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BIONOMICS AND CECIDOGENESIS OF *Contarinia petioli* (Kieffer) (Diptera, Cecidomyiidae)

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Abstract

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Recently, the abundant occurrence of galls of *Contarinia petioli* (Kieffer) was noted on *Populus tremula* in the Brno region and elsewhere in southern Moravia. The bionomics and cecidogenesis of the gall midge was studied on 5 to 15-year-old aspens in Forest District Bílovice nad Svitavou, Training Forest Enterprise Masaryk Forest in Křtiny in 2007 and 2008. Imagoes fly there at the end of April and at the beginning of May. Females lay eggs in several partial clutches at 1 to 6(10) pieces. About 91% newly hatched larvae settle on petioles of unfolding leaves, about 8% on the bark of terminal parts of shoots and about 1% on leaf blades. By means of sucking the larvae of the 1st and 2nd instars galls are created in the 1st half of May. Larvae of the 3rd instar occur in galls from the 20th May when galls are grown-up. Larvae abandon the galls in the 1st decade of June through an oval hole 0.6 × 0.4 mm in diameter. Galls are on average 6 mm long, 5.4 mm wide and 5.1 mm high. If they are localized within a short distance of each other then often create formations up to 17 × 11 × 9 mm in size. There are 1 to 6(10) chambers in galls and in each of them, only one larva develops. The paper deals in detail with the differentiation of galls including chambers as well as natural enemies of the gall midge. *Torymus quercinus* Boh., *T. cultrans* Graham & Gijswijt (Torymidae) and *Tetrastichus* sp. (Eulophidae) rank among natural enemies of larvae in galls.[1]

Cecidomyiidae, *Contarinia petioli*, occurrence, development, galls, control factors

Gall midges (Cecidomyiidae) are a species-rich and bionomically considerably heterogeneous family of the order of Diptera. On the area of the CR, this family is represented by 549 species (SKUHRAVÁ, 2006). The majority of them are cecidogenic and, therefore, Cecidomyiidae are far the most numerous group of cecidogenic animals. Except gall-forming species, the family includes also numerous zoofagous, saprophagous, gallicollous and endophytic, ie nongall-forming species. *C. petioli* (Kieffer) ranks among its species-rich and virtually important genus *Contarinia* Rondani. It concerns a phytophagous species, which develops in species-specific galls on petioles of leaves and on annual shoots of some species of the genus *Populus* spp., above all *P. tremula* L.

In 2007 and 2008, galls of *C. petioli* were abundantly found on *P. tremula* at a number of localities in southern Moravia. They also occurred abundantly close to Brno, in Forest District Bílovice nad Svitavou, TFE Masaryk Forest in Křtiny (former the Brno-venkov district). The outbreak of *C. petioli* was used for the systematic study of its occurrence, bionomics and formation of galls.

Systematic classification

Contarinia (= *Syndiplosis*) *petioli* (Kieffer, 1898) ranks among the subfamily Cecidomyiinae, viz. the tribe of (group) Cecidomyiidi. It was classified in the genus *Contarinia* described by Rondani in 1860. In the past, however, the species was very frequently noted under the name *Syndiplosis* Rübsaamen, 1910.

1 The paper was prepared at the Faculty of Forestry and Wood Technology, Mendel University in Brno within the MSM 62156648902 research plan.

In 1911, a German entomologist Prof. E. H. Rübsaamen described this gall midge as *S. winnertzii*. Rather frequently, it was formerly described as *Harmandia petioli* (Kieffer). Also a prominent Czech expert of gall-forming insect Prof. E. Bayer mentions this gall midge under this name. Prof. Bayer communicates an opinion of Prof. Rübsaamen from 1911. According to this opinion, the valid name of this gall midge is *S. winnertzii* (Rübs.) and *H. petioli* is mere nomen nudum (BAYER, 1912). In the literature, also other invalid names of *C. petioli* occur rather sporadically (eg. *Cecidomyia tremulae* Winnertz). In Czech as well as in the majority of other national languages, the gall midge has not been named yet. According to the localization of galls on leaf petioles and according to the main host plant, the species is named in Russian as osinovaja chereshkovaja gallica.

Geographic distribution

C. petioli is a Euro-Siberian species similarly as about 90% representatives of the fauna of Cecidomyiidae in the CR (SKUHRAVÝ and SKUHRAVÁ, 1996). It is broadly distributed mainly in Europe including the European part of the former USSR (GUSEV and RIMSKIJ-KORSAKOV, 1953; MAMAEV, 1969; POSTNER, 1982 etc.). It occurs also in central Siberia and Far East (SKUHRAVÁ and SKUHRAVÝ, 1993). According to SKUHRAVÁ and SKUHRAVÝ (1993), it was found in England, Denmark, the Netherlands, Germany, former Czechoslovakia, Poland, Hungary, former Yugoslavia, Romania, Norway, Sweden and the former USSR. Originally the species was described in France from where it was mentioned eg by DARBOUX and HOUARD (1901), BÉGUINOT (2006) etc. In SE Europe, its natural range reaches up to Spain (SKUHRAVÁ et al., 2002). Concrete finds of the gall midge are noted also from Luxemburg (LAMBINON et al., 2001), Lithuania (PAKALNIŠKIS et al., 2000, 2006) and Latvia (SPUŅĢIS and KALNIŅŠ, 2003). However, the centre of the gall midge occurs in Central Europe. To the south and north, the abundance of the species decreases (SKUHRAVÝ et al., 1997). Numberless dipterological, cecidological and faunistic publications deal with the occurrence of *C. petioli* in Europe.

SKUHRAVÝ and SKUHRAVÁ (1993) studied frequency of the occurrence of Cecidomyiinae (including *C. petioli*) on main forest tree species in three countries of Central Europe (in the CR, Slovakia and Austria). They examined 1 200 localities, out of them 670 localities in the CR. In 20 woody species, they found 44 species of gall midges. They ranged particular species according to the number of localities where the species were found. On the basis of determination of the frequency of occurrence, *C. petioli* was placed in the 19th place. It means that it is ranked among common species in Central Europe. In the area of the present CR, E. Bayer, E. Baudyš and F. L. Černík found it at 110 localities already in the last century. In 1957 to 1982, SKUHRAVÁ (1994b, 2008 – pers. comm.) found the gall midge at 156 other localities. Thus, *C. petioli* was found at 266 localities in the CR. SKUHRAVÁ (1994b) classed *C. petioli* to the 4th frequency group (out of six groups), ie among considerably abundant species. According to this author, the population density of *C. petioli* increased in the CR in the 2nd half of the 20th century. It occurs at altitudes from 162 m (nearby Neratovice – central Bohemia) to 1 000 m (nearby Hrabická Lada – the Bohemian Forest), most abundantly in the zone from 300 to 600 m. Thus, it refers to a collinous to submontane species penetrating to the montane zone. The horizontal and vertical occurrence of *C. petioli* is shown on a map and diagram (Fig. 1).

Host species and bionomics

Populus tremula L. (Salicaceae) is the host plant of *C. petioli* (DARBOUX and HOUARD, 1901; KIEFFER, 1913; RÜBSAAMEN and HEDICKE, 1925/1939; SCHEIDTER, 1928; BARNES, 1951; BAUDYŠ, 1954, 1956; WAHLGREN, 1960; SKUHRAVÁ and SKUHRAVÝ, 1960, 1963, 1973, 1974a,b; SKUHRAVÁ, 1987, 1994a,b, 1998; SKUHRAVÝ and SKUHRAVÁ, 1993, 1998; MAMAEV, 1969; SKRZYPCZYŃSKA, 1999, 2004; LAMBINON et al., 2001; PERSSON, 2002; BÉGUINOT, 2006 etc.). Nevertheless, *C. petioli* is not a definite monophague. According to ROSS (1911), GUSEV and RIMSKIJ-KORSAKOV (1953), PFEFFER et al. (1954) etc., it occurs also on *P. alba* L. BUHR (1965), POSTNER (1982) etc. mention the gall midge, in addition to *P. tremula* and *P. alba*, also on *P.* × *canescens* (Ait.) Smith (= *P. alba* × *P. tremula*).

SKUHRAVÝ et al. (1997) studied the occurrence and morphology of galls of cecidogenic gall midges on *P. tremula*, *P. tremuloides* Michl. and their hybrids in southern Bohemia. In total, they found there seven species of Cecidomyiidae. *Harmandiola cavernosa* (Rübs.) was the most abundant species of them. Galls of *C. petioli* created 14.4 to 27% of all galls. Nevertheless, *P. tremula* was attacked markedly most. Only several galls were found on *P. tremuloides.* On hybrid tree species, galls occurred only sporadically. Galls (mainly of *H. cavernosa*) on *P. tremuloides* and hybrids differed in their size and shape from galls on *P. tremula*. While in galls on an autochthonous host *P. tremula*, larvae of developed normally, the larvae very often died on an allochthonous and hybrid host. According to TURČEK (1956), the high trophic attractiveness of *P. tremula* for insect is particularly related to its chemistry and wide ecological valence and thus also high spatial dispersion.

In Europe, in total 13 (in the CR 11) species of gall midges have been found, which are related to aspen by their development (SKUHRAVÁ, 1994a,b; SKUHRAVÝ and SKUHRAVÁ, 1998). With respect to the frequency of occurrence, *C. petioli* is the fifth most abundant gall-forming species of Cecidomyiidae on *P. tremula* in the CR (SKUHRAVÝ and SKUHRAVÁ, 1993). Innumerable literature sources mention its occurrence and development. However, *C. petioli* has not been evidently studied in more detail yet.

MATERIAL AND METHODS

C. petioli was studied at Forest District Bílovice nad Svitavou, TFE Masaryk Forest in Křtiny (former the Brno-venkov district) in 2007 and 2008. The main investigation was carried out at Forest Range Resslovka, Hády Hill (altitude 420 m). Galls of *C. petioli* occurred there abundantly on 5 to 15-year *P. tremula*, viz mainly at margins of forest stands, on clearings reforested by target forest tree species, along cleared boundary lines, power transmission lines and forest roads. The mean annual temperature amounts to 7.7 °C (April–September 14.1 °C), mean annual precipitation 620 mm (April–September 388 mm) and the growing season takes 160 days.

Field inspections were carried out there usually in week intervals throughout the growing season. In the course of field trips, galls were sampled from selected stands for the purpose of subsequent laboratory examinations. In 2007, 19 samplings at 50 galls were carried out; in 2008, it was 22 samplings at 25 galls and (last) sampling at 14 galls. In each of the galls, the leaf size was first measured (ie length, width and area of the leaf blade), in a gall on a shoot then its diameter. Further, dimensions (length, width and height) of particular (or combined) galls were determined. Lengths were measured along the leaf petiole, in galls on shoots along the shoot longitudinal axis. The width of galls was measured in an area parallel to the leaf blade (and perpendicular to the leaf petiole), in galls on shoots in an area perpendicular to the longitudinal axis of a shoot (and perpendicular to the entrance corridor into the gall). The height of galls was measured in an area perpendicular to the leaf blade, in galls on shoots in an area perpendicular to the shoot axis (parallel to the entrance corridor). The number and localization of entrance craters was recorded and the length and width of craters (at the gall perimeter) and the length and width of the gall opening was determined by micrometry.

By means of a razor-blade or scalpel, every gall was gradually and carefully cut up in thin slices under a microscope. The objective of these analyses was to determine the number, size and the inner content of chambers. Attention was paid to the increasing degree and health condition of larvae of the gall midge and to the occurrence and development of insect parasitoids. Galls served for the development of imagoes of parasitoids, which were sent for determination to Dr. P. Janšta (Charles University, Prague). Through the systematic investigation, following findings were obtained on the occurrence, bionomics, cecidogenesis and importance of *C. petioli*.

RESULTS AND DISCUSSION

The occurrence of imagoes and egg laying

Larvae of *C. petioli* overwinter in soil where they also pupate next year in April. At research localities in the region of Brno, imagoes occurred in the open at the end of April and at the beginning of May. Their flying up from winter pupal chambers took only several few days. In the period of swarming, most of shrubs of aspen burst intensively into leaf. After mating, females search for shrubs occurring in the suitable degree of budding to lay eggs. They place their eggs on partly unfolded leaves, sporadically on young bark of terminal parts of shoots. They lay 1 to 5 (10) eggs on one place. On the same leaf, usually (in 89%) only one partial clutch is placed, rarely (in 10.1%) two clutches and sporadically (in 0.8%) three to four clutches (Fig. 2).

According to SKUHRAVÝ and SKUHRAVÁ (1998), imagoes fly early in the spring and lay eggs on leaf petioles of aspen or on apexes of young developing shoots. PERSSON (2002) found six gall-forming species of gall midges (including *C. petioli*) on *P. tremula* in north-eastern Sweden. The author considers that all these species are well adapted to the fragmented natural environment, namely because they have the ability of active and passive dispersion. Their fly and oviposition are markedly affected by wind (WITHERS and HARRIS, 1997). It is known that *P. tremula* grows on various places in the landscape in stands of the various degree of spatial isolation. Nevertheless, it appears that the occurrence frequency is not dependent on the distance from closed stands and in *Harmandiola globuli* (Rübs.), the frequency even increases with the isolation of stands (PERSSON, 2002). The fly and reproduction of imagoes are heavily affected by climatic/meteorological factors. Depending on these factors, the period of fly and oviposition can be different.

The creation of galls and the development of larvae

Soon after oviposition, larvae hatch from eggs of *C. petioli*. The larvae settle most often (in 91%) on petioles of young rapidly developing leaves. The smaller part of larvae (8.1%) settles on the bark of shoots and sporadic larvae (0.9%) settle nearby veins in the proximal up to central part of the leaf blade (Fig. 3). Thus, larvae begin to ingest food on a suitable place. In the course of sucking, they chemically irritate young undifferentiated plant tissues by secretes of their salivary glands. Through a transverse slot opening (mean dimensions 0.5 × 0.15 mm) they penetrate into the tissues. On petioles, the majority (about 81%) of entrance slits occurs on the lateral face. From the adaxial face, about 14% larvae enter the leaf petiole and from the abaxial face 5% larvae (Fig. 4). Most often (in 39%), only one larva penetrates into tissues. In the majority (in 61%) of partial clutches, 2 to 5(10) eggs occur (Fig. 5). Larvae hatched from these clutches generally use one and the same hole for entrance into tissues whereby the size of the entrance corridor increases. After the penetration of larvae into tissues the slot closes. Because of growth substances contained in the secret of sucking larvae cells of young meristems are stimulated to the fast growth and division. Through the growth of tissues galls are created fast.

Under natural conditions in Forest District Bílovice nad Svitavou, cecidogenesis starts at the turn of April and May. Already at the beginning of May, galls are mostly rather marked. At the end of the first week in May, galls reach about 2/3 of their final size and in mid-May, they grow up (Fig. 6). Newly hatched larvae are about 0.17 mm long and 0.07 mm wide, fusiform. In a creating gall, tissues closely circumfuse about young larvae. In mid-May, larvae are on average 0.4 mm long, 0.2 mm wide and 0.15 mm high. Up to this time, the larvae are of the same size as the space inhabited by them. Only from mid-May, an oval chamber begins to create around vital larvae. In galls with more chambers always one larva develops in each of the chambers.

At the end of May and at the beginning of June, larvae of *C. petioli* grow up in galls. Grown up larvae are 2.3 to 3.4 (on average 2.8) mm long, 0.8 to 1.1 (on average 1.0) mm wide and 0.6 to 0.9 (on average 0.7) mm high. According to POSTNER (1982) and SKUHRAVÝ and SKUHRAVÁ (1998), larvae are 3 to 4 mm long. Young larvae are colourless to faint-yellowish, older larvae are yellow to yellow-orange. In the period of growing-up the larvae (ie at the turn of May and June), chambers with vital larvae are on average 1.7 mm long and 1.3 mm wide. From this time, the size of chambers does not change.

The period of cecidogenesis of *C. petioli* is very short (on average only two weeks). The period of the development of larvae in galls is, however, substantially longer (on average four to five weeks). Also SKUHRAVÝ et al. (1997) mention the fast development of galls and much slower development of larvae. The authors even assume that this phenomenon is of more general value in gall midges. During their development larvae undergo three instars. Roughly in ¾, the growth of galls is induced by larvae of the first instar and only in ¼ by larvae of the second instar. Larvae of the third instar begin occur in galls from 20 May, ie in a period when galls are already entirely grown up. Therefore, larvae of the third instar do not participate in the growth of galls.

Abandoning the galls

In the course of May, primarily imperceptible entrance slits gradually increase in an oval crateriform formation. The crater margins often conically arise above the gall surface. At the end of the period of development of larvae in galls, tissues in the surroundings of the hole begin often to die and grow black (Fig. 7). Galls open spontaneously by means of a minute slit shaped to oval opening. Through this opening, larvae abandon galls and fall to the soil surface. In a suitable place, larvae hide in soil where they also winter.

Larvae of *C. petioli* develop optimally on *P. tremula*, namely in spring in the period of its leaf unfolding and fast growth. Within a year, only one generation of *C. petioli* develops. At studied localities, vital larvae were found in galls from 1 May until mid-June, quite sporadically also later (eg 7 and 28 August 2008). Nevertheless, a further explanation is missing for this anomalous occurrence of growing up larvae of this third instar (size 1.8 × 1.0 × 0.5 mm and 2.0 × 1.1 × 0.6 mm). In 2007, a large majority of larvae abandoned galls from 30 May to 9 June and the whole development of larvae took on average 34 days. In 2008, larvae abandoned galls from 2 to 12 June and the whole development of larvae took on average 37 days. Thus, it is possible to state that in the region of Brno, larvae in galls develop on average 5 weeks.

There are only very few data in available literature on the period of the *C. petioli* occurrence in galls. According to BUHR (1965), larvae occur in galls from May to June (or until July). SKUHRAVÁ and SKUHRAVÝ (1960) and SKUHRAVÝ and SKUHRAVÁ (1998) inform that larvae are fully developed already at the beginning of June when they begin to abandon galls. This statement is consistent with our findings obtained at Forest District Bílovice nad Svitavou.

Size and physiognomic differentiation of galls

C. petioli creates galls on petioles (sporadically on leaf blades) or on apical parts of shoots (Figs. 8 and 9). Galls are 2 to 11 (on average 6) mm long, 1 to 10 (on average 5.4) mm wide and 1.1 to 8 (on average 5.1) mm high (Tabs. I and II). As many as four galls can occur on one petiole. If galls are localized within a short distance of each other then they often merge creating large formations of irregular shape up to 17 × 11 × 9 mm in size (Fig. 2). Merged galls on petioles are almost always longer and sometimes also wider and higher than separate galls. Galls localized separately on petioles are on average always larger than individual galls in merged gall formations (Fig. 10). The number and size of particular galls creating these aggregate gall formations can be sometimes determined only with difficulties, namely after the careful microscopic analysis of entrance openings and related chambers. Mean number of galls on leaf petioles increases with the increasing area of the leaf blade (Fig. 11).

Smaller galls of *C. petioli* (ie galls with one or two inner chambers) are often localized only at one side of the leaf petiole. Such galls are roughly of coffee-bean shape and galls on shoots are of hemisphere shape. Larger individual galls (ie galls with three to ten chambers) are usually of oval shape enclosing the leaf petiole or shoot from all sides.

A short corridor enabling a young larva to penetrate into plant tissues closes soon. Therefore, larvae develop in gradually creating closed chambers. In galls with more chambers, corridors from individual chambers merge into one somewhat wider entrance corridor leading in a conical (crateriform) formation. Walls of entrance corridors open as late as in the period of growing up the larvae. The original slit entrance 0.5 × 0.15 mm in size increases up to on average 2.0 × 1.8 mm at the gall circumference during May until the first half of June. Galls occupied by insect parasitoids open on the outside mostly later or not at all. Craters of these galls are on average much smaller (about 1.7 × 1.5 mm). Galls with naturally

died larvae show craters of about 1.4 × 1.3 mm in size on their surface. These galls often do not open at all on the outside. Craters are on average 1.7 mm long and 1.5 mm wide (Tab. III). With the increasing number of chambers in galls their dimensions significantly increase (Tab. IV).

Galls with the undisturbed development of *C. petioli* open by means of an oval opening on average 0.7 mm long and 0.6 mm wide. Mean dimensions of the actual opening in parasitized galls are 0.6 × 0.4 mm, ie also three times smaller than dimensions of the whole crater. If openings are created in galls with naturally died *C. petioli*, then they are on average always smallest (about 0.4 × 0.3 mm) (Tab. V). The mean length and width of the actual entrance (= exit) hole in galls with the undisturbed development of larvae of *C. petioli* considerably increases with the increasing number of chambers in galls (Fig. 12). The mean size of a crater and the actual hole in galls slightly increases with the increasing leaf blade area (Tab. VI).

At the very beginning of cecidogenesis, galls are green. However, already from 5 May, semi-grown up galls begin colour to red on the insolated (ie adaxial) face of leaves in the Brno region. Red colouring occurs about in 50% galls, other galls remain green or yellow-green. After one week from abandonment (about from 17 June), galls begin to die. Browning and blackening the tissues begins usually around the entrance (or exit) hole (Fig. 13). During the second half of June to October, the percentage of the darkened gall surface increases. For example, in September and October 2007, blackening affected 55 to 59% of the gall surface (Tab. VII). Galls abandoned by larvae of *C. petioli* blackened most (65 to 76%) and galls with naturally died *C. petioli* blackened least (41 to 42%). With the increasing number of chambers in galls (ie with the increasing size of galls) the dieback of galls in principle accelerates (Fig. 14).

Galls of *C. petioli* on leaf petioles are characterized, for example by DARBOUX and HOUARD (1901), as oval up to 5 mm large swellings with one or more chambers. The swellings are more or less hairy and reddening with a lateral conical outgrowth. In the period of maturity, they open by means of an oval hole. Galls on young shoots are described as unilateral oval swellings with a lateral conical outgrowth. Similar information provide GUSEV and RIMSKIJ-KORSAKOV (1953) who mention that on *P. alba* (unlike *P. tremula*), galls are hairy. Many authors (eg PFEFFER et al., 1954; MAMAEV, 1969; SIMOVA-TOŠIČ and VUKOVIČ, 1999; LAMBINON, SCHNEIDER and FEITZ, 2001 etc.) mention pleurocecidiae of *C. petioli* only on leaf petioles where the gall midge occurs most often.

The size differentiation of chambers

In galls of *C. petioli*¸ only one chamber (in 39%) occurs and mostly 6 (10) chambers (Fig. 5). In examined galls in 2007, on average 2.3 chambers occurred and in 2008, on average 2.7 chambers (Tabs. I and II). In merged gall formations, 3 to 18 chambers were found. Galls on leaves (mainly on petioles, sporadically on leaf blades) were 11.3 times more numerous than galls on shoots (Fig. 3). The highest number of galls and chambers occurred on petioles with a medium size blade. The mean number of chambers was not, however, in positive even negative correlation with the size of a leaf blade. In galls on shoots of a diameter of 1.5 to 6 (on average 2.5) mm, on average 2.4 chambers occurred in 2007. In 2008; it was 3.8 chambers (Tab. VIII). It is necessary to note that information on the size of chambers is not available in literature.

At first, chambers show the shape of imperceptible slit shaped spaces of the size of an egg larva. During the development of larvae, oval chambers are created reaching a mean length of 1.55 mm and width of 1.25 mm already at the end of May. From this time, the size of chambers in principle does not change. The inner cavity of chambers is lined by a thin yellow-green trophic layer created mainly by large thin-walled cells. At the end of the development of larvae (ie at the end of May), the trophic layer begins to die and brown. The trophic layer is surrounded by a thick sclerenchymatic layer creating a fixed protective case around chambers. A parenchymatic layer is far thicker. On its surface, there is a thin protecting (cuticular) layer (Fig. 15). Galls on leaf petioles (or blades) and galls under bark on shoots show similar inner structure.

The development of galls is optimum only when the development of the gall midge larva is intact. If the death of the gall midge takes place the gall ceases soon to grow. Thus, mortality factors significantly affect not only the size and physiognomy of galls but also their inner structure. Therefore, chambers in galls with the intact development of *C. petioli* are on average always larger than chambers in galls with disturbed development (Tabs. IX to XII and Fig. 16). Tab. IX shows that the mean length and width of chambers markedly increases with the increasing number of chambers while in galls with the intact development of *C. petioli* the mean length and width of chambers dies not substantially change. The largest mean size (1.65 × 1.3 mm) is shown by chambers, which were abandoned by larvae of *C. petioli* (or chambers with a living grown up *C. petioli*). Chambers occupied by insect parasitoids are smaller (about 1.55 × 1.2 mm). Chambers with naturally died larvae of *C. petioli* are far smallest (about 1.3 × 1 mm). The mean size of chambers does not change from the end of May until October (Tabs. X and XI). With the increase in the leaf blade area, however, the mean length and width of chambers always increases (Tab. XII, Fig. 17). Thus, due to the growth process of host plants, also the size of chambers is significantly affected.

Control factors

C. petioli is a very abundant representative of the CR fauna. Its population density fluctuates considerably in the course of years (SKUHRAVÁ, pers. comm., 2008). The abundance of *C. petioli* is particu-

larly affected by climatic-meteorological factors and predators during wintering the larvae and spring reproduction. Considerable part of larvae is frequently subject to insect parasitoids from the Chalcidoidea superfamily. According to FULMEK (1968), *Torymus giraudianus* Hffm. and *T. quercinus* Boh. (Torymidae) were reared from galls. An inquiline gall midge *Camptoneuromyia petioli* H. Mamaeva (SKUHRAVÝ and SKUHRAVÁ, 1998) develops in galls. Endogenous factors and defence and occlusion activities of plant tissues significantly participate in the reduction of abundance of the *C. petioli* in galls.

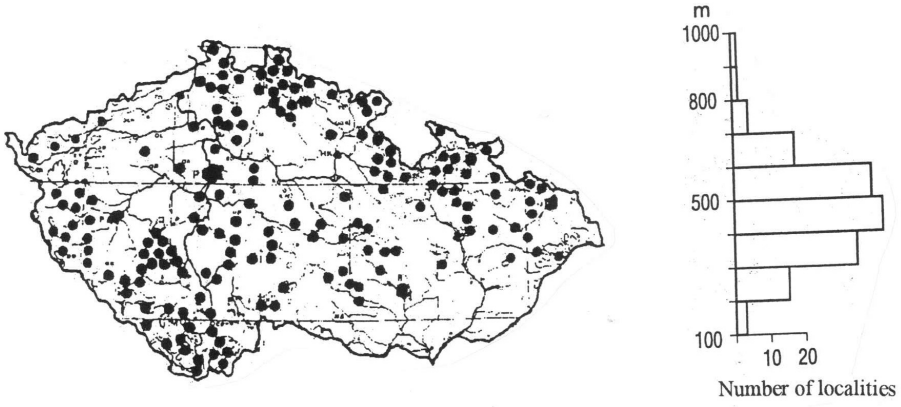
At studied localities, *C. petioli* was more abundant in 2007 than in 2008. In 2007, on average 34.6% larvae abandoned galls. On average 32.9% larvae were parasitized and 26.0% larvae died due to endogenous reasons or owing to defence or occlusion activities of plant tissues. Insect predators, birds and unknown factors participated minimally in mortality (Tab. XIII, Figs. 18 and 19). In 2008, 76.8% larvae successfully concluded their development, 10.5% larvae were parasitized and 12.3% died due to endogenous reasons (Tab. XIV). In both years, the proportion of chambers abandoned by the gall midge considerably increased with the increase of the number of chambers in galls and the proportion of chambers with the disrupted development of *C. petioli* decreased. Thus, the development came about best in the largest galls (Tab. XV). Evidently, the largest percentage of abandoned chambers occurred in galls on the largest leaves (Tab. XVI).

Eggs of insect parasitoids were found in galls from 9 May to 1 June and living larvae from 25 May to 18 October. Pupae were found from mid-June to the beginning of August and living imagoes (before their fly from galls) from 21 June to 2 August. The development of parasitoids from egg laying to flying out the imagoes took at least five weeks. In 2007, on average 38.8% larvae pupated. Imagoes hatched from the majority of pupae even in the same year. On average 29.6% larvae in galls wintered and 31.9% larvae died (Tab. XVII). In 2008, about 21% larvae pupated (and metamorphosed into imagoes). About 44% larvae wintered in galls and about 35% larvae died (Tab. XVIII). *Torymus quercinus* Boheman, 1834 (Torymidae) was a dominant parasitoid. *T. cultrans* Graham and Gijswijt, 1998 (Torymidae), *Tetrastichus* sp. (Eulophidae) and *Eupelmus* sp. (Eupelmidae) were reared from galls.

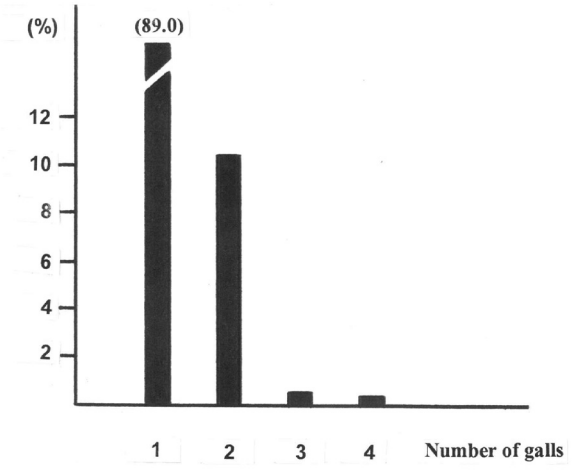
Damage and importance

C. petioli is common part of the cecidogenic species community of insect on *P. tremula*. It occurs mainly at well insolated open localities, rarely inside forest stands. Therefore, it often attacks advance growth and young-growth stands of aspen on a large scale in temporary communities (ecotones) and on clear-felled areas. Galls are created mainly on petioles of leaves, rarely on shoots and sporadically on leaf blades. Galls on petioles substantially reduce the growth of leaves and petioles. Under intensive attack, the leaf blade area is sometimes reduced up to less than 5 cm^2. Dwarfed laves often prematurely die and together with galls fall to the soil surface. Galls under bark on apical parts of young shoots can be even more harmful. These galls occur usually on the same trees together with leaf galls. Trees particularly suffer from combined mass damage to leaves and shoots. Stunted growth or partial drying ends of shoots with numerous galls was noted in Forest District Bílovice nad Svitavou in stand 372 E_{12} on natural advance growth of *P. tremula* of about 50 cm in height.

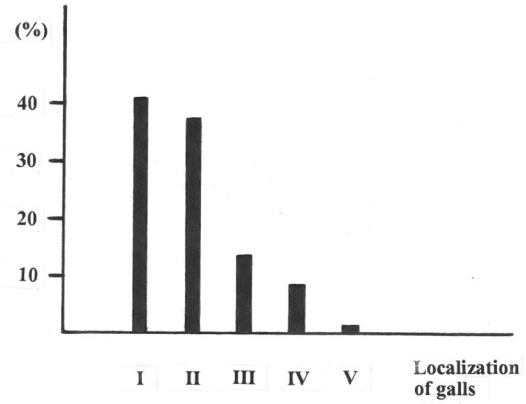
On the basis of the four-degree scale of damage (SKUHRAVÝ and SKUHRAVÁ, 1996), *C. petioli* can be ranked among slightly harmful species. Therefore, it not usually necessary to plan any control measures for the pest.



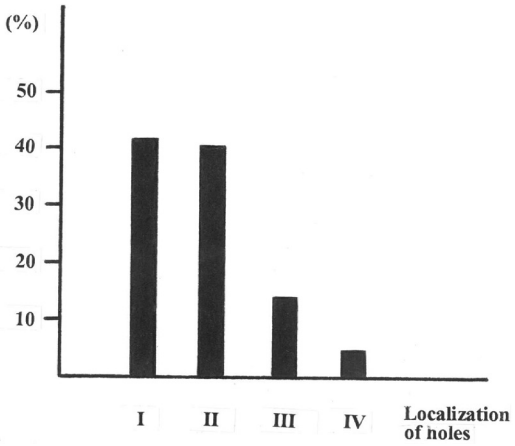
1: *The occurrence of galls of Contarinia petioli (Kieffer) on P. tremula in the Czech Republic (SKUHRAVÝ and SKUHRAVÁ, 1998)*



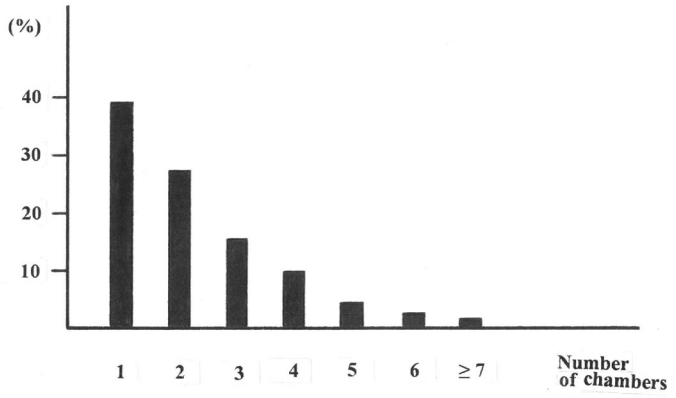
2: *Frequency of the occurrence of galls of C. petioli on leaf petioles (2007)*



3: *Localization of galls of C. petioli. I – galls on the leaf petiole (at the leaf blade), II – galls on the leaf petiole (in the central third), III – galls on the leaf petiole (at a shoot), IV – galls on shoots, V – galls on the leaf blade (2007, 2008)*



4: *Localization of holes in galls of C. petioli on leaf petioles. I – right side of galls, II – left side of galls, III – adaxial face of galls, IV – abaxial face of galls (2007)*



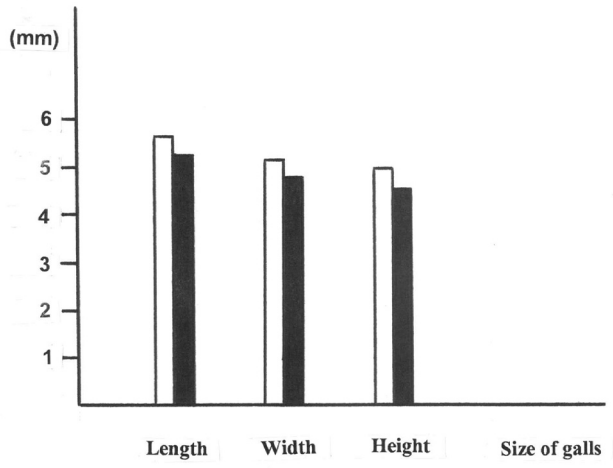
5: *Frequency of the occurrence of galls of C. petioli (according to the number of chambers in galls) (2007, 2008)*

6: *Growing up galls of C. petioli on leaf petioles (13/5/2007)*

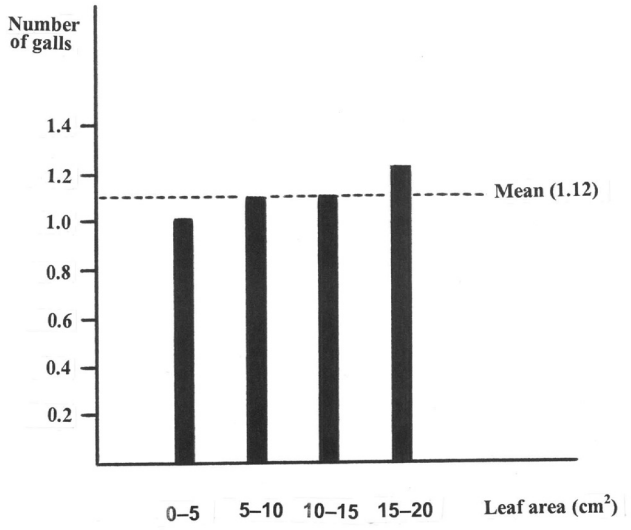
7: *Grown up galls of C. petioli on leaf petioles (left – three merged galls, right – two galls markedly divided from each other) (30/5/2007)*

8: *Side view of a gall of C. petioli localized on the leaf petiole (left). Two merged galls of a total length of 9 mm, width 7 mm and height 7 mm (right) (21/6/2007)*

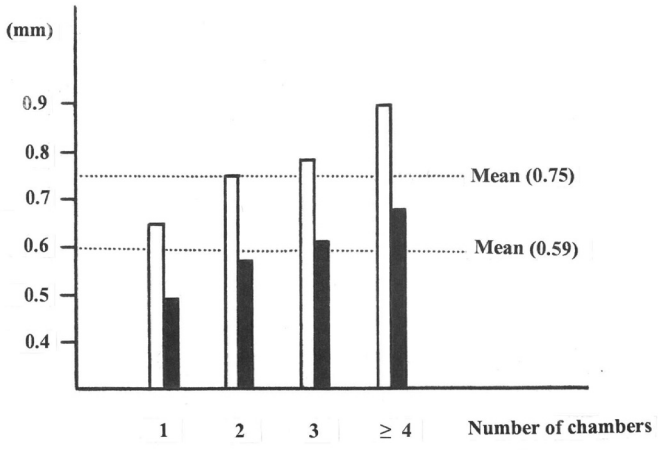
9: *The gall of C. petioli (size 10 × 8 × 8 mm) on the shoot. There were five chambers inside the gall (two of them abandoned by larvae of C. petioli and three with an insect parasitoid) (21/6/2007)*



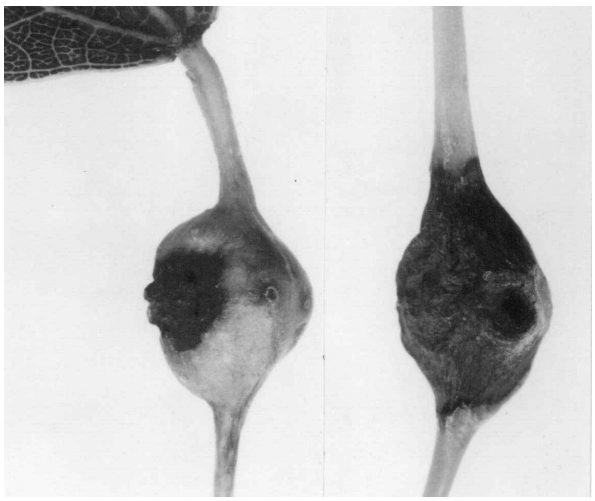
10: *Mean dimensions of galls of C. petioli localized on leaf petioles individually (light columns) and group-wise at two to four galls (dark columns) (2007)*



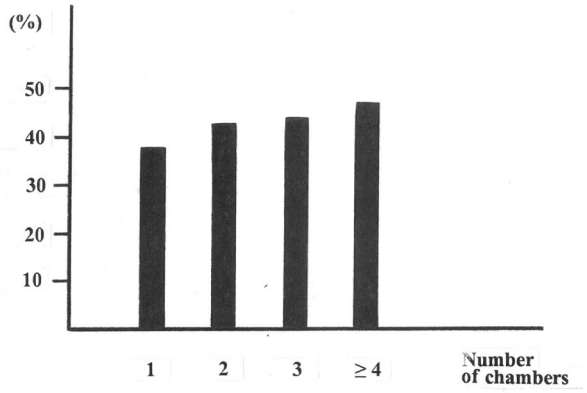
11: *Mean number of galls of C. petioli on leaf petioles (according to the leaf blade area) (25/5 to 18/10/2007)*



12: *The length (light columns) and width (dark columns) of an actual abandoned hole in galls of C. petioli with intact development (according to the number of chambers in galls). June to October 2007, 2008*

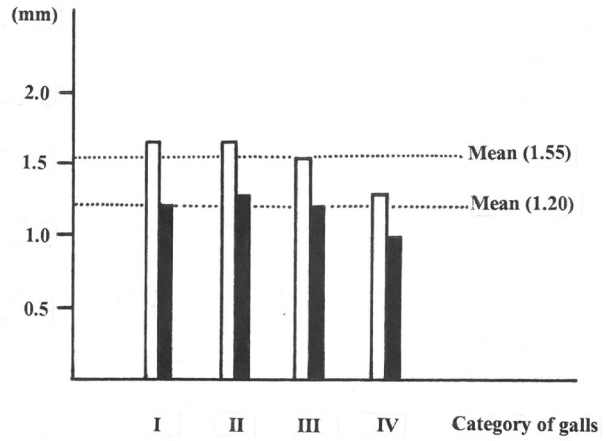


13: *Blackening the galls of C. petioli on leaf petioles (21/6/2006)*

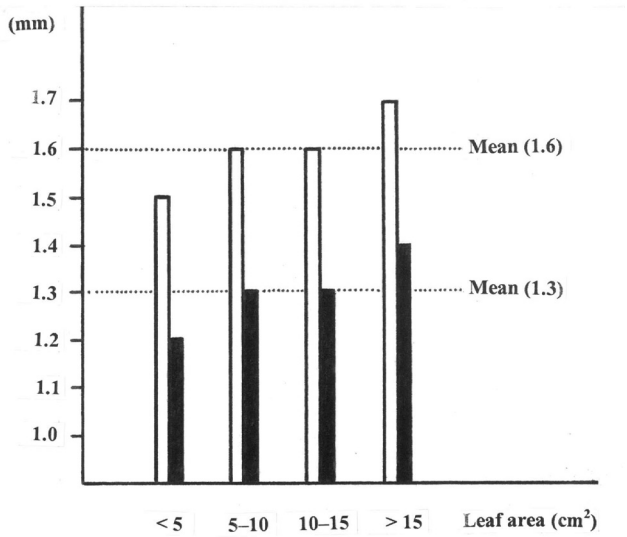


14: *The percentage of darkened (blackened) surface of galls of C. petioli (depending on the number of chambers in galls). June to October, 2007, 2008*

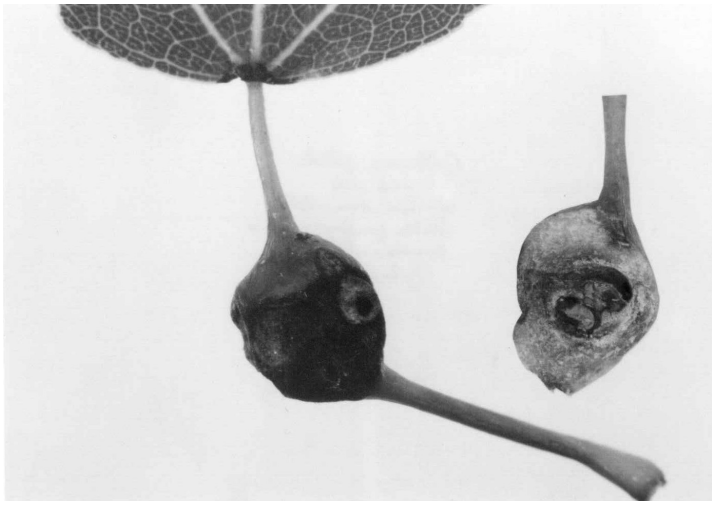
15: *A cross section through the gall of C. petioli localized at the end of a shoot (21/6/2007)*



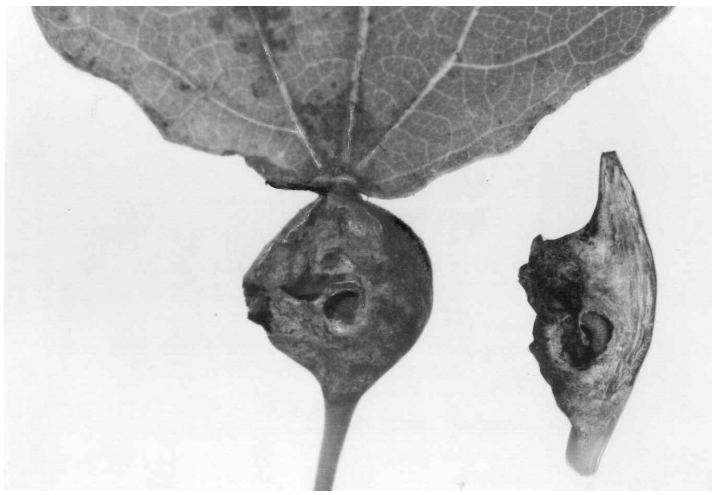
16: *The mean length (light columns) and width (dark columns) of chambers in galls of C. petioli. I – galls with living C. petioli, II – galls abandoned by C. petioli, III – galls with a parasitoid, IV – galls with naturally died C. petioli (2007, 2008)*



17: *The mean length of chambers (light columns) and width of chambers (dark columns) in galls of C. petioli on leaves (according to the area of leaves) (2008)*



18: *Galls of C. petioli on leaf petioles. Left – a gall surface-damaged by the butterfly caterpillar. Right – a cross section through a gall with a dead larva of the 3rd instar of C. petioli (21/6/2007)*



19: *Galls of C. petioli on leaf petioles. Left – a gall pecked out by a bird. Right – a cross section through a gall with the larva of a parasitoid (13/8/2007)*

I: *The number and mean size of galls of C. petioli on P. tremula at particular inspections. The number and mean dimensions of crateriform entrance holes (exit holes) and chambers in galls. In total, 950 galls were analysed (984 unmerged galls). Laboratory examination, 2007.*

Date	Number of galls on a petiole/ shoot/leaf blade	Mean length /width of the leaf blade (cm)	Mean length/ width/ height of galls (mm)	Entrance (exit) holes		Chambers	
				mean number	mean length/ width (mm)	mean number	mean length/ width (mm)
19. 5.	45/2/3	3.1/3.1	7.5/6.0/5.5	1.6	1.0/0.6	5.1	?
25. 5.	49/1/0	3.3/3.1	7.5/6.1/5.8	1.5	1.3/1.2	5.2	1.6/1.0
1. 6.	50/0/0	3.4/3.1	6.6/6.0/5.4	1.4	1.4/1.1	3.4	1.7/1.2
7. 6.	50/0/0	3.4/3.2	5.7/5.5/5.1	1.2	1.6/1.4	2.7	1.5/1.1
14. 6.	50/0/0	3.5/3.2	6.1/5.5/5.1	1.3	1.6/1.3	3.1	1.5/1.1
21. 6.	47/3/0	3.8/3.5	6.7/5.7/5.4	1.3	1.8/1.5	2.6	1.6/1.2
28. 6.	43/7/0	3.7/3.4	5.9/5.2/4.9	1.2	1.7/1.5	2.1	1.6/1.2
5. 7.	49/1/0	3.9/3.5	5.4/5.0/4.7	1.2	1.7/1.6	2.0	1.5/1.1
12. 7.	47/3/0	3.7/3.3	5.4/4.9/4.8	1.2	1.8/1.6	2.0	1.6/1.2
19. 7.	47/3/0	4.1/3.6	5.4/5.2/5.0	1.1	1.9/1.7	1.9	1.6/1.2
26. 7.	47/1/2	4.2/4.0	5.3/4.7/4.5	1.2	1.7/1.5	1.6	1.5/1.2
2. 8.	44/4/2	4.5/4.2	5.5/4.9/4.7	1.1	1.8/1.6	1.8	1.4/1.1
9. 8.	36/14/0	4.3/3.9	6.6/5.5/5.2	1.2	1.8/1.6	2.3	1.6/1.2
16. 8.	40/10/0	4.2/3.8	5.4/4.7/4.4	1.1	2.0/1.7	1.7	1.5/1.1
23. 8.	45/5/0	3.8/3.6	5.6/4.8/4.7	1.1	1.5/1.3	2.1	1.5/1.1
6. 9.	39/11/0	4.1/3.7	5.8/4.8/4.6	1.1	1.7/1.5	1.8	1.5/1.2
20. 9.	44/6/0	4.5/3.9	5.2/4.6/4.4	1.1	1.6/1.4	1.7	1.4/1.1
4. 10.	42/8/0	4.2/3.5	5.7/5.0/4.7	1.1	1.7/1.6	2.0	1.5/1.1
18. 10.	47/3/0	4.2/3.6	5.6/4.7/4.4	1.1	1.7/1.5	1.5	1.4/1.1
Total	861/82/7	3.9/3.5	5.9/5.2/4.9	1.2	1.6/1.4	2.4	1.5/1.1
Total (individual galls)	892/85/7	-	5.7/5.0/4.7	1.1	-	2.3	-
Total (from 14/6 to 18/10)	-	-	-	-	1.7/1.5	-	1.5/1.1

II: *The number and mean size of galls of C. petioli on P. tremula at particular inspections. The number and mean dimensions of crateriform entrance holes (exit holes) and chambers in galls. In total, 564 galls (601 unmerged galls) were analysed. Laboratory examination, 2008.*

Date	Number of galls on a petiole/ shoot/leaf blade	Mean length /width of the leaf blade (cm)	Mean length/ width/ height of galls (mm)	Entrance (exit) holes		Chambers	
				mean number	mean length/ width (mm)	mean number	mean length/ width (mm)
9. 5.	24/0/1	4.3/3.9	5.1/3.6/3.7	1.4	0.5/0.2	4.4	0.3/0.1
16. 5.	23/2/0	4.9/4.3	6.0/5.4/4.8	1.2	0.7/0.4	3.2	0.4/0.2
25. 5.	24/1/0	4.1/3.9	7.4/6.8/6.3	1.3	1.1/0.8	3.4	1.0/0.5
31. 5.	25/0/0	3.9/3.7	7.6/6.7/6.5	1.4	1.8/1.1	4.6	1.6/1.1
6. 6.	25/0/0	4.5/4.7	6.5/6.2/5.9	1.1	2.3/1.4	3.0	1.6/1.2
12. 6.	22/2/1	4.7/4.6	8.0/7.3//6.9	1.3	2.8/1.9	4.5	1.7/1.3
19. 6.	25/0/0	4.7/4.6	6.7/6.1/5.9	1.2	1.8/1.4	2.6	1.6/1.3
26. 6.	21/4/0	4.4/3.8	7.5/7.0/6.4	1.1	1.6/1.3	3.2	1.7/1.3
3. 7.	25/0/0	5.1/4.5	6.2/6.0/5.6	1.2	2.0/1.5	2.7	1.6/1.3
10. 7.	24/0/1	4.8/4.7	7.4/6.3/6.3	1.1	2.0/1.5	3.1	1.6/1.3
17. 7.	23/2/0	4.2/4.1	6.5/5.9/5.7	1.0	2.0/1.5	2.2	1.5/1.2
24. 7.	21/3/1	4.6/4.2	6.0/5.8/5.4	1.0	1.8/1.4	2.5	1.6/1.3
31. 7.	22/3/0	4.1/3.6	6.0/5.7/5.2	1.0	1.6/1.3	2.2	1.7/1.5
7. 8.	21/4/0	4.2/4.2	6.5/5.9/5.9	1.0	2.0/1.7	2.5	1.7/1.4
14. 8.	23/2/0	4.1/4.0	7.4/6.6/6.2	1.4	2.3/1.8	3.8	1.7/1.4
21. 8.	24/1/0	4.4/4.4	7.3/6.4/6.2	1.2	2.1/1.8	3.2	1.7/1.4

Date	Number of galls on a petiole/ shoot/leaf blade	Mean length /width of the leaf blade (cm)	Mean length/ width/ height of galls (mm)	Entrance (exit) holes		Chambers	
				mean number	mean length/ width (mm)	mean number	mean length/ width (mm)
28. 8.	18/7/0	4.8/4.5	7.1/6.2/5.9	1.1	2.0/1.7	3.2	1.7/1.4
4. 9.	23/0/2	4.6/4.4	6.3/5.2/5.2	1.2	1.8/1.5	2.4	1.6/1.4
11. 9.	20/5/0	5.0/4.7	6.3/5.9/5.6	1.1	1.9/1.7	2.0	1.6/1.4
18. 9.	24/1/0	3.9/3.6	6.0/5.3/5.2	1.0	1.7/1.4	2.3	1.6/1.4
25. 9.	14/11/0	4.6/4.0	6.7/6.2/6.0	1.0	2.2/1.8	3.1	1.6/1.4
2. 10.	23/1/1	5.2/4.8	6.7/6.0/5.5	1.0	1.9/1.6	2.4	1.6/1.3
9. 10.	14/0/0	4.0/3.6	5.9/5.7/5.3	1.0	1.9/1.7	1.9	1.7/1.5
Total	508/49/7	4.5/4.2	6.7/6.0/5.7	1.1	1.8/1.4	3.0	1.5/1.2
Total (individual galls)	545/49/7	-	6.2/5.8/5.5	1.0	-	2.7	-
Total (from 12/6 to 9/10)	-	-	-	-	2.0/1.6	-	1.6/1.4

III: *Mean dimensions of a crater around an actual hole in galls of C. petioli (depending on the health condition of C. petioli and the time of sampling the galls). 25 May to 18 October 2007.*

Month	Mean length/width of a crater around a hole in galls (mm)				
	abandoned by *C. petioli*	with a parasitoid	with a naturally died *C. petioli*	with living *C. petioli*	total
May	-	1.3/1.1	-	1.3/1.2	1.3/1.2
June	1.9/1.6	1.5/1.3	1.5/1.3	1.6/1.3	1.6/1.4
July	2.0/1.8	1.8/1.6	1.5/1.4	2.5/2.0	1.8/1.6
August	2.1/1.8	1.9/1.6	1.3/1.2	-	1.8/1.6
September	2.0/1.8	1.5/1.4	1.3/1.2	-	1.7/1.5
October	1.9/1.8	1.8/1.6	1.4/1.3	-	1.7/1.6
Total	2.0/1.8	1.7/1.5	1.4/1.3	1.4/1.2	1.7/1.5

IV: *Mean length/width of a wall around a crateriform formation in galls of C. petioli (according to the number of chambers in galls) (mm).*

Number of chambers	Galls with the intact development of *C. petioli*		Galls total	
	2007	2008	2007	2008
1	1.67/1.51	1.48/1.25	1.49/1.34	1.40/1.19
2	1.96/1.73	1.98/1.46	1.87/1.62	1.93/1.46
3	2.06/1.81	2.16/1.59	1.94/1.68	2.12/1.57
≥ 4	2.26/1.93	2.62/2.03	2.20/1.87	2.59/2.03
Total	1.97/1.73	2.08/1.61	1.71/1.50	1.93/1.52

V: *Mean dimensions of an actual entrance (or exit) hole in galls of C. petioli (depending on the health condition of C. petioli and the time of sampling the galls). 25 May to 18 October 2007.*

Month	Mean length/width of an actual hole in galls (mm)				
	abandoned by *C. petioli*	with a parasitoid	with naturally died *C. petioli*	with living *C. petioli*	total
May	-	-	-	-	-
June	0.8/0.6	0.5/0.4	0.5/0.4	0.6/0.5	0.7/0.5
July	0.7/0.6	0.6/0.4	0.4/0.3	0.6/0.4	0.6/0.5
August	0.7/0.5	0.6/0.4	0.4/0.3	-	0.6/0.4
September	0.7/0.5	0.5/0.4	0.3/0.2	-	0.5/0.4
October	0.7/0.5	0.6/0.5	0.3/0.3	-	0.6/0.4
Total	0.7/0.6	0.6/0.4	0.4/0.3	0.6/0.5	0.6/0.5

VI: *Mean dimensions of a crater and actual entrance (or exit) hole in galls of C. petioli (depending on the leaf blade area) (2007).*

Area of leaves (cm^2)	Mean length/width	
	crater around the hole (mm)	actual hole (mm)
< 5	1.5/1.3	0.5/0.4
5–10	1.6/1.4	0.6/0.4
10–15	1.7/1.5	0.6/0.5
> 15	1.7/1.5	0.6/0.5
Total	1,6/1,4	0,6/0,5

VII: *The course of blackening the galls (depending on the health condition of C. petioli and the time of sampling the galls) (2007).*

Month	% black surface of galls				
	abandoned by *C. petioli*	with a parasitoid	with naturally died *C. petioli*	with living *C. petioli*	total
May	-	0.0	-	0	0.0
June	7.3	16.0	42.0	0	19.2
July	42.1	43.2	28.5	0	38.9
August	43.7	42.5	27.8	-	38.9
September	76.1	59.4	41.2	-	58.9
October	64.6	53.1	42.4	-	54.5
Total	43.5	42.3	34.7	0	40.6

VIII: *Frequency of the occurrence of galls and chambers in galls of C. petioli on shoots (according to the shoot diameter). 2007 (numerator), 2008 (denominator).*

Shoot diameter (mm)	Number of galls	%	Mean number of chambers
1.5	10/7	14.3/14.3	1.7/2.6
2.0	31/9	44.3/18.4	2.2/4.3
2.5	13/10	18.6/20.4	3.2/4.8
3.0	6/10	8.6/20.4	3.0/4.1
3.5	4/5	5.7/10.2	2.3/4.1
4.0	5/3	7.1/6.1	2.6/3.6
4.5	0/1	0/2.0	0/3.0
5.0	1/2	1.4/4.1	1.0/2.5
5.5	0/1	0/2.1	0/1.0
6.0	0/1	0/2.0	0/1.0
Total	70/49	100.0/100.0	2.4/3.8

IX: *Mean dimensions of chambers in galls of C. petioli (according to the number of chambers in galls) (mm). Galls with one entrance hole were included into the monitoring.*

Number of chambers	Length/width of chambers (mm)			
	Galls with the intact development of *C. petioli*		Galls total	
	2007	2008	2007	2008
1	1.61/1.26	1.66/1.40	1.43/1.06	1.49/1.24
2	1.63/1.25	1.70/1.39	1.51/1.15	1.63/1.32
3	1.63/1.20	1.66/1.33	1.55/1.15	1.63/1.31
4	1.67/1.27	1.69/1.39	1.63/1.23	1.64/1.35
≥ 5	1.65/1.22	1.70/1.34	1.63/1.22	1.70/1.38
Total	1.64/1.24	1.69/1.36	1.53/1.15	1.63/1.33

X: *Mean dimensions of chambers in galls of C. petioli (depending on the health condition of C. petioli and the time of sampling the galls). 25 May to 18 October 2007.*

Month	Mean length/width of chambers (mm)				
	abandoned by *C. petioli*	with a parasitoid	with naturally died *C. petioli*	with living *C. petioli*	total
May	-	1.7/1.2	1.4/0.8	1.7/1.1	1.7/1.1
June	1.6/1.2	1.6/1.1	1.4/1.0	1.7/1.2	1.5/1.1
July	1.6/1.3	1.5/1.2	1.3/1.0	1.7/1.3	1.5/1.2
August	1.6/1.2	1.5/1.2	1.3/1.0	-	1.5/1.1
September	1.6/1.3	1.5/1.2	1.3/0.9	-	1.5/1.1
October	1.6/1.2	1.5/1.2	1.2/0.9	-	1.5/1.1
Total	1.6/1.2	1.5/1.2	1.3/1.0	1.7/1.2	1.6/1.1

XI: *Mean dimensions of chambers in galls of C. petioli (depending on the health condition of C. petioli and the time of sampling the galls). 31 May to 9 October 2008.*

Month	Mean length/width of chambers (mm)				
	abandoned by *C. petioli*	with a parasitoid	with naturally died *C. petioli*	with living *C. petioli*	total
May	-	1.5/1.2	-	1.6/1.1	1.6/1.1
June	1.7/1.3	1.6/1.2	1.3/0.9	1.6/1.2	1.7/1.3
July	1.7/1.4	1.5/1.3	1.3/1.0	-	1.6/1.3
August	1.7/1.4	1.6/1.3	1.4/1.1	1.5/1.2	1.7/1.4
September	1.7/1.4	1.5/1.2	1.3/1.0	-	1.6/1.4
October	1.8/1.5	1.5/1.2	1.2/1.0	-	1.6/1.4
Total	1.7/1.4	1.6/1.2	1.3/1.0	1.6/1.2	1.6/1.3

XII: *Mean dimensions of chambers in galls of C. petioli (depending on the health condition of C. petioli and the leaf blade area) (2007). In the last column, mean dimensions of chambers in 2008 are given.*

Area of leaves (cm^2)	Mean length/width of chambers (mm)					
	abandoned by *C. petioli*	with a parasitoid	with naturally died *C. petioli*	with living *C. petioli*	total (2007)	total (2008)
< 5	1.6/1.2	1.5/1.0	1.3/0.9	1.4/0.9	1.4/1.0	1.5/1.2
5–10	1.6/1.2	1.5/1.2	1.3/0.9	1.8/1.3	1.5/1.1	1.6/1.3
10–15	1.6/1.3	1.6/1.2	1.4/1.0	1.7/1.3	1.5/1.2	1.6/1.3
> 15	1.7/1.3	1.6/1.2	1.3/1.0	1.8/1.5	1.5/1.2	1.7/1.4
Total	1.6/1.2	1.5/1.2	1.3/1.0	1.7/1.2	1.5/1.1	1.6/1.3

XIII: *The health condition of C. petioli in galls at particular inspections. In numerator – number of chambers, denominator – their % proportion. In each of the dates, 50 galls were examined (2007).*

Date	Chambers with the intact development of *C. petioli*		Chambers with the disturbed development of *C. petioli*				Chambers with undefined content	Chambers Total
	with a larva	abandoned	with a parasitoid	with a naturally died larva	eat out by insect	pecked out by birds		
19. 5.	255/100.0	-	-	-	-	-	-	255/100.0
25. 5.	217/83.1	-	20/7.7	18/6.9	6/2.3	-	-	261/100.0
1. 6.	50/29.2	22/12.9	53/31.0	46/26.9	-	-	-	171/100.0
7. 6.	9/6.8	53/39.8	32/24.1	39/29.3	-	-	-	133/100.0
14. 6.	4/2.6	62/40.5	38/24.9	49/32.0	-	-	-	153/100.0
21. 6.	-	58/44.2	30/22.9	39/29.8	4/3.1	-	-	131/100.0
28. 6.	-	40/38.5	33/31.7	31/29.8	-	-	-	104/100.0
5. 7.	-	45/45.0	27/27.0	28/28.0	-	-	-	100/100.0
12. 7.	-	45/45.4	27/27.3	27/27.3	-	-	-	99/100.0

Date	Chambers with the intact development of *C. petioli*		Chambers with the disturbed development of *C. petioli*				Chambers with undefined content	Chambers Total
	with a larva	abandoned	with a parasitoid	with a naturally died larva	eat out by insect	pecked out by birds		
19. 7.	1/1.0	56/57.7	21/21.7	19/19.6	-	-	-	97/100.0
26. 7.	-	36/44.4	23/28.4	22/27.2	-	-	-	81/100.0
2. 8.	-	22/25.0	29/33.0	20/22.7	15/17.0	-	2/2.3	88/100.0
9. 8.	-	34/29.8	49/43.0	30/26.3	1/0.9	-	-	114/100.0
16. 8.	-	21/25.3	32/38.6	16/19.3	2/2.4	2/2.4	10/12.0	83/100.0
23. 8.	-	15/14.4	48/46.2	25/24.0	5/4.8	-	11/10.6	104/100.0
6. 9.	-	22/24.5	37/41.1	22/24.4	-	-	9/10.0	90/100.0
20. 9.	-	32/37.2	17/19.8	30/34.9	-	1/1.1	6/7.0	86/100.0
4. 10.	-	45/44.1	31/30.4	23/22.5	1/1.0	-	2/2.0	102/100.0
18. 10.	-	14/18.9	27/36.5	29/39.2	-	-	4/5.4	74/100.0
Total	536/23.1	622/26.7	574/24.7	513/22.0	34/1.5	3/0.1	44/1.9	2 326/100.0
Total (July – October)	1/0.1	387/34.6	368/32.9	291/26.0	24/2.1	3/0.3	44/4.0	1 118/100.0
Total (August – October)	-	205/27.7	270/36.4	195/26.3	24/3.3	3/0.4	44/5.9	741/100.0

XIV: *The health condition of C. petioli in galls at particular inspections. Numerator – number of chambers, denominator – their % proportion. In each of the dates, 25 galls were examined (9/10 only 14 galls) (2008).*

Date	Chambers with the intact development of *C. petioli*		Chambers with the disturbed development of *C. petioli*				Chambers with undefined content	Chambers Total
	with a larva	abandoned	with a parasitoid	with a naturally died larva	eat out by insect	pecked out by birds		
9. 5.	103/94.5	-	2/1.8	4/3.7	-	-	-	109/100.0
16. 5.	73/92.4	-	3/3.8	3/3.8	-	-	-	79/100.0
25. 5.	79/92.9	-	-	6/7.1	-	-	-	85/100.0
31. 5.	111/95.7	-	2/1.7	3/2.6	-	-	-	116/100.0
6. 6.	20/26.3	51/67.1	3/4.0	2/2.6	-	-	-	76/100.0
12. 6.	7/6.3	94/83.9	6/5.4	5/4.4	-	-	-	112/100.0
19. 6.	2/3.1	53/82.8	2/3.1	7/11.0	-	-	-	64/100.0
26. 6.	1/1.3	67/83.7	6/7.5	6/7.5	-	-	-	80/100.0
3. 7.	-	60/89.5	3/4.5	4/6.0	-	-	-	67/100.0
10. 7.	-	59/75.7	10/12.8	9/11.5	-	-	-	78/100.0
17. 7.	-	40/74.0	5/9.3	9/16.7	-	-	-	54/100.0
24. 7.	-	33/52.4	21/33.3	9/14.3	-	-	-	63/100.0
31. 7.	-	47/93.9	5/8.9	4/7.2	-	-	-	56/100.0
7. 8.	1/1.6	51/80.9	3/4.8	7/11.1	-	1/1.6	-	63/100.0
14. 8.	-	75/79.8	8/8.5	10/10.6	1/1.1	-	-	94/100.0
21. 8.	-	71/89.8	1/1.3	7/8.9	-	-	-	79/100.0
28. 8.	1/1.3	61/76.2	11/13.7	7/8.8	-	-	-	80/100.0
4. 9.	-	47/77.0	5/8.2	9/14.8	-	-	-	61/100.0
11. 9.	-	34/69.4	7/14.3	8/16.3	-	-	-	49/100.0
18. 9.	-	40/70.2	6/10.5	11/19.3	-	-	-	57/100.0
25. 9.	-	63/80.8	5/6.4	10/12.8	-	-	-	78/100.0
2. 10.	-	40/65.6	10/16.4	11/18.0	-	-	-	61/100.0
9. 10.	-	21/80.7	1/3.9	4/15.4	-	-	-	26/100.0
Total	398/23.6	1 007/59.7	125/7.4	155/9.1	1/0.1	1/0.1	-	1 687/100.0

Date	Chambers with the intact development of *C. petioli*		Chambers with the disturbed development of *C. petioli*				Chambers with undefined content	Chambers Total
	with a larva	abandoned	with a parasitoid	with a naturally died larva	eat out by insect	pecked out by birds		
Total (July – October)	2/0.2	742/76.8	101/10.5	119/12.3	1/0.1	1/0.1	-	966/100.0
Total (August – October)	2/0.3	503/77.6	57/8.8	84/13.0	1/0.1	1/0.2	-	648/100.0

XV: *The health condition of larvae of C. petioli in galls (in % according to the number of chambers in galls). 2007 (numerator), 2008 (denominator).*

Number of chambers	Percentage proportion of chambers			
	abandoned by *C. petioli*	with a parasitoid	with naturally died *C. petioli*	total
1	20.5/53.5	36.4/16.9	43.1/29.6	100.0
2	40.5/71.8	32.3/12.8	27.2/15.4	100.0
3	42.9/82.1	30.3/11.8	22.4/6.1	100.0
4	48.8/79.9	29.6/8.3	21.6/11.8	100.0
≥ 5	47.4/88.6	28.7/5.4	23.9/6.0	100.0
Total	40.2/79.2	31.7/9.5	28.1/11.3	100.0

XVI: *The health condition of C. petioli in galls (depending on the leaf blade area). 1 June to 18 October 2007.*

Area of leaves (cm^2)	Number/% proportion of chambers				
	abandoned by *C. petioli*	with a parasitoid	with naturally died *C. petioli*	with living *C. petioli*	total
< 5	46/26.9	48/28.1	59/34.5	18/10.5	171/100.0
5–10	217/34.8	183/29.3	192/30.8	32/5.1	624/100.0
10–15	164/37.1	150/33.9	115/26.0	13/3.0	442/100.0
> 15	127/41.6	85/27.9	90/29.5	3/1.0	305/100.0
Total	554/35.9	466/30.2	456/29.6	66/4.3	1 542/100.0

XVII: *The occurrence of particular developmental stages of parasitoids in galls of C. petioli. Numerator – number of parasitoids, denominator – their % proportion (2007).*

Date	Eggs	Larvae		Pupae		Imagoes			Total
		living	dead	living	dead	living	dead	flown out	
19. 5.	-	-	-	-	-	-	-	-	-
25. 5.	8/40.0	12/60.0	-	-	-	-	-	-	20/100.0
1. 6.	2/3.8	51/96.2	-	-	-	-	-	-	53/100.0
7. 6.	-	32/100.0	-	-	-	-	-	-	32/100.0
14. 6.	-	27/71.1	4/10.5	7/18.4	-	-	-	-	38/100.0
21. 6.	-	22/73.3	4/13.3	1/3.4	1/3.4	1/3.3	-	1/3.3	30/100.0
28. 6.	-	14/42.4	3/9.1	2/6.1	-	1/3.0	1/3.0	12/36.4	33/100.0
5. 7.	-	8/29.7	6/22.2	1/3.7	1/3.7	3/11.1	1/3.7	7/25.9	27/100.0
12. 7.	-	10/37.1	9/33.3	1/3.7	2/7.4	-	-	5/18.5	27/100.0
19. 7.	-	9/42.8	6/28.6	-	-	-	-	6/28.6	21/100.0
26. 7.	-	10/43.5	3/13.0	-	-	-	-	10/43.5	23/100.0
2. 8.	-	7/24.1	7/24.1	1/3.5	-	1/3.5	1/3.4	12/41.4	29/100.0
9. 8.	-	12/24.5	18/36.7	-	-	-	-	19/38.8	49/100.0
16. 8.	-	12/37.5	9/28.1	-	-	-	2/6.3	9/28.1	32/100.0
23. 8.	-	15/31.2	14/29.2	-	-	-	-	19/39.6	48/100.0

Date	Eggs	Larvae		Pupae		Imagoes			Total
		living	dead	living	dead	living	dead	flown out	
6. 9.	-	12/32.4	13/35.1	-	-	-	-	12/32.5	37/100.0
20. 9.	-	5/29.4	7/41.2	-	1/5.9	-	-	4/23.5	17/100.0
4. 10.	-	10/32.3	9/29.0	-	1/3.2	-	-	11/35.5	31/100.0
18. 10.	-	7/25.9	9/33.3	-	-	-	1/3.7	10/37.1	27/100.0
Total	10/1.8	275/47.9	121/21.1	13/2.3	6/1.0	6/1.0	6/1.1	137/23.8	574/100.0
Total (August – October)	-	80/29.6	86/31.9	1/0.4	2/0.7	1/0.4	4/1.5	96/35.5	270/100.0

XVIII: *The occurrence of particular developmental stages of parasitoids in galls of C. petioli. Numerator – number of parasitoids, denominator – their % proportion (2008).*

Date	Eggs	Larvae		Pupae		Imagoes			Total
		living	dead	living	dead	living	dead	flown out	
9. 5.	2/100.0	-	-	-	-	-	-	-	2/100.0
16. 5.	3/100.0	-	-	-	-	-	-	-	3/100.0
25. 5.	-	-	-	-	-	-	-	-	-
31. 5.	-	2/100.0	-	-	-	-	-	-	2/100.0
6. 6.	-	3/100.0	-	-	-	-	-	-	3/100.0
12. 6.	-	6/100.0	-	-	-	-	-	-	6/100.0
19. 6.	-	1/50.0	1/50.0	-	-	-	-	-	2/100.0
26. 6.	-	3/50.0	1/16.7	2/33.3	-	-	-	-	6/100.0
3. 7.	-	-	2/66.7	1/33.3	-	-	-	-	3/100.0
10. 7.	-	6/60.0	1/10.0	1/10.0	1/10.0	1/10.0	-	-	10/100.0
17. 7.	-	4/80.0	1/20.0	-	-	-	-	-	5/100.0
24. 7.	-	12/57.1	2/9.5	-	-	-	1/4.8	6/28.6	21/100.0
31. 7.	-	1/20.0	1/20.0	-	-	-	-	3/60.0	5/100.0
7. 8.	-	1/33.3	1/33.3	-	-	-	-	1/33.4	3/100.0
14. 8.	-	5/62.5	3/37.5	-	-	-	-	-	8/100.0
21. 8.	-	-	-	-	-	-	-	1/100.0	1/100.0
28. 8.	-	6/54.5	2/18.2	-	1/9.1	-	-	2/18.2	11/100.0
4. 9.	-	4/60.0	1/20.0	--	-	-	-	1/20.0	5/100.0
11. 9.	-	2/28.6	4/57.1	-	1/14.3	-	-	-	7/100.0
18. 9.	-	3/50.0	2/33.3	-	-	-	-	1/16.7	6/100.0
25. 9.	-	-	5/100.0	-	-	-	-	-	5/100.0
2. 10.	-	5/50.0	1/10.0	-	-	-	-	4/40.0	10/100.0
9. 10.	-	-	1/100.0	-	-	-	-	-	1/100.0
Total	5/4.0	63/50.4	29/23.2	4/3.2	3/2.4	1/0.8	1/0.8	19/15.2	125/100.0
Total (August – October)	-	25/43.9	20/35.1	-	2/3.5	-	-	10/17.5	57/100.0

SUMMARY

Recently, the abundant occurrence of galls of *Contarinia petioli* (Kieffer) was noted on *Populus tremula* in the Brno region and elsewhere in southern Moravia. The bionomics and cecidogenesis of the gall midge was studied on 5 to 15-year-old aspens in Forest District Bílovice nad Svitavou, Training Forest Enterprise Masaryk Forest in Křtiny in 2007 and 2008. Imagoes fly there at the end of April and at the beginning of May. Females lay eggs in several partial clutches at 1 to 6(10) pieces. About 91% newly hatched larvae settle on petioles of unfolding leaves, about 8% on the bark of terminal parts of shoots and about 1% on leaf blades. By means of sucking the larvae of the 1st and 2nd instars galls are created in the 1st half of May. Larvae of the 3rd instar occur in galls from the 20th May when galls are grown-up. Larvae abandon the galls in the 1st decade of June through an oval hole 0.6 × 0.4 mm in diameter. Galls are on average 6 mm long, 5.4 mm wide and 5.1 mm high. If they are localized within a short distance of each other then often create formations up to 17 × 11 × 9 mm in size. There are 1 to 6(10) chambers in galls and in each of them, only one larva develops. The paper deals in detail with the differentiation of galls including chambers as well as natural enemies of the gall midge. *Torymus quercinus* Boh., *T. cultrans* Graham & Gijswijt (Torymidae) and *Tetrastichus* sp. (Eulophidae) rank among natural enemies of larvae in galls.

SOUHRN

Bionomie a cecidogeneze *Contarinia petioli* (Kieffer) (Diptera, Cecidomyiidae)

V poslední době byl na *Populus tremula* na Brněnsku a jinde na jižní Moravě pozorován hojný výskyt hálek *Contarinia petioli* (Kieffer). Bionomie a cecidogeneze bejlomorky byly studovány v letech 2007 a 2008 na pětiletých až patnáctiletých osikách na polesí Bílovice n. Svitavou, ŠLP Masarykův les ve Křtinách. Imága tam létají koncem dubna a začátkem května. Samičky kladou vajíčka do několika dílčích snůšek po 1 až 6 (10) kusech. Kolem 91 % čerstvě vylíhlých larev se usazuje na řapících rozvíjejících se listů, kolem 8 % na kůře koncových částí výhonků a kolem 1 % na čepelích listů. Sáním larev 1. a 2. instaru se v 1. polovině května vytváří hálka. Larvy 3. instaru se v hálkách objevují od 20. května, kdy jsou hálky dorostlé. Larvy hálky opouštějí v 1. dekádě června oválným otvorem o průměru 0,6 × 0,4 mm. Hálky jsou průměrně 6 mm dlouhé, 5,4 mm široké a 5,1 mm vysoké. Jsou-li lokalizovány blízko sebe, pak se často spojují v nádory o velikosti až 17 × 11 × 9 mm. V hálkách je 1 až 6 (10) komůrek a v každé z nich se vyvíjí jen jedna larva. Práce se podrobně zabývá diferenciací hálek vč. komůrek a přirozenými nepřáteli bejlomorky. K přirozeným nepřátelům larev v hálkách mj. patří *Torymus quercinus* Boh., *T. cultrans* Graham & Gijswijt (Torymidae) a *Tetrastichus* sp. (Eulophidae).

Cecidomyiidae, *Contarinia petioli*, výskyt, vývoj, hálky, regulační činitelé

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