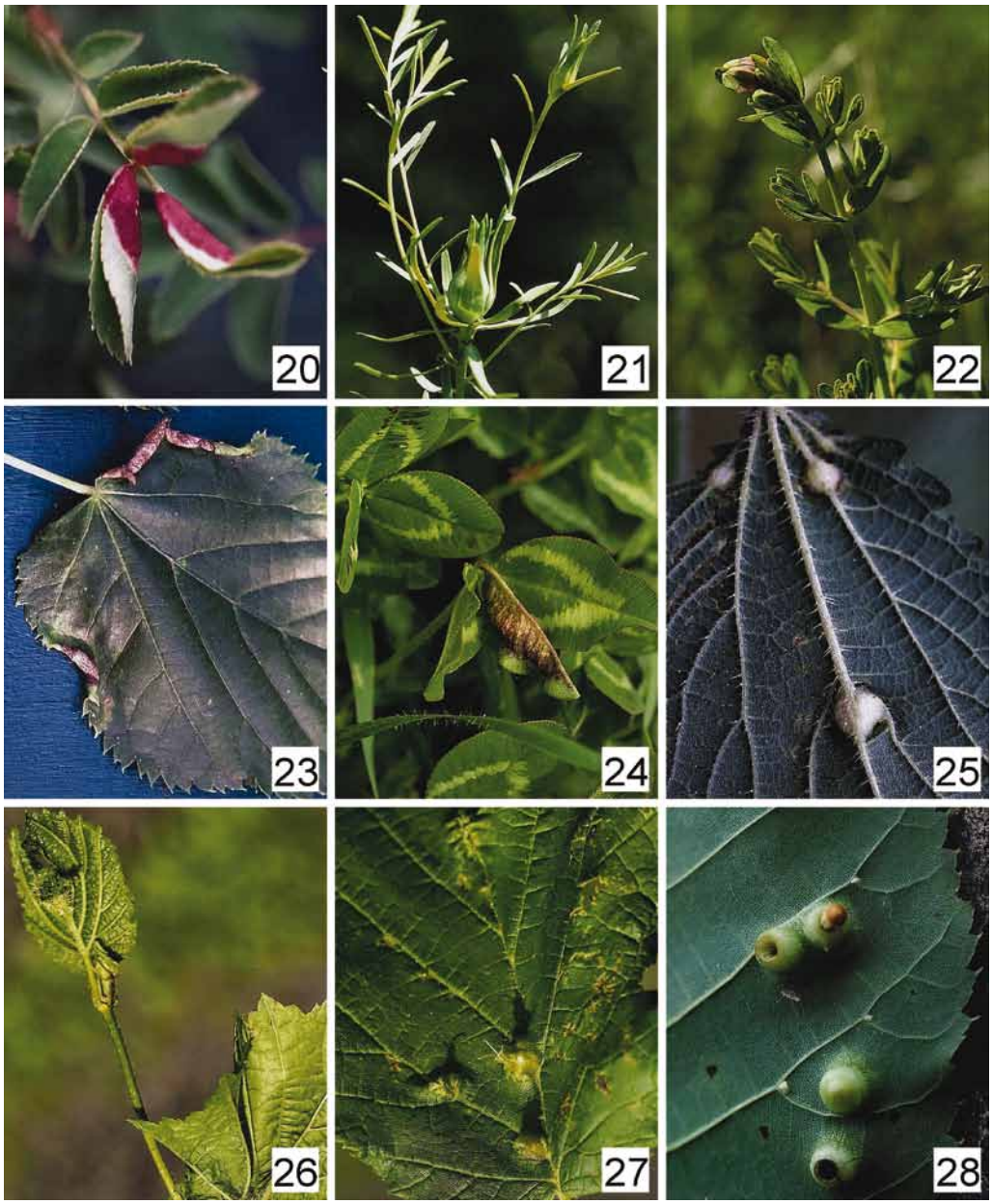
A solitary white larva causes a small pouch or pocket-shaped swelling along the mid vein on the older leaves of *Corylus avellana* L. (Corylaceae; Fig. 27). The gall is only 2–5 mm long forming a small pocket, inside is a small chamber with one white larva.
Occurrence. Korscha, 24 June 2013.
Distribution. Caucasus.

****Dasineura*** **sp.**

Larvae cause folded leaflets of *Galega officinalis* Lam. (Fabaceae).
Occurrence. Archoty, 21 July 2004.
Distribution. West Asian.
Note. Only one gall midge species, *Resseliella galegae* (Neacsu, 1971), occurring in Romania, is known from this host plant species; adults were reared from stems of *Galega officinalis*.

Didactylomyia longimana (Felt, 1908)

Biology unknown. Adults were caught.
References. Mamaev 1967, Skuhravá (1986).
Distribution. Cosmopolitan.



Figs 20–28. Galls of gall midges found in Georgia. 20 – Folded leaflet of *Rosa spinosissima* caused by *Dasineura rosae*. 21 – Artichoke leaf bud gall on *Linum austriacum* caused by *Dasineura sampaina*. 22 – Leaf bud gall on *Hypericum perforatum* caused by *Dasineura serotina*. 23 – Rolled leaf margin of *Tilia begoniifolia* caused by *Dasineura tiliae*. 24 – Folded leaflet of *Trifolium* sp. caused by *Dasineura trifolii*. 25 – Swellings on leaf veins of *Urtica dioica* caused by *Dasineura urticae*. 26 – Damaged shoot tip on *Corylus avellana* caused by *Dasineura* sp. 1. 27 – Small galls on leaf veins on *Corylus avellana* caused by *Dasineura* sp. 2. 28 – Woody galls on leaf of *Tilia begoniifolia* caused by *Didymomyia tiliacea.*

Didymomyia tiliacea (Bremi, 1847)

Cecidoyia tiliacea Bremi, 1847
Cecidomyia frauenfeldi Kaltenbach, 1872
Hormomyia reaumuriana Löw, 1878

Larvae produce hard woody galls on leaves of *Tilia platyphyllos* Scop. and *T. cordata* Mill. (Tiliaceae). The gall is conical on upper side, hemispherical on lower leaf side. In summer a cylindrical inner part containing yellow larva separates from the rest swelling on the leaf and fall to ground where it remain up to the spring of the following year. Only one generation develops per year.
Occurrence. Lagodechi National Park, 1432 m a. s. l., Monastyr Nekresi, 5 June 2013, Tbilisi (Botanical Garden), 16 June 2013 (at all localities on *Tilia begoniifolia* Steven; Fig. 28).
References. Shengelija (1941), Skuhravá (1986), Kolomoets et al. (1989).
Distribution. Eurosiberian.

****Ephedromyia*** sp.

Larvae cause swelling on the stem of *Ephedra procera* Fisch. et Mey (Ephedraceae; Fig. 29). The gall is rounded or spindle-formed, 5–10 mm in diameter, walls are thick, inside is a large central chamber (in time of collecting without larvae or pupae), with an opening after emergence of adults. Mirumian (2011) do not give any gall midge species causing galls on Ephedra in Armenia.
Occurrence. Tbilisi, 25 June 2013.
Distribution. Euro-Asian, Caucasian.

****Etsuhoa sabinae*** (Kieffer, 1898)

Oligotrophus sabinae Kieffer, 1898

Larvae cause globular galls on shoot tips of *Juniperus sabina* L. (Cupressaceae; Fig. 30). Each gall is formed of 3–5 whorls of needles.
Occurrence. Stepantsminda, 7 June 2013.
Distribution. Euro-Asian, with disjunct areas in Europe and in Kazakhstan.

****Geocrypta galii*** (Loew, 1850)

Reddish-yellow larvae cause round bladder swellings on stems and flower stalks of *Galium mollugo* L., *G. verum* L. and other species (Rubiaceae; Fig. 31). The galls are solitary or gregarious and coalescent, their walls are fleshy, glossy, with a lateral opening. Inside each gall is one chamber. Several generations develop per year. Pupation and hibernation takes place in the soil.
Occurrence. Dshuta, 18 July 2004 (*G. verum* L.). Kazbegi, 13 July 2005 (*G. verum* L.), Gergeti, 22 June 2011 (*G. mollugo* L.), Tbilisi, 27 May 2013.
Distribution. Eurosiberian, Kazakhstan.

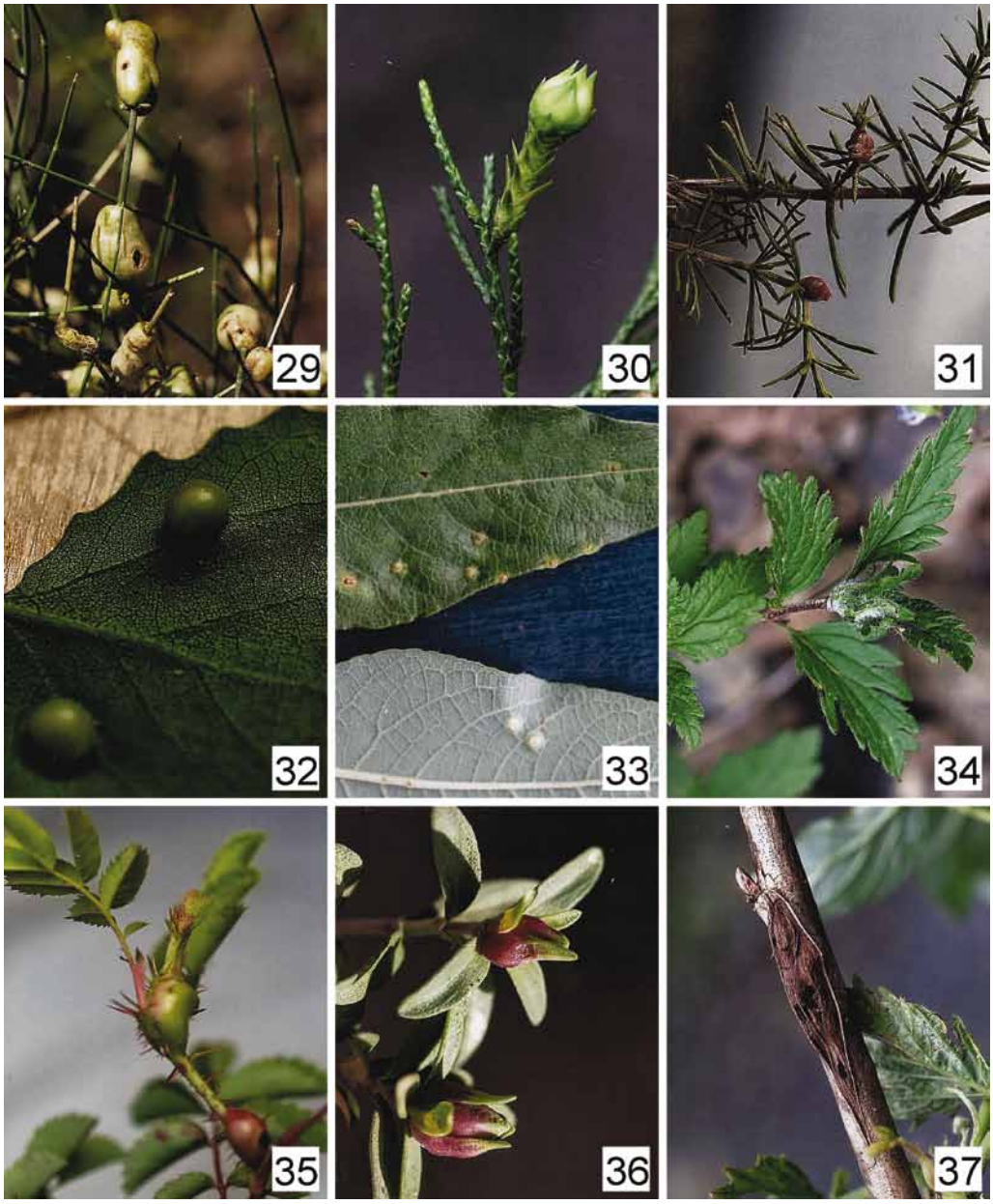
****Harmandiola cavernosa*** (Rübsaamen, 1899)

Solitary orange red larvae produce large, thick walled galls on the leaves of *Populus tremula* L. (Salicaceae; Fig. 32). The gall is globular on the lower surface, partly extending on the upper surface where it is a slit-like opening. One generation develops per year. Larvae hibernate in the soil.
Occurrence. Omalo, 18 June 2013.
Distribution. Eurosiberian, up to Turkey and Kazakhstan.

Hartigiola annulipes (Hartig, 1839)

Cecidomyia piligera Loew, 1850

Solitary white larva produces a cylindrical gall on the upper side of the leaf of *Fagus sylvatica* L. (Fagaceae). One generation develops per year. In autumn the full-grown larva closes the opening



Figs 29–37. Galls of gall midges found in Georgia. 29 – Swellings on stem of *Ephedra major* caused by *Ephedromyia* sp. 30 – Swelling on shoot tip of *Juniperus sabina* caused by *Etsuhoa sabinae*. 31 – Swellings on stems of *Galium* sp. caused by *Geocrypta galii*. 32 – Galls of *Harmandiola cavernosa* on lower leaf side of *Populus tremula*. 33 – Small galls of *Iteomyia capreae* on leaf of *Salix caprea*. 34 – Galls on growing top of *Veronica chamaedrys* caused by *Jaapiella veronicae*. 35 – Spindle swellings on branch of *Rosa spinosissima* caused by *Janetiella frankumi*. 36 – Galls on shoot tip of *Thymus* sp. caused by *Janetiella thymi*. 37 – Stem swelling on *Rubus idaeus* caused by *Lasioptera rubi*.

at the base of the gall by a lid. The gall separates from the leaf and falls to the soil where larva hibernates hidden in the gall. In the spring the larva pupates inside the gall and then the adult gall midge emerges.
References. Shengelija (1941), Vanin (1941), Gusev & Rimskij-Korsakov (1951), Skuhravá (1986), Kolomoets et al. (1989).
Distribution. European, occurring up to Armenia and Turkey.

Iteomyia capreae (Winnertz, 1853)

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; Fig. 33). 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.
Occurrence. Gereti, 13 July 2005 (on *Salix caucasica* Anders), Korscha, 24 June 2013 (on *Salix caprea* L.).
Distribution. Eurosiberian, up to Turkey.

Jaapiella genistamtorquens (Kieffer, 1888)

Pink larvae live gregariously in leaf bud galls on stem of *Genista pilosa* L. (Fabaceae).
References. Rübsaamen (1895), Skuhravá (1986).
Distribution. European.

Jaapiella genisticola (Löw, 1877)

First white, then pale rose coloured larvae cause galls at the growing top of *Genista tinctoria* L. (Fabaceae). Terminal leaves are tufted, swollen, forming a yellowish hairy mass about the size of a hazel nut.
References. Rübsaamen (1895), Skuhravá (1986), Kolomoets et al. (1989).
Distribution. Eurosiberian.

Jaapiella thalictri (Rübsaamen, 1895)

Red larvae develop among small leaves in bud galls at shoot tips of *Thalictrum flavum* L. (Ranunculaceae) or in swollen flower buds that remain closed.
Occurrence. Schatili, 27 July 2004.
Distribution. Eurosiberian, up to Armenia and Kazakhstan.

Jaapiella veronicae (Vallot, 1827)

Several orange coloured larvae develop in galls on growing top of *Veronica chamaedrys* L. (Scrophulariaceae; Fig. 34). The two terminal leaves are shell-like thickened, densely covered with white hair, pressed together, forming a cavity in which the larvae live and pupate in white cocoons. Several overlapping generations develop per year. Larvae hibernate in the soil where they pupate in the spring.
Occurrence. Omalo, 18 June 2013.
Distribution. European, up to Kazakhstan.

Janetiella frankumi Harris, 2003

Larvae cause spindle swelling of the stem of *Rosa spinosissima* L. (Rosaceae; Fig. 35). The gall is 14 mm long, 7 mm broad, and inside includes several chambers, each with one orange larva.
Occurrence. Omalo, 18 June 2013.
Distribution. European, as far as we know the galls of this species were found only in UK (Harris 2003).

****Janetiella thymi*** (Kieffer, 1888)

Yellow-red larvae develop in small, smooth galls at the shoot tips of *Thymus serpyllum* L. and *T. pulegoides* L. (= *T. chamaedrys* L.) (Lamiaceae), and other *Thymus*-species (Fig. 36). Two generations develop per year. Larvae pupate and hibernate in the soil.
Occurrence. Roschka, 25 July 2004, Stepantsminda, 10 June 2013, Tbilisi (Tower Hill), 25 May 2013.
Distribution. Eurosiberian, up to Armenia.

Kiefferia pericarpiicola (Bremi, 1847)

Cecidomyia pimpinellae Loew, 1850
Asphondylia pimpinellae Löw, 1874
Asphondylia umbellatarum Löw, 1877

Red larvae develop inside swollen fruits of *Pimpinella saxifraga* L., *P. magna* L., *Daucus carota* L., *Silaum silaus* (L.) Sch. et Th. (= *Silaum pratense*) and some other species and genera of Apiaceae. Only one generation develops per year. Larvae hibernate in the soil. No seed is formed as a result of infestation.
Occurrence. Kazbegi, 15 July 2005 (on *Chaerophyllum aureum* L.), Lagodechi National Park, 1966 m a. s. l., 15 August 2006 (on *Chaerophyllum* sp.).
Reference. Mamaeva & Mamaev (1981).
Distribution. Eurosiberian, up to Kazakhstan.

Lasioptera carophila Löw, 1874

A solitary orange coloured larva causes a swelling at the point of insertion of umbellules in inflorescences of many species and genera of Apiaceae. Two generations develop per year. Larvae hibernate and pupate in the galls.
References. Rübsaamen (1895), Mamaeva & Mamaev (1981), Skuhravá (1986).
Distribution. European, occurring up to Turkey, Kazakhstan and North Africa.

****Lasioptera francoisi*** (Kieffer 1901)

Lasioptera niveocincta Kieffer, 1904

Larvae cause small spindle-shaped swellings on midribs and leaflets of *Achillea millefolium* L. (Asteraceae). Each gall includes only one larva.
Occurrence. Dedoplistskaro, Mta. Elias, 4 June 2013.
Distribution. European.

Lasioptera rubi (Schrank, 1803)

Orange larvae develop gregariously in hard woody swellings on stems of *Rubus idaeus* L., *R. caesius* L. and other *Rubus*-species (Rosaceae; Fig. 37). One generation develops per year. Pupation takes place in the gall. It is a minor but widespread pest of *Rubus* species (Darvas et al. 2000).
Occurrence. Korscha, 24 June 2013 (on *Rubus idaeus*).
References. Mamaeva & Mamaev (1981), Skuhravá (1986).
Distribution. Eurosiberian, spread to Turkey and Kazakhstan.

Lasioptera umbelliferarum Kieffer, 1909

Larvae cause large plurilocular swellings on stems and leaf stalks of *Hippomarathrum* sp. (formerly *Seseli*) (Apiaceae), up 20 mm long. Rübsaamen discovered swelling on stems of *Seseli* sp. at Petrowsk near the Caspian Sea but did not described the causer (Rübsaamen 1895). Kieffer (1909) described the species very briefly. Dorchin & Freidberg (2011) redescribed this species and established a neotype.

References. Rübsaamen (1895), Möhn (1968), Skuhravá (1986).
Occerrence. Tbilisi (Didi Dighomi, on *Bilacunaria microcarpa* (Bieb.) (*Hippomarathrum microcarpum* Bieb.), 17 July 2005.
Distribution. Euro-Asian.

***Loewiola centaureae** (Löw, 1875)

Yellow larvae cause blister-like galls on leaves of *Centaurea scabiosa* L., *C. jacea* L. and other *Centaurea*-species (Asteraceae). Galls are situated on the midrib or side vein and are surrounded with yellow or purple margin. Two or three generations develop per year. Larvae pupate and hibernate in the soil.
Occurrence. Archoty, 21 July 2004.
Distribution. European up to Kazakhstan.

Macrodiplosis pustularis (Bremi, 1847)

Diplosis dryobia Löw, 1877

First white, later red-yellow larvae cause galls on leaf margins of *Quercus robur* L. and *Q. petraea* (Matt.) Liebel (Fagaceae). The marginal leaf lobe is a little thickened and folded downwards forming a cavity for development of larvae. Only one generation develops per year. Larvae leave galls, hibernate in the soil where they pupate in the spring of the next year.
Occurrence. Ninigori, 10 August 2008 (on *Quercus imeretina* Steven ex Woronow), Tbilisi, 16 June 2013 (on *Quercus macranthera* Fisch.).
Reference. Kolomoets et al. (1989).
Distribution. European, spread up to Armenia, Turkey and Kazakhstan.

Macrodiplosis roboris (Hardy, 1854)

Macrodiplosis volvens Kieffer, 1895

First whitish, later orange-yellow larvae cause galls on leaf margins of *Quercus robur* L. and *Q. petraea* (Matt.) Liebel (Fagaceae). The part of the leaf between two lobes is rolled upwards forming inside a chamber for development of larvae. Only one generation develops per year. Larvae leave galls, hibernate in the soil where they pupate in the spring of the next year.
Occurrence. Ninigori, 10 August 2008. Reference: Kolomoets et al. (1989).
Distribution. European, occurring up to Turkey and Kazakhstan.

***Macrolabis lamii** Rübsaamen, 1915

Whitish larvae live in leaf galls at stem tips of *Lamium album* L. (Lamiaceae; Fig. 38).
Occurrence. Korscha, 24 June 2013.
Distribution. European.

Massalongia rubra (Kieffer, 1895)

First white, later red larvae cause swellings on the midrib of the leaf of *Betula pendula* Roth and *B. pubescens* Ehrh. (Betulaceae). Only one generation develops per year. Larvae hibernate and pupate in the soil.
References. Vanin (1941), Skuhravá (1986), Kolomoets et al. (1989).
Distribution. European, occurring up to Kazakhstan.

Mayetiola destructor (Say, 1817)

White larvae cause swellings on the lower part of the stem on *Triticum aestivum* L. (*T. vulgare* Vill.), *Secale cereale* L., *Hordeum vulgare* L. and occasionally also on various species of weed

grasses (Poaceae). There are usually two generations per year. Larvae hibernate in puparia on plants and pupate there in the next spring. It is a minor pest in Europe but the main pest of cereals in North America (Skuhravá et al.1984, Darvas et al. 2000).
References. Shengelija (1941), Shchhegolev (1955), Mamaeva & Mamaev (1981), Skuhravá (1986).
Distribution. Palaearctic, widespread in Europe, western Asia, Morocco to Tunisia, immigrant in Nearctic wherever wheat is grown; also New Zealand.

Mikiola fagi (Hartig, 1839)

A solitary white larva produces a large, smooth, hairless hard gall, pointed at the tip, on the leaf of *Fagus sylvatica* L. (Fagaceae). Inside the gall is one large chamber. One generation occurs per year. Full-grown larvae shut the opening at the base of the gall by a spinned lid. In autumn the galls separate from leaves and drop to the ground where they remain in the litter up to the spring of the next year. Larvae hibernate inside galls and pupate there. Occasionally it is a serious pest of young trees in submountain and mountain zones of Central Europe (Skuhravá & Roques 2000).
References. Shengelija (1941), Gusev & Rimskij-Korsakov (1951), Skuhravá (1986), Kolomoets et al. (1989).
Distribution. European, occurring up to Georgia, Armenia and Turkey.

Mikiola orientalis Kieffer, 1908

A solitary orange larva cause a large, smooth, hairless hard gall on the leaf of *Fagus orientalis* Lipsky (Fagaceae; Fig. 39). The gall of *M. orientalis* is oval, not pointed as *M. fagi*. Kieffer (1908) described this species on the basis of galls collected by Trotter (1903) in Asia Minor (Turkey). Rübsaamen (1985) found galls at "Borschom" (= Borzhomi, Georgia).
Occurrence. Bakuriani, 10 July 2005, Korscha, 24 June 2013, Nikolay Pass, 11 June 2013.
References. Vanin (1941), Skuhravá (1986). Distribution: Euro-Asian (Turkey, southern Bulgaria).
Note. The natural range of the host plant, *Fagus orientalis*, extends from the south-east Bulgaria (Strandja Mountain) through nortwest Turkey east to the Caucasus and Alborz Mountains of Iran.

******Mikiola* **sp.**

A small gall on the leaf vein of *Fagus orientalis* Lipsky (Fagaceae; Fig. 40). The gall is visible on both leaf sides: on the upper side it is an oval elevation with central small nipple, on the lower side a small, 2–3 mm high hemisphere prolonged in a small point. Inside gall is a chamber, but no larva was found during dissection on 23 July 2013. This gall is a component of the leaf, it does not separate from leaf as the galls of *Mikiola fagi* and *M. orientalis* do.
Occurrence. Korscha, 24 June 2013, Nikolay Pass, 11 June 2013.
Distribution. Euro-Asian. These gall were found only in Caucasus.

Monarthropalpus flavus (Schrank, 1776)

Cecidomyia buxi Laboulbéne, 1873

A solitary yellow-green larva develops in blister leaf gall on *Buxus sempervirens* L. (Buxaceae). As a result of the larval feeding on leaf tissue, the leaves drop off prematurelly. One generation develops per year. Larvae hibernate in galls where they pupate in the spring. *M. flavus* is sometimes a serious pest of ornamental boxwood shrubs in parks and gardens.
References. Shengelija (1941), Gusev & Rimskij-Korsakov (1951), Skuhravá (1986), Kolomoets et al. (1989).

Distribution. European, occurring up to Turkey, immigrant in North America (USA: California).

****Obolodiplosis robiniae*** (Haldeman, 1847)

White larvae cause galls on leaflets of *Robinia pseudoacacia* L. (Fabaceae; Fig. 41). The margin of attacked leaflets is swollen and rolled downwards.
Occurrence. Avchala, 30 May 2013.
Distribution. Nearctic, in Europe it is alien species which very quickly spread throughout the whole territory (Skuhravá et al. 2007, 2010).

Phegomyia fagicola (Kieffer, 1901)

Reddish larvae cause galls in form of leaf fold along lateral veins on *Fagus sylvatica* L. (Fagaceae). One generation develops per year. Larvae hibernate in the soil.
Reference. Gusev & Rimskij-Korsakov (1951): Caucasus.
Distribution. European, occurring up to Armenia.

****Placochela ligustri*** (Rübsaamen, 1899)

Pale yellow larvae develop in slightly swollen, unopened flower bud of *Ligustrum vulgare* L. (Oleaceae; Fig. 42).
Occurrence. Tbilisi (Botanical Garden), 29 May 2013.
Distribution. European.

****Placochela nigripes*** (Löw, 1877)

Orange-red larvae develop in swollen flower buds of *Sambucus nigra* L. and *S. ebulus* L. (Caprifoliaceae; Fig. 43). One generation develops per year. Larvae hibernate in the soil.
Occurrence. Korscha, 24 June 2013.
Distribution. European.

****Psectrosema barbatum*** (Marikovskij, 1961)

Larvae cause spindle galls on *Tamarix ramosissima* Ledeb. (Tamaricaceae; Fig.44). The gall is formed of swollen young shoot, it is 10 mm long, 2 mm broad, inside is one chamber. The walls of the galls are thin. Outer walls are covered with several small leaves. Marikovskij (1961) described this species on the basis of material collected in mountains of southern Kazakhstan.
Occurrence. Rustavi, 04 July 2010, Avchala, 30 May 2013.
Distribution. Euro-Asian, mountainous.

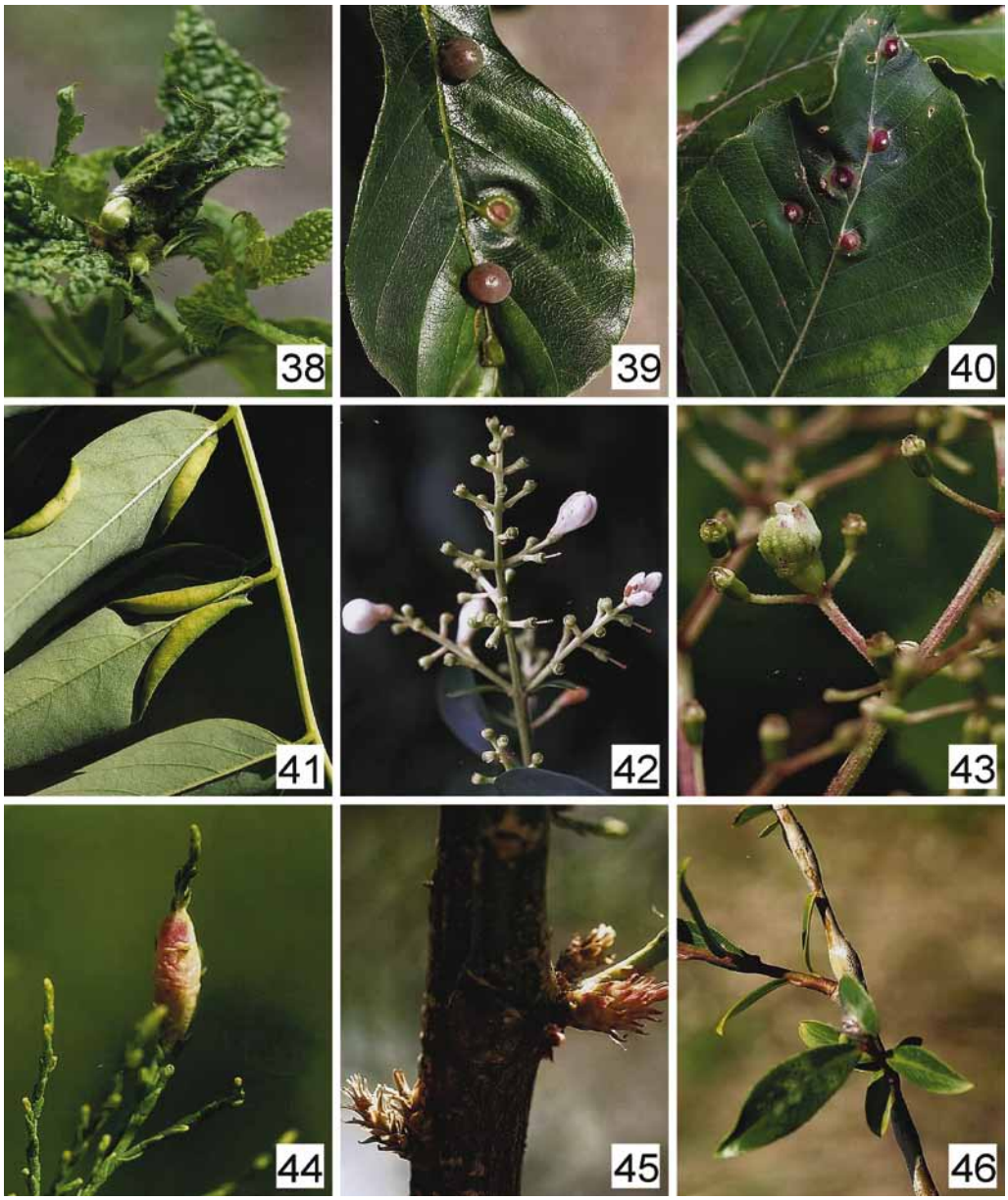
****Psectrosema turkmenicum*** Mamaev et Becknazharova, 1983

Larvae cause bud galls on *Tamarix ramossissima* Ledeb. (Tamaricaceae; Fig. 45). The gall is formed of a small cone, it is a swollen shortened shoot, covered with many leaves, 8 mm long, 4 mm broad, with thin wall, inside with a large central chamber, in time of dissection (20 July 2013) without larvae. This species was described on the basis of material collected in Karakum Desert in Turkmenistan by Mamaev & Becknazharova (1983).
Occurrence. Avchala, 30 May 2013.
Distribution. Euro-Asian, Turanian.

****Rabdophaga gemmicolata*** Gagné, 2004

Bremiolina gemmicola Mamaev et Mirumian, 1990

Orange larvae cause galls on thin branch of *Salix triandra* L. (Salicaceae; Fig. 46). The gall is formed of deformed enlarged young leaf bud with swollen basal part, inside with a chamber.



Figs 38–46. Galls of gall midges found in Georgia. 38 – Gall at stem tip of *Lamium album* caused by *Macrolabis lamii*. 39 – Rounded larger galls on leaf of *Fagus orientalis* caused by *Mikiola orientalis*. 40 – Small galls on leaf veins of *Fagus orientalis* caused by *Mikiola* sp. 41 – Rolled leaflet margins of *Robinia pseudoacacia* caused by *Obolodiplosis robiniae*. 42 – Flower bud galls on *Ligustrum vulgare* caused by *Placochela ligustri*. 43 – Flower bud gall on *Sambucus nigra* caused by *Placochela nigripes*. 44 – Spindle swelling on shoot of *Tamarix ramosissima* caused by *Psectrosema barbatum*. 45 – Small cone-shaped galls on branch of *Tamarix ramosissima* caused by *Psectrosema turkmenicum*. 46 – Enlarged leaf bud of *Salix triandra* caused by *Rabdophaga gemmicolata*.

Adults leave galls in early spring through an opening at the base of the gall. There is only one generation per year.
Occurrence. Avchala, 31 May 2013 (Photo of gall on *Salix* sp.).
Distribution. Euro-Asian, Caucasian.

****Rabdophaga heterobia*** (Loew, 1850)

Several orange-red larvae cause galls on *Salix triandra* L. (= *S. amygdalina* L.) (Salicaceae). Two generations develop per year. Larvae of hibernating generation develop in deformed and swollen male catkins where they also pupate (Fig. 48). Larvae of summer generation develop in small rosettes of haired leaves at the extremities of the shoots or in swollen lateral buds or lateral rosettes (Fig. 47). Barnes (1949) made extensive experiments with host plant range and found that *R. heterobia* (Loew) is specificly associated to *Salix triandra.* Similar galls on *Salix repens, S. purpurea* and other species of *Salix* cited in the literature as food plants are caused by another species of the genus *Rabdophaga*.
Occurrence. Korscha, 25 June 2013, Avchala, 30 May 2013.
Distribution. Eurosiberian, up to Armenia, Turkey and Kazakhstan.

****Rabdophaga terminalis*** (Loew, 1850)

Orange or reddish larvae live gregariously in galls formed by terminal leaves of *Salix fragilis* L. and *S. alba* L. (Salicaceae). Terminal leaves remain curled, folded and crinkled. The growth of the shoot is stopped and side shoots develop. Terminal part of the shoot turns black and dies. Two or more generations develops per year. Larvae pupate partly in the galls, partly in the soil.
Occurrence. Avchala, 31 May 2013.
Distribution. Eurosiberian, up to Armenia, Turkey and Kazakhstan.

****Rhopalomyia artemisiae*** (Bouché, 1834)

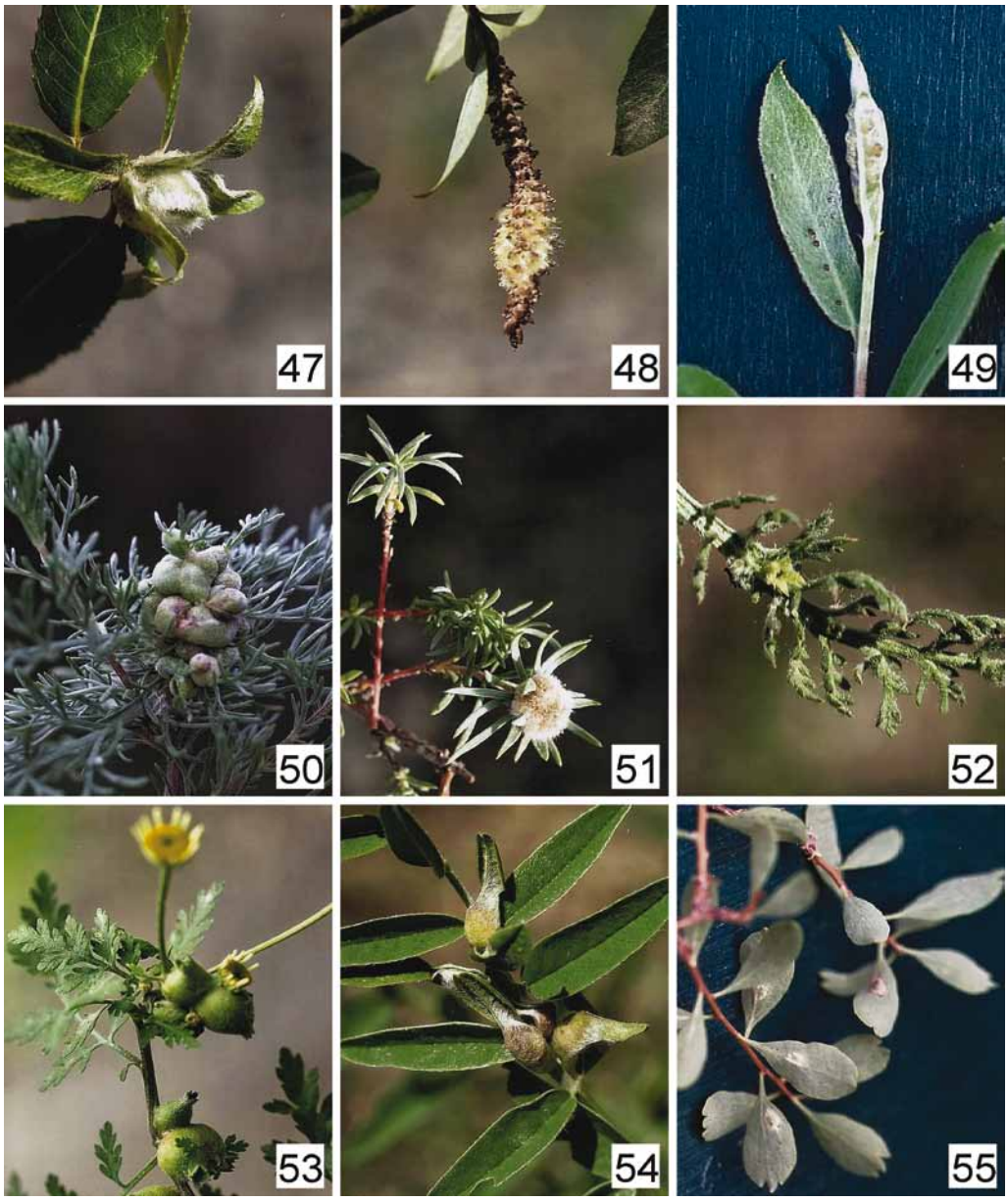
Orange coloured larvae cause large globular galls at the tip or in axils of *Artemisia campestris* L. and *A. scoparia* WK (Asteraceae). One or several chambers are inside one gall, each with only one larva. Pupation takes place in the gall. Several generations develop per year.
Occurrence. Avtchala (on *Artemisia campestris* L.), 16 July 2004, Tbilisi (Zahesi Hill) (on *Artemisia chamaemelifolia* Vill.), 31 July 2005.
Distribution: European, sub-Mediterranean. The galls of this species have been found also in Japan.

****Rhopalomyia baccarum*** (Wachtl, 1883)

Orange coloured larvae produce berry-shaped fleshy galls on the stems of *Artemisia vulgaris* L. and *A. scoparia* W.K. (Asteraceae).
Occurrence. Schatili-Mutzo, 27 July 2004 (on *Artemisia campestris*), Tbilisi (Zahesi Hill), 31 July 2005 (on *Artemisia chamaemelifolia* Vill.), Tbilisi, 26 May 2013 (on *Artemisia fragrans* Willd.; Fig. 50).
Distribution. Eurosiberian, up to Armenia and Turkey.

****Rhopalomyia heteropalpis*** (Marikovskij, 1964)

Larvae cause large semiglobular galls covered with whitish hairs on stems of *Artemisia cina* Berg. and *A. terrae-albae* Krasch. (Asteraceae). This species was discovered in south-eastern Kazakhstan and described by Marikovskij & Moiseeva (1964).
Occurrence. David Gareja, 852 m a. s. l., 06 June 2006, Vashlovani National Park, 3 June 2013; at both localities galls similar to them caused by *R. heteropalpis* were found on *Artemisia fragrans* Willd. (Fig. 51).



Figs 47–55. Galls of gall midges found in Georgia. 47 – Small rosette of densely haired leaves on shoot of *Salix alba* caused by *Rabdophaga heterobia*. 48 – Swollen catkin on *Salix triandra* caused by *Rabdophaga heterobia*. 49 – Spindle gall on shoot tip of *Salix triandra* caused by *Rabdophaga terminalis*. 50 – Berry-shaped fleshy galls on stem of *Artemisia fragrans* caused by *Rhopalomyia baccarum*. 51 – Globular whitish hairy gall of *Rhopalomyia heteropalpis* on *Artemisia fragrans*. 52 – Small galls of *Rhopalomyia millefolii* on leaf of *Achillea* sp. 53 – Bud galls of *Rhopalomyia tanaceticola* on *Tanacetum parthenicum*. 54 – Folded leaflets of *Glycyrrhiza glabra* caused by *Sophoromyia armeniaca*. 55 – Pustule galls on leaves of *Spiraea hypericifolia* caused by *Spiromyia cystiphorae*.

Reference. Mamaeva & Mamaev 1981.
Distribution. Euro-Asian, Turanian.

Rhopalomyia millefolii (Loew, 1850)

Yellow larvae produce unilocular galls in flower heads and leaves, and axillary bud galls on stems of *Achillea millefolium* L. (Asteraceae). The galls are oval, fleshy, first green, then brown and glossy. Larvae pupate in the galls and hibernate in the soil. Several generations develop per year.
Occurrence. Dedoplitskaro, 18 June 2010 (on *Achillea filipendulina* Lam.), 24 June 2013 (Fig. 52).
References. Rübsaamen (1895), Skuhravá (1986), Kolomoets et al. (1989). Distribution: Euro-Asian, up to India.

****Rhopalomyia tanaceticola*** (Karsch, 1879)

Orange coloured larvae cause galls on axillary buds, on leaves, in axils of leaves and in flower heads of *Tanacetum vulgare* L. (Asteraceae). Several generations develop per year. Larvae pupate in the galls.
Occurrence. Archoty, 20 July 2004, Stepantsminda, 08 June 2013, Omalo, 18 June 2013, Korscha, 24 June 2013 (at all localities on *Tanacetum parthenium* (L.) Sch. Bip; Fig. 53).
Distribution. Eurosiberian, up to Kazakhstan.

Rhopalomyia tubifex (Bouché, 1847)

White larvae produce tubular galls on leaf axils, stems and change into tubular galls the flower heads of *Artemisia campestris* L. (Asteraceae). Galls are 10–15 mm long. Each gall contains one larva. Two generations develop per year. Larvae pupate in the galls.
References. Shengelija (1941), Skuhravá (1986), Kolomoets et al. (1989).
Distribution. European, sub-Mediterranean.

****Semudobia betulae*** (Winnertz, 1853)

A single orange coloured larva develops in swollen fruit in catkin of *Betula pubescens* Ehrh. and *B. pendula* Roth. (Betulaceae). The attacked seed is swollen, with a small window-pit (for future emergence), and the wings of fruit are reduced. One generation develops per year. Larvae hibernate in the gall where they pupate in the spring.
Occurrence. Omalo, 18 June 2013 (on *Betula* sp.).
Distribution. Eurosiberian, immigrant in North America .

****Sophoromyia armeniaca*** Mamaev et Mirumian 1989

Larvae develop in folded leaflets of *Glycyrrhiza glabra* L. (Fabaceae; Fig. 54). This species was discovered in Armenia and described by Mamaev & Mirumian (1989).
Occurrence. Tbilisi, Avchala, 30 July 2005, 21 August 2006, 4 July 2010.
Distribution. Euro-Asian.

****Spiromyia cystiphorae*** (Fedotova, 1985)

Dasineura cystiphorae Fedotova, 1985

Larvae cause small pustule galls on leaves of *Spiraea hypericifolia* L. (Rosaceae; Fig. 55). This species was discovered in mountains in south-eastern Kazakhstan by Fedotova (1985).
Occurrence. Tbilisi, 27 May 2013.
Distribution. Central and West Asian.

***_Spurgia_ sp. 1**

Larvae cause green pyramidal and pointed galls on the shoot tip of *Euphorbia boisseriana* (Woronow) Prokh. (Euphorbiaceae). The gall consists of several leaves that are broadened at the base (Fig. 56).

Occurrence. Avchala, 30 May 2013.

Distribution. Euro-Asian.

***_Spurgia_ sp. 2**

Larvae cause small rounded galls on the shoot tip of *Euphorbia boisseriana* (Woronow) Prokh. (Euphorbiaceae; Fig. 57). The gall consists of several leaves that are very short and broadened.

Occurrence. Avchala, 30 May 2013.

Distribution. Euro-Asian. Asian.

Figs 56–61. Galls of gall midges found in Georgia. 56–57. Galls on stem tip of *Euphorbia boisseriana*. 56 – Green pointed gall caused by *Spurgia* sp.1. 57 – Small rounded gall caused by *Spurgia* sp. 2. 58 – Red pointed galls caused by *Spurgia* sp. 3 on *Euphorbia* sp. 59 – Rolled leaf margin caused by *Tavolgomyia karelini* on *Spiraea hypericifolia*. 60 – Artichoke--shaped gall on shoot of *Taxus baccata* caused by *Taxomyia taxi*. 61 – Swellings along midrib of leaf of *Carpinus betulus* caused by *Zygiobia carpini*.

***Spurgia* sp. 3**

Larvae cause pointed galls, red coloured, on the shoot tip of *Euphorbia boisseriana* (Woronow) Prokh. (Euphorbiaceae). The gall consists of several leaves that are broadened at the base (Fig. 58).
Occurrence. Stepantsminda, 7 June 2013.
Distribution. Euro-Asian.

Stenodiplosis bromicola Marikovskij et Agafovova, 1961

Larvae develop in inflorescences of *Bromus inermis* (Poaceae).
Reference. Mamaeva & Mamaev (1981).
Distribution. European, up to Kazakhstan.

Tavolgomyia karelini (Fedotova, 1982)

Wachtliella karelini Fedotova, 1982

Larvae cause galls on young leaves at the vegetative tip of *Spiraea hypericifolia* L. (Rosaceae; Fig. 59). The leaf margin is rolled, forming a reddish coloured tubular gall. Fedotova (1982) found galls in south-eastern Kazakhstan.
Occurrence. Tbilisi, 27 May 2013.
Distribution. Euro-Asian.

Taxomyia taxi (Inchbald, 1861)

A solitary orange red larva causes an artichoke-shaped gall on the shoots of *Taxus baccata* L. (Taxaceae; Fig. 60). The development lasts usually two years. The gall develops in the second year of its life cycle. Larvae pupate in the gall.
References. Gusev & Rimskij-Korsakov (1951), Kolomoets et al. (1989).
Distribution. European, occurring up to Caucasus.

Vitisiella oenephila (Haimhoffen, 1875)

Janetiella oenephila (Haimhoffen, 1875)

Orange to salmon pink larvae cause galls on leaves of *Vitis vinifera* L. (Vitaceae). The gall is round or oval, hard and visible on both surfaces of the leaf. Only one larva develops in a gall.
Reference. Mamaeva & Mamaev (1981).
Distribution. Mediterranean, up to Caucasus.

Wachtliella persicariae (Linné, 1767)

Whitish-orange larvae produce galls in the form of rolled leaf margin on *Polygonum amphibium* L. (Polygonaceae). Each gall contains several larvae that pupate here in a white cocoon. Several generations develop per year.
References. Rübsaamen (1895), Skuhravá (1986), Kolomoets et al. (1989).
Distribution. European, occurring up to Armenia and Kazakhstan.

Zygiobia carpini (Löw, 1874)

White larvae produce small swellings along the median vein and side veins of the leaves of *Carpinus betulus* L. (Corylaceae; Fig. 61). Each swelling contains one larva. In autumn the larvae leave galls and hibernate in the soil. One generation develops per year.
Occurrence. Korscha, 24 June 2013.
References. Vanin (1941), Shengelija (1941), Skuhravá (1986), Kolomoets et al. (1989).
Distribution. European, up to Armenia and Turkey.

Table 1. List of host plants and associated gall midges in Georgia

host plant species	gall midge species
Acer campestre	*Acericecis campestre*
Acer pseudoplatanus	*Dasineura irregularis*
Achillea filipendulina	*Rhopalomyia millefolii*
Achillea sp.	*Lasioptera francoisi*
Aegonychon purpureo-caeruleum	
(*Lithospermum purpureo-caeruleum*)	*Dasineura lithospermi*
Alhagi pseudoalhagi	*Contarinia desertorum*
Alyssum	*Dasineura alyssi*
Artemisia campestris	*Rhopalomyia baccarum*
	Rhopalomyia artemisiae
Artemisia chamaemelifolia	*Rhopalomyia baccarum*
	Rhopalomyia artemisiae
Artemisia fragrans	*Rhopalomyia heteropalpis*
	Rhopalomyia baccarum
Asperula pontica	*Dasineura asperulae*
Atraphaxis caucasica	*Atraphaxiola bogutensis*
Berberis vulgaris	*Contarinia* sp.
Betula litwinowii	*Anisostephus betulinum*
	Massalongia rubra
	Semudobia betulae
Bilacunaria microcarpa	
(= *Hippomarathrum microcarpum*)	*Lasioptera umbelliferarum*
Brassica spp.	*Contarinia nasturtii*
Buxus sempervirens	*Monarthropalpus flavus*
Campanula tridentata	*Dasineura thomasi*
Carpinus caucasica, Carpinus betulus	*Zygiobia carpini*
	Contarinia carpini
Centaurea scabiosa	*Loewiola centaureae*
Chaerophyllum aureum	*Kiefferia pericarpiicola*
Coronilla varia	*Asphondylia baudysi*
	Corylus avellana Contarinia coryli
	Contarinia cybelae
	Dasineura sp. (folded leaf)
	Dasineura sp. (small leaf gall)
Cotinus coggygria	*Contarinia cotini*
Crataegus monogyna, *C. laevigata*	*Contarinia anthobia*
	Dasineura crataegi
	Dasineura oxyacanthae
	Ametrodiplosis medialis
Ephedra procera	*Ephedromyia sp.*
Euphorbia boissieriana	*Spurgia* sp. 1 (green pyramidal pointed)
	Spurgia sp. 2 (small oval gall)
	Spurgia sp. 3 (red pointed gall)
	Dasineura capsulae
	Dasineura euphorbiarum (fruit gall)
Euphorbia glaberrima	*Spurgia* sp.
Euphorbia iberica	*Spurgia* sp.
Fagus orientalis	*Mikiola orientalis*
	Mikiola sp.
Fagus sylvatica	*Hartigiola annulipes*
	Mikiola fagi
	Phegomyia fagicola
Fraxinus excelsior	*Dasineura acrophila*
	Dasineura fraxinea
	Dasineura fraxini

Table 1. (continued)

host plant species	gall midge species
Galega officinalis	*Dasineura* sp.
Galium mollugo	*Geocrypta galii*
Galium verum	*Contarinia vera*
	Geocrypta galii
Genista pilosa	*Jaapiella genistamtorquens*
Genista tinctoria	*Jaapiella genisticola*
Geranium pratense	*Dasineura geranii*
Gleditsia triacanthos	*Dasineura gleditchiae*
	Glycyrrhiza glabra
(originally identified as *Sophora jaubertii*)	*Sophoromyia armeniaca*
Hedera helix	*Dasineura kiefferi*
Hedysarum caucasicum	*Bremiola hedysarii*
Hesperis voronovii	*Contarinia* sp.
Hippomarathrum sp. (*Seseli* sp.)	*Lasioptera umbelliferarum*
Hypericum perforatum	*Dasineura serotina*
	Dasineura hyperici
Juniperus sabina	*Etsuhoa sabinae*
Lamium album	*Macrolabis lamii*
Lepidium draba (= *Cardaria draba*)	*Contarinia cardariae*
Ligustrum vulgare	*Placochela ligustri*
Linum austriacum	*Dasineura sampaina*
Lonicera orientalis	*Contarinia lonicerearum*
Lotus pedunculatus	*Contarinia loti*
Malus sylvestris	*Dasineura mali*
Medicago sativa	*Contarinia medicaginis*
Ononis pusilla	*Dasineura columnae*
Papaver rhoeas	*Dasineura papaveris*
Polygonum amphibium	*Wachtliella persicariae*
Populus tremula	*Contarinia petioli*
	Harmandiola cavernosa
Quercus imeretina, *Q. macranthera*	*Macrodiplosis pustularis*
Quercus robur, Q. petraea	*Macrodiplosis pustularis*
	Macrolabis roboris
Robinia pseudoacacia	*Obolodiplosis robiniae*
Rosa canina	*Dasineura rosae*
Rosa spinossissima	*Dasineura rosae*
	Janetiella frankumi
Rubus idaeus	*Lasioptera rubi*
Salix alba	*Rabdophaga heterobia*
Salix caprea	*Iteomyia capreae*
Salix caucasica	*Iteomyia capreae*
Salix fragilis	*Rabdophaga terminalis*
Salix triandra	*Rabdophaga gemmicolata*
	Rabdophaga heterobia
Salix sp.	*Rabdophaga terminalis*
	Rabdophaga karschi
Sambucus nigra	*Placochela nigripes*
Scrophularia grossheimii, *S. variegata*	*Asphondylia scrophulariae*
Securigera securidaca	*Asphondylia* sp.
Silene sp.	*Contarinia steini*
Sisymbrium loeselii	*Dasineura bayeri*
Sonchus oleraceus	*Cystiphora sonchi*
Spiraea hypericifolia	*Spiromyia cystiphorae*
	Tavolgomyia karelini

host plant species	gall midge species
Symphytum asperum	*Dasineura symphyti*
Tamarix ramosissima	*Psectrosema barbatum*
	Psectrosema turkmenicuám
Tanacetum parthenifolium	*Rhopalomyia tanaceticola*
Thalictrum	*Jaapiella thalictri*
Thymus	*Bayeriola thymicola*
	Janetiella thymi
Tilia begoniifolia	*Dasineura tliliae*
	Didymomyia tiliacea (*D. reaumuriana*)
Trifolium canescens	*Dasineura trifolii*
Triticum vulgare	*Contarinia tritici*
	Mayetiola destructor
Urtica dioica	*Dasineura urticae*
Valeriana aliariifolia	*Dasineura valerianae*
Verbascum	*Asphondylia verbasci*
Veronica chamaedrys	*Jaapiella veronicae*
Vicia purpurea (= *V. alpestris*)	*Contarinia craccae*
Vicia sepium	*Dasineura viciae*
Vicia sosnowskyi	*Dasineura viciae*
Vicia tenuifolia	*Contarinia craccae*
Vitis vinifera	*Vitisiella oenephila*
Zygophyllum fabago	*Contarinia zygophylli*
	Asphondylia sp.

EVALUATION OF RESULTS

Number of species forming present fauna

The gall midge fauna of Georgia is composed of 123 species belonging to 47 genera. Of them 12 species are identified to the genus level: two species to *Asphondylia*, two species to *Contarinia*, three species to *Dasineura*, one species to *Ephedromyia*, one species to *Mikiola*, and three species to *Spurgia*. It is necessary to obtain better material for identification of these species. 82 gall midge species are new members of the gall midge fauna of Georgia; their galls were found during several research trips in the years 2004–2013.

In Georgia the two species richest genera are *Dasineura* with 29 species and *Contarinia* with 19 species (Table 2). This finding is in accordance with the results that we obtained in the evaluation of species numbers of the main genera of gall midges in Europe (Skuhravá & Skuhravý 2010). Other gall midge genera in Georgia are not so rich: *Rhopalomyia* includes 6 species, *Asphondylia* 5 species, *Lasioptera* and *Jaapiella* four species. We compared species numbers of main genera occurring in Georgia with that in adjacent countries and with Kazakhstan (Table 2).

The number of species of the main genera is in most cases similar in both adjacent countries, in Georgia and Armenia. It is interesting that four species of *Lasioptera* was recorded in Georgia and any species in Armenia. It seems that this phenomeon is connnected with the fact that the species number of *Lasioptera* decreases in direction to the east: in Turkey seven species occur and in Kazakhstan only three species.

The gall midge fauna of Georgia including 123 species may be evaluated as rich in comparison with the gall midge fauna of adjacent countries from which comparable data are at disposal: in Armenia 96 species (Mirumian (2011), in Turkey 116 species (Skuhravá et al. 2005, Skuhravá & Skuhravý, in preparation), in Azebaijan 11 species (Skuhravá 1986). Unfortunately there are no direct data on the occurrence of gall midges in the southern part of Russia adjacent to Georgia but

it is possible to use data published in Gusev & Rimskij-Korsakov (1951), Mamaeva & Mamaev (1981) and Kolomoets et al. (1989). Useful data for comparison of gall midge fauna of Georgia with that of Central Asia are given in the book of Fedotova (2000). She gives 820 gall midge species forming the gall midge fauna of Kazakhstan.

The similarity or relationships between the fauna of gall midges of Georgia and four adjacent countries – Russia (European part), Turkey, Armenia and Azerbaijan, may be shown by number of common (or shared) species, that are such species occurring in two adjacent countries. The number of common species indicates a similarity of areas in faunal composition: the higher the number of common species means a higher degree of similarity of the areas. The similarity in composition of gall midge fauna in Georgia and adjacent countries and of Kazakhstan is shown in Fig. 62. It is necessary to emphasize that the number of common species is influenced mainly by the geographical position of the country, country area size, species number of gall midge fauna and the level of knowledge of the country (Skuhravá & Skuhravý 2010a).

The highest number of common species – 40 species of gall midges – occurs between Georgia and Armenia, 32 common species between Georgia and southern part of Russia, 33 species between Georgia and Turkey and only 2 species between Georgia and Azerbaijan. Common species are usually such species that occupy large distribution areas in Europe where they occur abundantly and reach up to Caucasus. A relatively large number of common species (35) seems to occurs between Georgia and Kazakhstan, spread in Central Asia. It is influenced mainly by the fact that Kazakhstan is a very large country with various landscape types and its gall midge fauna includes a large number – 820 species. Some of common species are associated with host plants occurring in desert and semidesert areas of this country. Of 40 common species between Georgia and Armenia, nine species are very rare but very interesting from the zoogeographical point of view: *Contarinia desertorum* causing galls on *Alhagi, Contarinia* sp. (in fruits of *Berberis vulgaris*), *Rabdophaga gemmicolata* on *Salix triandra, Rhopalomyia heteropalpis* on *Artemisia fragrans* and *Etsuhoa sabinae* on *Juniperus sabina*.

We verify the similarity in the composition of gall midge faunas in Georgia and adjacent countries using the Sørensen index (Sørensen's similarity coefficient). The shortened version of the formula is: $QS = 2C / A+B$; where A and B are the species numbers in country A and country B, respectively, and C is the number of species shared by the two countries. Its range is from 0 to 1 (Sørensen T. 1948).

We received similar results after substituting values into this formula as in the previous case. The Sørensen index for Georgia and Armenia is highest with the value 0.36, for Georgia and Turkey 0.28, for Georgia and Russia 0.12 and for Georgia and Azerbaijan 0.03.

The Sørensen index for Georgia and Kazakhstan is very low – 0.07 – and show the low level of similarity of these two gall midge faunas.

Geographical distribution

The gall midge species occurring in Georgia may be divided, according to their overall distribution in the world, into six zoogeographic units: European, Euro-Siberian, Euro-Asian, Holarctic and Mediterranean. In addition, species that penetrated into Georgia from Nearctics are designated as non native or alien. Of 123 species of the subfamily Cecidomyiinae, forming the present fauna of Georgia, 38% are European, 22% Eurosiberian, 18% Euro-Asian, 5% Holarctic and 2% alien species.

European species occur only in Europe and are considered to have their centres of origin in Europe. In Georgia 47 species (38%) belong to European elements. Typical representatives of European gall midges are *Mikiola fagi* galling leaves of *Fagus sylvatica* and *Macrodiplosis pustularis* with galls on leaves of *Quercus robur* and its relatives. Both these species reach up to Caucasus and to Georgia and exceed the boundary of Europe.

Euro-Siberian species inhabit the Euro-Siberian subregion of the Palaearctic region. They have centres of origin in Europe where they occur usually abundantly and extend at least to Western Siberia, with some of them reaching to Central Siberia and only a few reaching to Eastern Siberia and to the most eastern part of the Palaearctic Region, to the Far East. In Georgia 27 species (22%) belong to Eurosiberian elements. Typical representatives are *Harmandiola cavernosa* causing galls on leaves of *Populus tremula, Lasioptera rubi* inducing galls on stems of *Rubus idaeus* and its relatives*, Iteomyia capreae* on *Salix caprea, Geocrypta galii* on *Galium mollugo* and *Dasineura urticae* on *Urtica dioica.* Some of these species reach to Caucasus and to Georgia, exceed the boundary of Europe and occur also in Kazakhstan.

Euro-Asian or **Palaearctic** species inhabit Europe or the Eurosiberian subregion and at least one of the other Palaearctic subregions, i.e. Central Asian or East Palaearctic subregions. In Georgia a relative large number – 35 species (28%) – belong in this group. Most of these species originate from Central Asia and are associated with host plants growing in this center, e.g. *Contarinia desertorum* with *Alhagi pseudoalhagi*, *Psectrosema barbatum* and *P. turkmenicum* associated with *Tamarix*, *Spiromyia castiphorae and Tavolgomyia karelini* with *Spiraea hypericifolia*. These species that originate in deserts and semideserts of Central Asia, usually are called **Turanian**. On the other hand, such species that originate or have been found only in the area of Caucasus, are called **Caucasian**, as for example *Sophoromyia armeniaca* folded leaflets of *Glycyrrhiza glabra* and *Contarinia* sp. developing in fruits of *Berberis vulgaris*. Of course, in the future, these species can be found in adjacent countries in the wider region.

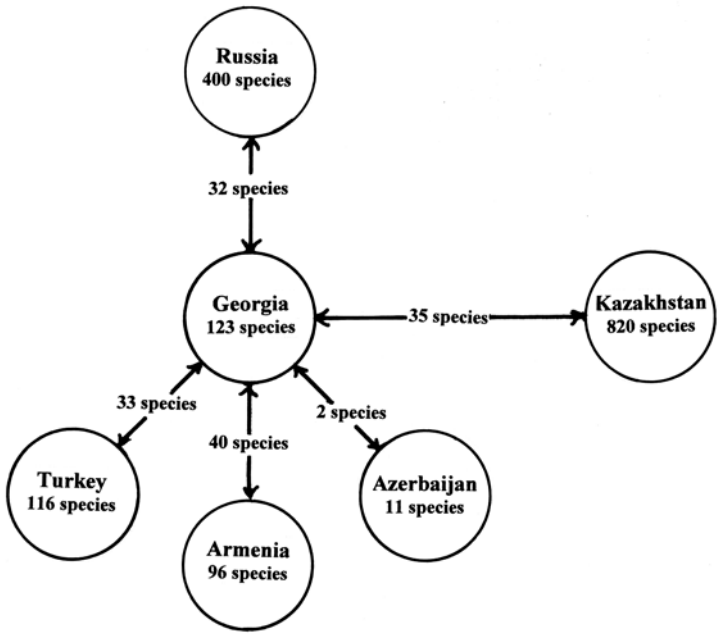


Fig. 62. Similarity in the composition of gall midge fauna in Georgia and adjacent countries and of Kazakhstan shown in numbers of common (shared) species.

Table 2. Species numbers of the main genera of gall midges in Georgia and adjacent countries in comparison with eastern Europe and Kazakhstan (Central Asia)

genus	Georgia	Armenia	Turkey	Azerbaijan	E Europe	Kazakhstan
Dasineura Rondani, 1840	32	27	15	0	61	92
Contarinia Rondani, 1860	19	14	10	0	42	79
Asphondylia Loew, 1850	5	4	9	0	20	9
Rhopalomyia Rübsaamen, 1892	6	6	3	0	9	60
Lasioptera Meigen, 1818	4	0	7	1	9	3
Stefaniola Kieffer, 1913	0	1	0	2	0	74
Rabdophaga Westwood, 1847	3	8	5	0	18	11
Jaapiella Rübsaamen, 1915	4	6	2	0	9	51
Resseliella Seitner, 1906	0	0	3	0	9	1
Macrolabis Kieffer, 1892	1	1	1	0	5	22
Baldratia Kieffer, 1897	0	1	0	0	1	20
Mayetiola Kieffer, 1896	1	1	2	0	1	1

Some species occur abundantly in Europe and reach up to India, e.g. *Rhopalomyia millefolii* causing galls on *Achillea millefolium*, and *Dasineura papaveris* associated with *Papaver rhoeas* reach up to Israel. *Etsuhoa sabinae* causing galls on *Juniperus sabina* has a disjunct Euro-Asian area of distribution. Galls of *E. sabinae* occur rarely in mountains of Europe, they were found in Caucasus (Georgia) and also in mountains of eastern Kazakhstan. *Lasioptera umbelliferarum* causing galls on *Hippomarathrum* (formerly *Seseli*) has a disjunct distribution area. Galls were found in southern Italy (Sicily), in southern Russia, Georgia, Azerbaidjan, Iran and Israel.

Mediterranean species have centres of origin in the Mediterranean area. They occur along the shores of the Mediterranean and are associated with Mediterranean host plant species. Some of them occur over greater areas and a few species reach the northern limits of their distribution areas in Central Europe. In such case they are defined as **Submediterranean species.** In Georgia only six gall midge species occur, viz. *Asphondylia scophulariae*, *A. verbasci*, *Dasineura sampaina*, *Rhopalomyia artemisiae*, *R. tubifex*, and *Vitisiella oenephila*.

Some of them occur abundantly in the Mediterranean area reach the northern limits of their distribution in the eastern part of Austria, southern part of the Czech Republic and of Slovakia.

Holarctic species occur simultaneously in the Palaearctic and in the Nearctic regions. Six species occur in Georgia. They are associated with host plants, mainly with cereals that occur in both regions, e.g. *Contarinia tritici* and *Mayetiola destructor*. Most of Holarctic species are primarily of European origin and a number of gall midges were transported accidentally from Europe into North America with their host plants.

Alien species (non-native, exotic, non-indigenous, foreign) are species introduced outside their normal distribution. Invasive alien species are alien species whose establishment and spread modify ecosystems, habitats, or species. They were introduced into Europe unintentionally from other parts of the world. Two alien species are members of gall midge fauna of Georgia: *Obolodiplosis robiniae* causing galls on leaflets of *Robinia pseudoacacia*, and *Dasineura gleditchiae*, causing galls on *Gleditchia triacanthos,* both have been imported into Europe unintentionally, probably with seedlings of their host plant. (Skuhravá et al. 2010).

From the **zoogeographical point of view**, very interesting are the following species:

Mikiola orientalis and other species (*Mikiola* sp., probable a new species) causing galls on leaves of *Fagus orientalis*, the tree species occupying a natural range from the south-east Bulgaria (Strandja Mts.) through nortwest Turkey east to the Caucasus and Alborz Mountains of Iran.

Rabdophaga gemmicolata causing galls on *Salix triandra* and *Sophoromyia armeniaca* inducing galls on leaflets of *Glycyrrhiza glabra*, discovered and described in Armenia several years ago (Mamaev & Mirumian 1989, 1990) .

Janetiella frankumi inducing galls on stems of *Rosa spinosissima* (Rosaceae). The finding of galls at Omalo in Georgia is the first record after a description of this species published by Harris (2003). Galls were found on stem of *Rosa pimpinellifolia* in England.

Contarinia loti causing galls on *Lotus pedunculatus* was found at the highest situated locality, Kazbegi, at an altitude of 2191 m a. s. l.. It is an European species occupying a large distribution area in Europe and reaching up to Caucasus. Galls of this species were found in the Alps at an altitude of 2518 m (Skuhravá & Skuhravý 2010b).

Relation to host plants

In Georgia 123 species of gall midges are associated with 102 plant species which belong to 40 plant families (Table 1). About one third of host plant species (38) are trees and shrubs and the other two third (64) are herbaceous plants. Most gall midge species are associated with Fabaceae (15 species) and, to a lesser extent, with Asteraceae (nine species) and Rosaceae (nine species). Each of another two families – Corylaceae and Fagaceae – host seven gall midge species, Salicaceae six species, Euphorbiaceae five species and each of two families – Brassicaceae and Oleaceae – host four species. Each of the other six families – Apiaceae, Betulaceae, Lamiaceae, Poaceae, Rubiaceae and Scrophulariaceae host three gall midge species. Each of eight plant families – Aceraceae, Boraginaceae, Caprifoliaceae, Hypericaceae, Polygonaceae, Tamaricaceae, Tiliaceae and Zygophyllaceae – host two gall midge species and each of remaining 17 plant families only one gall midge species.

Usually only one species of gall midges is associated with one host plant species. Each of three tree – *Betula litwinowii*, *Fraxinus excelsior* and *Fagus sylvatica* – host three gall midge species.

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