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# A new gall midge species *Janetiella potentillogemmae* sp. nov. (Diptera: Cecidomyiidae), causing galls on *Potentilla recta* (Rosaceae) in western Turkey, a candidate for biological weed control

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**Abstract**. *Janetiella potentillogemmae* sp. nov. is described based on specimens reared from leaf bud galls of *Potentilla recta* L. (Rosaceae) found in western Turkey. Male, female, larva, pupa and gall are described and morphological characters are illustrated. Only one generation develops per year. Adults emerge from galls in the second half of April up to early May. Females lay eggs on the meristematic tissue of young lateral buds of the main shoot. Gall formation was recorded approximately four to seven weeks after oviposition. Subsequent development of galls on lateral buds prevents the formation of side shoots with new inflorescences. Several larvae (up to 26) develop together in one gall. Each larva spins a cocoon in which it hibernates in the gall and pupates in the spring of the following year. On average 5.1 cocoons were recorded per gall. The gall midge is considered as a candidate for biological control of *P. recta* in North America.

**Key words**. Taxonomy, new species, Diptera, Cecidomyiidae, *Janetiella*, *Potentilla*, Turkey, biological control

## INTRODUCTION

*Potentilla* L. is a plant genus of the family Rosaceae. It includes usually perennial, rarely annual or biennal herbs, or small shrubs. About 300 species are known to occur in the world, and about 75 of those species occur in Europe (Tutin et al. 1964–1980). Many species are cultivated in gardens for ornamental purposes. Several species have been transported to other parts of the world where some of them have become noxious weeds.

*Potentilla recta* L., popularly named sulphur cinquefoil, rough-fruited cinquefoil or common tormentil, is a plant species distributed over the whole of Europe, with the exception of the most northern areas. It occurs in western Asia including southern Siberia, Iran, Iraq and Turkey (Davis 1982), in Middle Asia (Kazakhstan, Kyrgyzstan, Tadjikistan, Turkmenistan and Uzbekistan) and in China. Lauber & Wagner (2001) consider *P. recta* as a south-eastern European and Asian element.

*Potentilla recta* was brought to North America and to New Zealand by human agency. It has now spread over the whole of North America except the northernmost part of Canada and Alaska. It is a declared noxious weed in North America (USDA, NRCS 2009) because it invades pastures, clearcuts, and native plant communities in the north-western USA and Canada (Rice 1999). At the CABI Centre in Switzerland, a biological control programme was started in 1992 and extensive surveys were carried out in eastern and south-eastern Europe as well as in south-western Asia.

Five gall midge species are associated with various species of *Potentilla* in the Holarctic Region, two of them in Europe, two in Asia (Kazakhstan) and one in North America (Gagné 1989, Fedotova 2000, Skuhravá 2011).

*Dasineura potentillae* (Wachtl, 1885) causing flower bud galls on *Potentilla argentea* was originally described on the basis of material found at Znaim, Mähren (now: Czech Republic). It is distributed mainly in the southern parts of Europe. *Guignonia potentillae* Kieffer, 1913, was described on a male that was reared from a gall on *Potentilla verna* in France. Nothing more is known about the biology and distribution of this species. In Kazakhstan larvae of *Dasineura potentillaeflora* Fedotova, 2005 cause flower bud galls on *Potentilla asiatica* and larvae of *Potentillomyia kazenasae* Fedotova, 1990 develop in unopened flower buds of *Potentilla bifurca*. *Neolasioptera potentillaecaulis* (Stebbins, 1910) is the only native gall midge species associated with *Potentilla canadensis* in North America. It causes swellings on stems. This species is known only from a description of the gall.

In addition, Loew (1850: 30) mentioned a gall midge species as "*Cecidomyia tormentillae m*." ("m." means "mihi", i.e. of Loew) and gave a very short diagnosis of a gall: "Erzeugt kleine rundliche Gallen am Stengel von *Tormentilla erecta*" (now: *Potentilla erecta*). He found this stem gall near Posen (now Poland). This finding was subsequently mentioned in the cecidological literature: in Houard (1908–1909, Nr. 3063, as Cécidomyide), in Ross & Hedicke (1927, Nr. 1972, as Gallmücke), in Rübsaamen & Hedicke (1925–1939: 332) and in Buhr (1964–1965, Nr. 5165, as ungeklärte Gallmücke) without any additional information about the causer, biology or occurrence. Gagné (2004: 282; 2010: 418) included this species among "Unplaced species of Cecidomyiidae". No recent records of this gall midge species and its galls are known from Europe. No gall midge species causing galls on *Potentilla* has been found in Turkey in the past (Skuhravá et al. 2005).

In the present article we provide a description of morphological characters of a new gall midge species *Janetiella potentillogemmae* sp. nov. larvae of which cause leaf bud galls on *Potentilla recta* and were discovered in western Turkey in the course of CABI surveys in 1999. This gall midge species was included in the biological control program searching for potential biological control agents for use against the weed species *P. recta* (Schaffner et al. 2002). We present also some basic data on the biology of *Janetiella potentillogemmae* sp. nov. and discuss its suitability as a biological control agent of *P. recta*.

## MATERIAL AND METHODS

Leaf bud galls on *Potentilla recta* were discovered for the first time during surveys for potential biological control agents of sulphur cinquefoil (*Potentilla recta*) at a site near Dumlupinar (Western Anatolia) in 1999. This locality was visited to collect galls of the biological control candidate *Xestophanes* sp. (Hymenoptera: Cynipidae). The collection site was in a young, well-spaced pine afforestation on shallow soil. Flow cytometry revealed that the *Potentilla recta* populations in this area all belong to the hexaploid form of *P. recta*. Besides the relatively round galls of the gall wasp, which are mainly situated at the shoot base near the root crown, smaller and more elongated galls were found on leaf petioles of the rosettes and on lateral buds of the main shoots of *P. recta*. The shape and position of these galls indicated that they were not formed by the gall wasp, but by a different insect species. Additional galls on *Potentilla recta* of similar shape were collected by F. Turanli (Ege University, Izmir, Turkey) in autumn 2000 and 2007 at the same site and shipped to the CABI Centre in Delémont. The galls were kept during winter in plastic cylinders covered with gauze lids and stored in an outdoor shelter at ambient temperature. In 2009, 34 galls collected on 4 November 2007 were dissected under a dissecting microscope. The number of cocoons per gall and the content of the cocoons were recorded.

Larvae, pupae and adults reared from galls on *Potentilla recta* were mounted on microscope slides using Canada balsam as medium. The holotype and paratypes are deposited in the collection of M. Skuhravá in Prague (Czech Republic).

Terminology of morphological characters of adults follows the terminology given in Skuhravá (1997), Sylvén & Tastás-Duque (1993) and Gagné (1994), terminology of larvae after Möhn (1955), terminology of pupae after Möhn (1961), with some small exceptions.

TAXONOMY

## *Janetiella* Kieffer, 1898

*Janetiella* Kieffer, 1898: 23.

Type species. *Cecidomyia thymi* Kieffer, 1888 (subsequent designation of Coquillett 1910: 556).

The genus is defined by the following combination of characters:

Antennae 2+12 to 2+15, flagellomeres in male with stems, in female without stems, mouthparts well developed, palpi three or four segmented, wing with $R_5$ uniting with costa before wing apex, cu forked, tarsal claws simple, without tooth, empodium about as long as the claws, ovipositor long, cylindrical, cerci of female fused, male genitalia with gonostyli gradually tapering and pubescent, larva with bilobed sternal spatula and 8 terminal papillae (Skuhravá 1997).

*Janetiella* is a Holarctic genus with 25 species of which thirteen occur in Europe, three in Asia and nine in North America (Skuhravá 2006, Gagné 2010). Larvae cause stem swellings, leaf and flower bud galls, swellings of needles or develop in seed. They are associated with host plants belonging to twelve plant families. Most species of this genus are poorly known, insufficiently described and the original material of most species, including the type species, is lost. Recently two new species of *Janetiella* were described. Larvae of *Janetiella frankumi* Harris, 2003, cause stem swellings on *Rosa pimpinellifolia* (Rosaceae) in the United Kingdom and larvae of *Janetiella onosmae* Skuhravá, 2011 cause rosette leaf bud galls on *Onosma frutescens* (Boraginaceae) in Greece (Skuhravá 2011). Gagné (2009) redescribed the male and female of *Janetiella thymi* on the basis of material collected, reared and identified by E. Sylvén in Sweden and illustrated important morphological characters of adults.

### *Janetiella potentillogemmae* sp. nov. Skuhravá
(Figs. 1–15)

Type material. **Holotype**: male, *Potentilla recta*, leaf bud gall, Turkey: Dumlupinar, em. 10.05.2008, leg. F. Turanli. Microscope slide Nr. 8333, deposited in the collection of M. Skuhravá, Prague, Czech Republic. **Paratypes**: one male, 3 females, 1 larva, 11 pupae, same data as in holotype.

Diagnosis. Medium sized flies, body 2.0–2.4 mm long (n=5). Head and thorax black-brown, antennae brown, thorax, abdomen and legs slightly orange brown, 1–6 segments dorsally with brown tergites, legs and antennae honey-coloured.

Description. **Male**. Body size: 2.0–2.2 mm, wing 1.9–2.0 mm long, 0.8 mm broad (n=2).

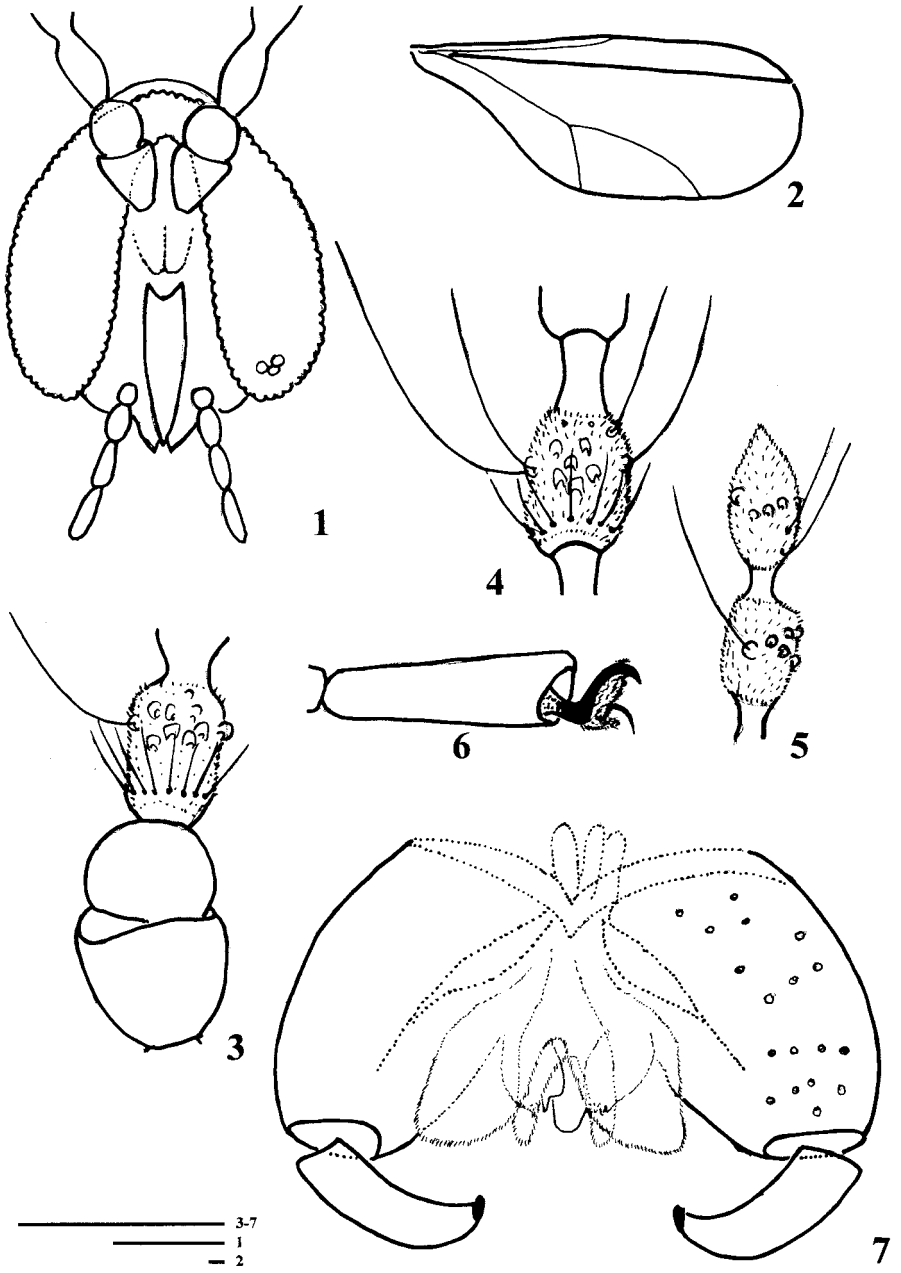
Head of normal size and position, with large holoptic eyes. Eye bridge four ommatidia broad medially; ommatidia small.

Mouthparts well developed, but not prolonged. Palpi four segmented; the first ovoid, the second and third segments nearly twice as long; the fourth segment slender and a little longer; all segments covered densely with microtrichia and each with several long setae.

Antennae 2+13 to 2+14 segmented (n=2). Scape obconical, basally narrower, pedicel ovoid, first and second flagellomeres fused. Each flagellomere consists of a basal node and distal stem; the stem is shorter than node; at base of node is a ring of short thin setae, with several sensory pores in the middle part, some of them with long setae; all flagellomeres densely covered with microtrichia.

Wing with costa interrupted at junction with $R_5$; $R_1$ reaches the middle of the anterior wing margin; $R_5$ straight, joining costa before the wing apex; Cu forked.

Legs very long and slender, tarsal claws simple, without tooth, empodia as long as claws.




Figs 1–7. *Janetiella potentillogemmae* sp. nov., male. 1 – head, 2 – wing, 3 – scape, pedicel and first flagellomere, 4 – fifth flagellomere, 5 – last two flagellomeres, 6 – fifth tarsomere with claw and empodium, 7 – male terminalia. Scale bars = 0.1 mm.

Male genitalia: gonocoxites are large, ovoid, stout, gonostyles short, they are about as long as the gonocoxites are broad, slightly bent, tapering at the end, densely covered with microtrichia, apically with a claw; aedeagus broad, rounded at the end, cerci broad, deeply and broadly emarginate, hypoproct narrow, deeply emarginated, parameres sheathing aedeagus, shorter than gonocoxites and with several small protuberances at the end.

**Female**. Body size: 2.0–2.3 mm, wing 1.9–2.1 mm long, 0.8 mm broad (n=2).

Head with large holoptic eyes, eye bridge four ommatidia broad medially; ommatidia small and circular. Mouthparts well developed, palpi four-segmented.

Antennae 2+13 to 2+14 segmented (n=3); scape obconical and pedicel globular, both of about same size; first and second flagellomeres fused; flagellomeres cylindrical, without stems; all flagellomeres densely covered with microtrichia and with several long setae. Sclerites on the eighth abdominal segment joined in the posterior part (Fig. 12). Ovipositor very long, fully protrusible, terminal lamella slender, densely covered with microtrichia and setae.

**Larva**. The third larval instar is 1.8–1.9 mm long, 0.95 mm broad, orange-coloured in fresh condition. Integument of both body sides is formed of very small plates, terminal papillae are not visible. Sternal spatula on the ventral side of the prothoracic segment is 125–128 μm long (n=2), with bilobed anterior blade and slender stem which is broadened at the bottom.

**Pupa**. The pupa is 1.7–1.9 mm long, 0.85–0.95 mm wide (n=11), head is black, upper body parts including thorax, wing sheaths and basal parts of leg sheaths are dark brown, abdomen with distal part of leg sheaths are honey-coloured. Integument of ventral and dorsal sides of the abdominal segments is covered with very small spinulae. At the bases of antennal sheaths are a pair of pointed antennal protuberances, on the pupal head is a pair of cephalic papillae with 190–210 μm long cephalic setae. Prothoracic spiracle is in the form of 120 μm long tube.

**Cocoon**. The cocoon is oval, whitish, 2.7 mm long and 1.4 mm broad. It is produced by the third instar larva to protect the resting pupal stage against the unfavourable influence of environmental factors.

Differential diagnosis. *J. potentillogemmae* sp. nov. differs from its congener, *Janetiella onosmae* Skuhravá, 2011, larvae of which cause large rosette leaf bud galls on *Onosma frutescens* (Boraginaceae) in Greece (Skuhravá 2011). In contrast to adults of *Janetiella onosmae*, the adults of *J. potentillogemmae* do not have prolonged mouthparts and have shorter and thicker palpal segments. *J. potentillogemmae* sp. nov. differs from *J. frankumi* Harris, 2003, larvae of which cause stem swellings on *Rosa pimpinellifolia* (Rosaceae) in the UK, by size of empodia on claws which are in *J. frankumi* more than twice the length of claws, whereas in *J. potentillogemmae* sp. nov. they are as long as claws. *J. potentillogemmae* sp. nov. differs also from the larva of *J. frankumi* in the shape and size of the sternal spatula which is in *J. frankumi* short and broad (Harris 2003, Fig. 6) and in *J. potentillogemmae* sp. nov. longer and more slender.

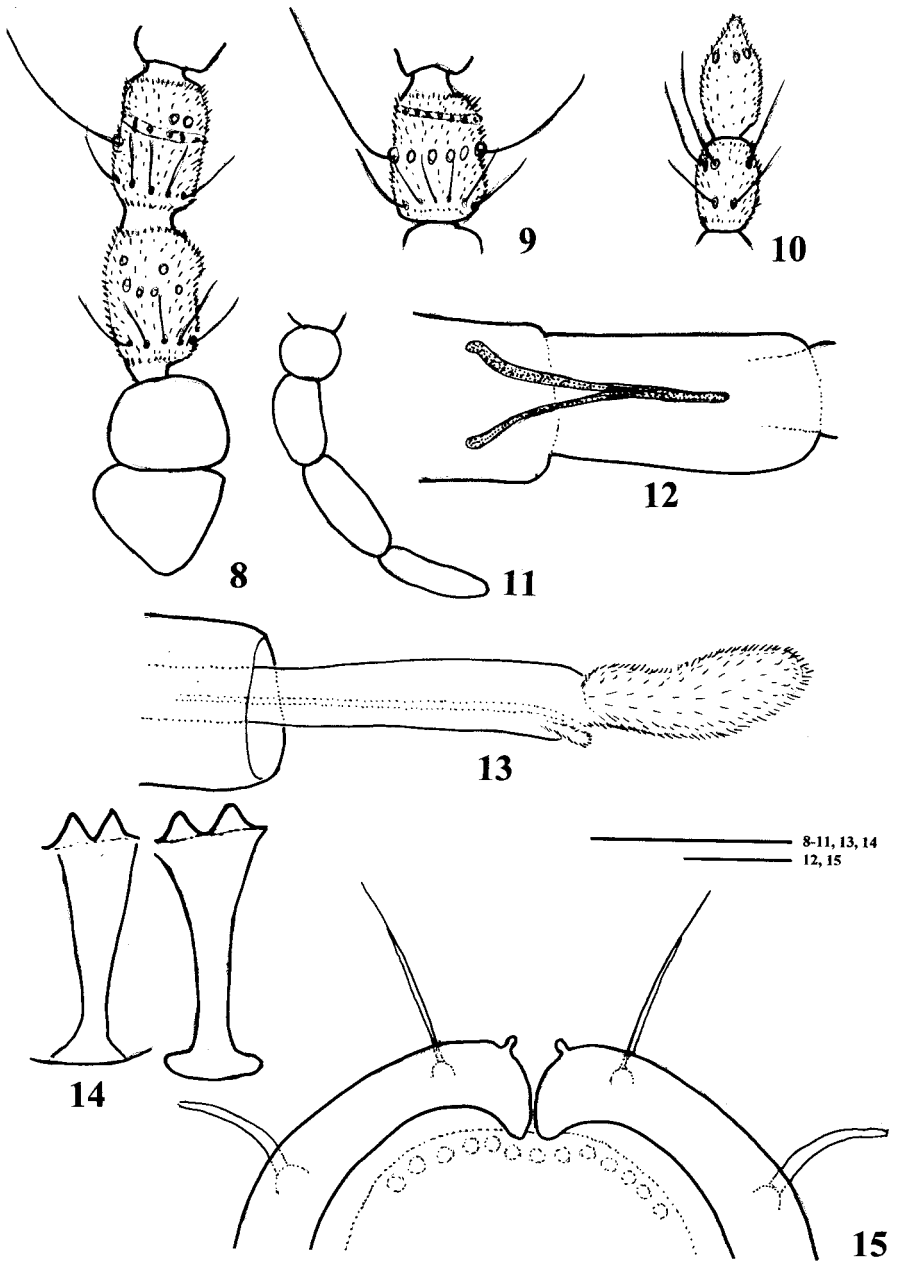
Etymology. The specific name of this species, *potentillogemmae*, is derived from the generic Latin name of the host plant *Potentilla* and the Latin word *gemma* which means a bud.

Host plant. *Potentilla recta* L. (Rosaceae).

Gall. The gall of *J. potentillogemmae* sp. nov. is formed on a lateral leaf bud which is swollen, egg-shaped, pointed. It consists of several small densely haired leaves. Inside is a chamber where the larvae develop (Figs 16–18).

Distribution. Western Turkey.

Life history. **Emergence of adults**. In 2000 in experimental plots at Delemont, the adults of *J. potentillogemmae* sp. nov. emerged at the end of April from galls kept during winter outdoors at ambient temperature. A total of 83 adults emerged, of which 52 were females and 31 males, between 20 April and 2 May (Fig. 19). Sexual index was 1 ♂ : 1.6 ♀.




Figs 8–15. *Janetiella potentillogemmae* sp. nov., female, larva and pupa. 8 – scape, pedicel, first and second flagellomeres, 9 – fifth flagellomere, 10 – last two flagellomeres, 11 – palpus, 12 – sclerit on the eight abdominal segment (dorsal view), 13 – ovipositor (lateral view), 14 – sternal spatula of two larvae, 15 – anterior body part of pupa. Scale bars = 0.1 mm.

In 2001 the adults of *J. potentillogemmae* sp. nov. emerged for several days earlier than in the previous year. Between 11 and 27 April, during 17 days, a total of 104 specimens emerged, of which 93 were females and 11 males. Sexual index in 2001 was 1 ♂ : 8.4 ♀.

In 2001 twelve specimens of parasitic Hymenoptera emerged from galls together with gall midges. Emergence of the gall midges in both years was highly synchronized, about 90% of adults emerged within one week.

**Oviposition and gall formation**. In 2000 2–4 females and 1–4 males of *J. potentillogemmae* sp. nov. that emerged from galls collected in Turkey were transferred onto potted North American *Potentilla recta* plants which were covered by a plastic cylinder, and behaviour and survival of the gall midges were recorded. In total, 12 *P. recta* plants were exposed to the gall midge in 2000.

In 2001, this experiment was repeated with 8 females and 1 male and seven *P. recta* plants. After exposure, the potted plants were transferred to the Centre's garden and regularly checked for gall formation.

Females of *J. potentillogemmae* sp. nov. started extruding their ovipositor and 'calling' for males soon after emergence. Oviposition attempts by mated females were repeatedly observed


Figs 16–18. Galls of *Janetiella potentillogemmae* sp. nov. on leaf bud of *Potentilla recta* in the nature (16) and in laboratory (17–18). 17 – one gall midge larva (on the left) and larva of parasitic Hymenoptera (on the right) developing together in one gall, 18 – gall midge cocoons in gall chamber (all photos by Ghislaine Cortat).

into the meristematic tissue of the main shoot or into young lateral buds. While all females died within five days after emergence, a few males lived up to ten days.

In 2000, no galls were obtained on *P. recta* plants exposed to the gall midge. In 2001, however, an average of 2.3 ± 2.8 galls (range 0–7) was obtained on the seven *P. recta* plants exposed to female gall midges. Gall formation was recorded approximately four to seven weeks after oviposition. As soon as gall formation started, the potted plants were put in a gauze cage to prevent parasitism and monitor adult emergence. No gall midge emergence was recorded during the second half of

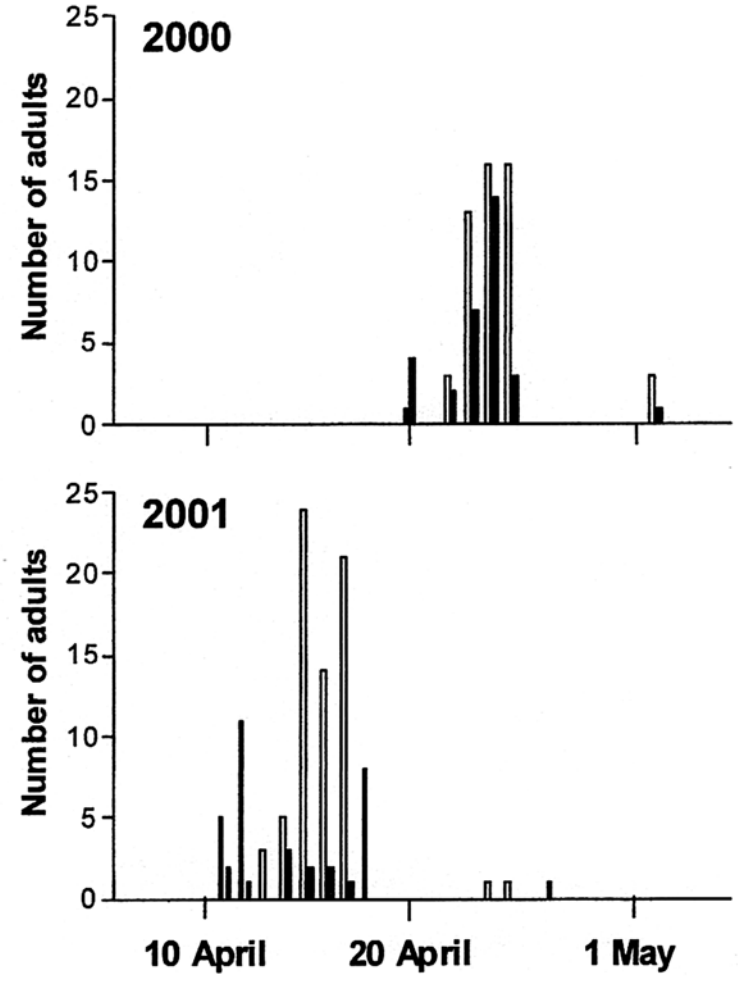



Fig. 19. Number of adult specimens of *Janetiella potentillogemmae* sp. nov. emerging in 2000 and 2001 from galls that were collected in western Turkey and kept outdoors in Delémont, Switzerland, at ambient temperature. White columns – females, black columns – males.

the season, indicating that this species may have one generation per year. Successful oviposition and gall formation was obtained on both the tetraploid and the hexaploid *P. recta*, indicating that this midge can attack both cytotypes.

Attack of the meristematic tissue sometimes, but not always, prevented further growth of the main shoot or formation of side shoots with new inflorescences.

**Dissections of galls**. In 2008, only 15 adults of *J. potentillogemmae* sp. nov. (4 males and 11 females) emerged between 7 and 10 May 2008 from galls collected in autumn 2007. Dissections of galls showed that 91.2% of the galls contained cocoons whereas 8.8% of the galls were empty suggesting that the insects died as early instar larvae. One up to 26 larvae were found in a gall, with an average of 5.1 cocoons per gall. Twenty-eight per cent of the cocoons were empty, 53.7% of the cocoons contained dead larvae and pupae of the gall midge, 14.9% of the cocoons contained dead parasitoids. We were not able to determine the content of 6 cocoons. It is likely that the mature larvae and pupae of *J. potentillogemmae* sp. nov. recorded during dissections dried out and therefore remained in the galls.

**Biological control**. In 1992, the CABI Centre in Switzerland, started investigations on the potential of biological control to reduce the competitive ability of *P. recta* and reduce its populations to below a desired level. The challenge of a biological control approach in controlling *P. recta* lies in the particularly narrow host-range which is needed for a biocontrol agent in order to avoid or minimize non-target effects: some 60 *Potentilla* spp. are native to North America, and the closely related strawberry is an important crop species (Powell 1996). Since gall midges tend to exhibit a narrow host-range, *Janetiella potentillogemmae* sp. nov. might have a narrower host-range than other potential agents considered (Schaffner et al. 2002). Besides host-specificity, the other key criteria when selecting biological control agents is their impact on the population dynamics of the target weed. While it seems unlikely that *Janetiella potentillogemmae* sp. nov. can kill established *P. recta* plants, it has the potential to considerably reduce the reproductive output of its host-plant. However, further investigations are required to improve our understanding of the impact of *Janetiella potentillogemmae* sp. nov. on the population dynamics of *P. recta*.

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