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Description of a New Gall Midge (Diptera, Cecidomyiidae) Causing Leaf Galls on *Camellia japonica* L., with Notes on Its Bionomics*

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Abstract A new gall midge causing leaf galls on *Camellia japonica* L. in Japan is described under the name, *Lasioptera camelliae*, together with notes on its host plant, gall, life history, parasitoids and geographical distribution. This species is distinguishable from its relatives by characteristics of the flagellomeres, ovipositor, and larval terminal papillae. The gall midge is essentially univoltine, but some individuals require two, rarely three years to complete their life cycle. At least three parasitoid species are associated with the gall midge, but they have not yet been identified.

Introduction

Camellia japonica L., the well-known small evergreen tree, called "Yabutsubaki" in Japanese, is distributed in Japan (Honshu, Shikoku, Kyushu and Ryukyu), Korea and China. This plant grows up to 1–10 m high, and is indicated as one of the important elements of the warm temperate forest in Japan (HORIKAWA, 1972).

On the midrib and larger secondary leaf veins of *C. japonica*, there can be seen relatively hard, sometimes woody swellings (Fig. 1D) produced by an unidentified gall midge species of the genus *Lasioptera* (YUKAWA, 1978). For the purpose of comparative ecological studies on gall midges inhabiting broad-leaved evergreen trees, field populations of this gall midge have been surveyed since 1976 by the present authors and their collaborators mainly in Kagoshima City and its vicinity. As the authors' first contribution to the ecological studies on the species, the present paper is intended to describe the gall midge as a new species together with notes on its host plant, gall, life history, parasitoids and geographical distribution.

Materials and Methods

The leaf vein galls of the present species were collected mainly from Kagoshima Prefecture and partly from other localities in Kyushu, Shikoku and on the Izu

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Islands through occasional field surveys from 1976 to 1983. Some of the galls collected were measured and then dissected to obtain larval and pupal specimens. To rear the adult midges, the remains of galls were kept in the laboratory by the method described in YUKAWA *et al.* (1976). The life history of the present species was investigated by occasional dissections of the leaf vein galls collected from Kagoshima City and its vicinity, and also by direct observations in the census field at Shiroyama, Kagoshima City.

In preparing microscope slides, the authors adopted the xylene-balsam method. The drawings were made with the aid of a camera lucida.

The holotype and paratypes are kept in the collection of the Entomological Laboratory of Kagoshima Uuiversity.

Table 1. *Lasioptera camelliae* sp. nov.: fronto-clypeal and thoracic setal counts, and measurements of wing, flagellomeres and legs.

No. specimens examined		26 ♂♂*		16 ♀♀*	
		mean±s.d.	(range)	mean±s.d.	(range)
Fronto-clypeal setae		182.3±30.0	(140–242)	186.0±18.0	(166–216)
Mesopreural setae		12.7±3.2	(9–18)	17.6±4.4	(13–24)
Mesepimeral setae		19.2±3.5	(10–25)	21.1±3.3	(13–27)
Wing length (mm)		2.97±0.17	(2.54–3.32)	3.02±0.39	(2.05–3.46)
Wing width (mm)		1.04±0.09	(0.80–1.19)	1.16±0.13	(0.98–1.44)
Flagellomere 3	be**(μm)	46.8±5.1	(37.5–57.5)	48.0±3.5	(47.5–55.0)
	w	41.6±1.8	(40.0–45.0)	49.3±2.9	(45.0–52.5)
Flagellomere 5	be	37.8±3.5	(30.0–45.0)	43.7±3.3	(40.0–50.0)
	w	40.3±3.2	(35.0–45.0)	46.2±5.4	(35.0–50.0)
Fore leg	Fe (mm)	0.92±0.08	(0.75–1.03)	0.95±0.10	(0.80–1.10)
	Ti	1.14±0.08	(1.05–1.25)	1.12±0.08	(1.03–1.25)
	T_2	1.71±0.15	(1.45–2.00)	1.52±0.13	(1.28–1.68)
	T_3	0.68±0.07	(0.53–0.80)	0.62±0.05	(0.53–0.70)
	T_4	0.43±0.04	(0.35–0.50)	0.43±0.05	(0.35–0.48)
	T_5	0.20±0.02	(0.15–0.23)	0.22±0.02	(0.18–0.25)
Mid leg	Fe	0.95±0.10	(0.80–1.30)	0.93±0.10	(0.78–1.13)
	Ti	1.13±0.08	(0.95–1.23)	1.19±0.10	(1.00–1.38)
	T_2	1.73±0.17	(1.45–2.00)	1.56±0.15	(1.38–1.95)
	T_3	0.69±0.08	(0.58–0.88)	0.54±0.17	(0.38–0.85)
	T_4	0.43±0.05	(0.30–0.53)	0.43±0.04	(0.38–0.85)
	T_5	0.20±0.03	(0.15–0.25)	0.21±0.02	(0.18–0.23)
Hind leg	Fe	1.02±0.08	(0.83–1.15)	1.01±0.09	(0.88–1.13)
	Ti	1.14±0.09	(0.98–1.30)	1.22±0.08	(1.10–1.33)
	T_2	1.96±0.17	(1.73–2.23)	1.98±0.23	(1.40–2.15)
	T_3	0.78±0.07	(0.68–0.93)	0.81±0.10	(0.58–0.93)
	T_4	0.48±0.08	(0.28–0.63)	0.52±0.09	(0.30–0.60)
	T_5	0.18±0.03	(0.18–0.28)	0.24±0.03	(0.20–0.23)

* All the specimens listed in Table 1 are included.

** be: length of basal enlargement, w: maximum width of basal enlargement.

Lasioptera camelliae sp. nov.

Japanese name: Yabutsubaki-uroko-tamabae.
English name: Camellia leaf vein midge.

Male: Eye bridge 3 to 4 facets long medially. Palpus consisting usually of 3, rarely 4 segments, 1/3 to 2/5 as long as height of head, with relatively short setae and scales. Antenna: scape with ventral setae and scales densely, dorsal ones sparsely; number of flagellomeres varying from 17 to 20; first and second flagellomeres fused; each flagellomere basally with a whorl of long scales which are a little shorter than length of basal enlargement. Claws of all legs bifid; empodium nearly as long as claw. Wing about 2.9 times as long as wide (Table 1). Genitalia: hypoproct (subanal plate) entire, weakly rounded distally; gonostylus basally broader, distally slender, apically with a strong claw; gonocoxite basally with a setose lobe which is nearly as long as gonocoxite; aedeagus slender, distally weakly rounded (Fig. 1A).

Female: Wing length about 2.6 times as long as wide (Table 1). Antenna with 19 to 22 flagellomeres. Ovipositor (Fig. 1B): ninth segment laterally with a dense group of short spines; cercus (upper lamella) dorsally with many fish-hook

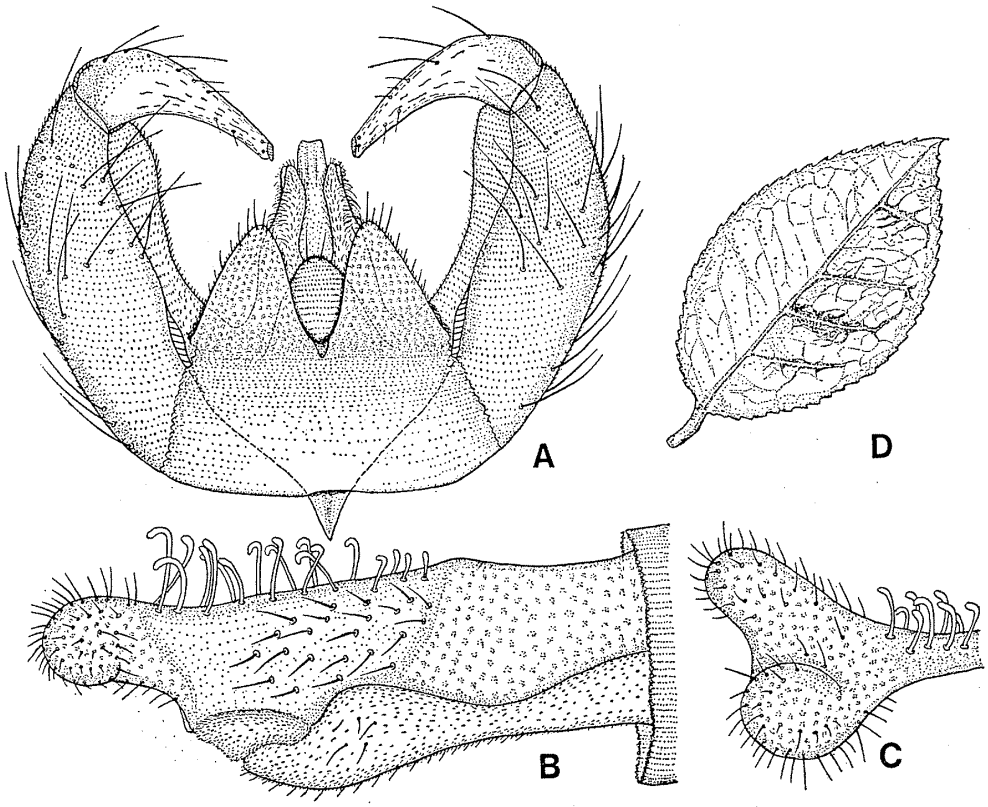

Fig. 1. *Lasioptera camelliae* sp. nov.: A, male genitalia; B, Ovipositor; C, Apical lobes of ovipositor; D, Galls on the leaf veins of *Camellia japonica*.

shaped spines, laterally with short spines which are arranged irregularly in 2 to 3 rows; apical portion of cercus emarginated, forming relatively short setose lobes (Fig. 1C). Otherwise practically as in male.

Egg: Orange in colour, spheroidal, with the major axis 320 μm and the minor axis 100 μm on an average.

Mature larva: Second antennal segment short, conical, about 12.5 μm in length, about 2.0 times as long as basal width; cervical papillae without setae; 6 dorsal papillae present on each of thoracic and first to seventh abdominal segments, all with setae which are 12 to 16 μm; 2 dorsal papillae of eighth abdominal segment with setae which are 17 to 20 μm; pleural papillae with setae about 18 μm long; only 4 terminal papillae present, of which 2 with setae about 15 μm long, remaining 2 with setae about 10 μm long; stigmata normal in number and position. Sternal spatula relatively long, 400 to 430 μm, distally bifid (Fig. 2A); lateral papillae 4, 2 with minute setae on all thoracic segments; sternal papillae without seta on all thoracic segments; inner pleural papillae without seta on prothorax, with short steae on meso- and metathorax; 4 anterior ventral papillae all without seta; 2 posterior ventral papillae with short setae; 4 ventral papillae of eighth abdominal segment with setae; 4 anal papillae all without seta.

Pupa: Apical spine not distinctly developed; apical papillae with short setae 9 to 10 μm long; anterior (upper) and posterior (lower) facial protuberances absent (Fig. 2C); posterior and lateral facial papillae indistinct; prothoracic spiracle relatively short, 40 to 65 μm long (Fig. 2B); stigmatal tubercles present on second to sixth abdominal segments, each 12 to 20 μm long and 4 to 7 μm wide basally; each abdominal segment with dense minute spinules dorsally, laterally and ventrally.

Host plant: *Camellia japonica* L. "Yabu-tsubaki". The leaf vein galls of this species have not yet been seen on cultivated *Camellia*-trees.

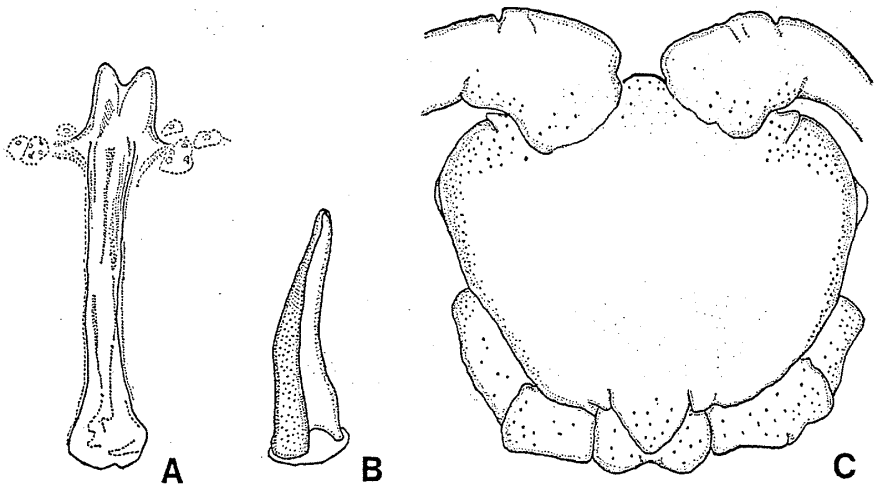

Fig. 2. *Lasioptera camelliae* sp. nov.: A, Sternal spatula of mature larva; B, Prothoracic spiracle of pupa; C, Basal portion of antennal sheath and frontal area of pupa.

Gall (Fig. 1D): Leaf vein gall, "Hamyaku-fushi"; relatively hard, sometimes woody swelling on midrib and larger secondary veins, with fine branches of the swelling on netted veins; mostly hypophyllous, with a slight elevation on upper surface; only 1 midge larva inhabiting each gall; each gall with a spot, or a "window" on undersurface for emergence of an adult midge (YUKAWA, 1978). Relationship between the developmental stages of larvae and the thickenss of the leaf vein galls are shown in Table 2. The galls containing the third-stage larvae were distinctly thicker than those with the second, so one can easily determine the larval stages by appearance of the galls.

Table 2. Thickness of the galls in relation to the larval developmental stages.

Larval stage	1st	2nd	3rd
No. of galls measured	unmeasured*	30	18
Thickness: mean±s.d. (mm)	—	1.09±0.20	2.38±0.42

* The sign of attack by the lst-stage larva is a slight elevation of the leaf vein accompanied with fine, short swellings of the netted veins.

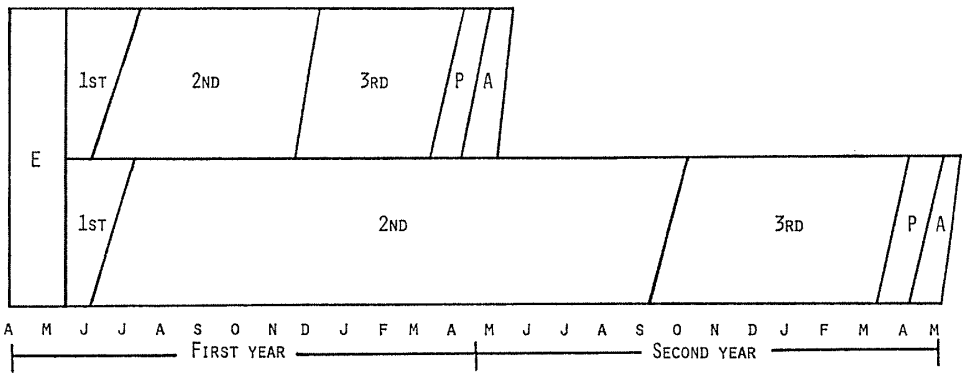

Fig. 3. *Lasioptera camelliae* sp. nov.: Schematic representation of the one-year and two-year type life histories. A, adult; E, egg; 1st-3rd, larval; P, pupal stages, respectively.

Life history (Fig. 3): This species is essentially univoltine (one-year type), but some individuals require two or, rarely three years to complete their life cycle (two- and three-year types). The percentage of the one-year type individuals among a population varies from year to year. The emergence of adults in the field starts usually from the middle of April and continues until early May in Kagoshima City. The females lay their eggs on the undersurface of the new leaves. Egg stage lasts for 7 to 10 days. The newly hatched larvae settle into the leaf blade from the place where the eggs were oviposited, and mine into large veins. The first-stage larvae molt into the second in June, when the leaf vein galls exhibit the distinct swellings. In the one-year type life history, the second-stage larvae usually molt into the third-stage in December. Then, the third-stage larvae hibernate, and pupate in the following spring. In the two-year type life history, however, the

second-stage larvae do not molt into the third in December of the first year. They pass through the winter, spring and summer in the galls, and then molt into the third in September of the second year. Thereafter, the third-stage larvae hibernate and pupate in a manner similar to the one exhibited by the one-year type individuals.

Parasitoids: The following two unidentified species of hymenopterous parasitoids have been reared from the galls collected in Kyushu: 1 braconid (ectoparasitoid of the third-stage larvae) and 1 platygastrid (endoparasitoid of the egg, emerging from third-stage larvae). In addition, some pupae of a eulophid parasitoid were obtained from the galls collected in Kyushu and on the Izu Islands, but the bionomics of this wasp have not yet been clarified.

Specimens examined: Holotype, 1 ♂ (on slide, Cecid. No. C6901) gall collected from Shiroyama, Kagoshima City, Kyushu, 31.III.1977, K. OHNO leg., on *Camellia japonica* L., emerged on 4.IV.1977, reared by K. OHNO & J. YUKAWA. Paratypes, 25 ♂♂, 16 ♀♀, 5 mature larvae, 17 pupae (on slides), see Table 3 for the collection data. In addition to these specimens, the alcohol-stored specimens obtained from the following localities were examined: Ohshima, Miyakejima and Niijima of the Izu Islands; Minamiuwa, Ehime Pref.; Muroto and Ashizuri, Kochi

Table 3. List of slide-mounted specimens examined.

♂	♀	L	P	Locality	Coll. date of galls	Leg.	Date of emergence	Cecid. No.
1	0	0	0	Shiroyama, Kagoshima City, KY	31.III.1977	K. OHNO	4.IV.1977	C6901
1	4	0	0	Shiroyama, Kagoshima City, KY	18–26.III.1977	K. OHNO	20–29.IV.1977	C6902–06
0	0	4	0	Shiroyama, Kagoshima City, KY	3.XII.1976	K. OHNO	——	C6907–10
0	0	0	16	Shiroyama, Kagoshima City, KY	18–29.IV.1977	K. OHNO	——	C6911–26
13	6	0	1	Kekura, Kagoshima City, KY	1–29.IV.1977	T. SUNOSE	17–22.IV.1977	C6931–50
0	2	0	0	Ishiki, Kagoshima City, KY	18.IV.1977	J. YUKAWA	22.IV.1976	C6951–52
1	1	0	0	Ryûgamizu, Kagoshima City, KY	1.IV.1977	T. SUNOSE	12.IV.1977	C6955–56
5	0	0	0	Ariake, Kagoshima Pref., KY	21.III.1977	K. OHNO	3.IV–1.V.1977	C6961–65
3	0	0	0	Kashiwabaru, Kagoshima Pref., KY	21.III.1977	K. OHNO	3.IV–1.V.1977	C6967–69
1	1	0	0	Hayato, Kagoshima Pref., KY	14.III.1977	T. SUNOSE	12.IV.1977	C6971–72
1	1	0	0	Satsumataki, Kagoshima Pref., KY	11.III.1977	T. SUNOSE	3.IV.1977	C6974–75
0	1	0	0	Tsuno, Miyazaki Pref., KY	12.III.1977	T. SUNOSE	29.IV.1977	C6977
0	0	2	0	Hinagu, Kumamoto Pref., KY	10.III.1977	T. SUNOSE	——	C6979–80

Pref.; Kunisaki, Oita Pref.; Karatsu, Saga Pref.; Tachibanayama and Itoshima, Fukuoka Pref.; Iki, Tsushima and the Goto Islands, Nagasaki Pref.; Kobayashi, Miyazaki Pref.; Kamikoshiki, Shimokoshiki, Nagashima, Tanegashima and Yakushima, Kagoshima Pref.; Gogayama, Okinawa Pref.

Distribution: Japan (Izu Islands, Shikoku, Kyushu including the above-mentioned islands, and Okinawa).

Remarks: The genus *Lasioptera* MEIGEN (1818) is distinguished from the related genera by the combination of the following characters (YUKAWA, 1971): flagellum with more than 12 segments; R5 straight, close to R1 but not bowed at middle; distance between costa and R5 widest at the base of wing; cercus of ovipositor with fish-hook shaped spines. Details of larval characteristics were described in MÖHN (1955, 1966/1968).

At least 12 species of the genus are known to exist in Japan (YUKAWA, 1971). Some of them have been classified chiefly by the difference in an arrangement of spines arising on the cercus of ovipositor, and partly by the different numbers of eye bridge ommatidia and the shape of the hypoproct. The present species resembles *Lasioptera achyranthii* SHINJI (1939) by having an entire hypoproct and an eye bridge which is three to four facets long medially. This species is, however, distinguishable from *L. achyranthii* and other relatives in the following aspects: lateral spines of the ovipositor are arranged irregularly (Fig. 1B); apical portion of the cercus is emarginated, forming relatively short setose lobes (Fig. 1C); each flagellomere basally has a whorl of relatively long scales; and mature larvae have only four terminal papillae.

In particular, the reduction from eight to four in number of the terminal papillae is unusual for the genus *Lasioptera*, though that from eight to six has been noted for some species (MÖHN, 1966/1968). Such reduction from eight to four is one of the main characteristics for the mature larvae of the genus *Ozirhincus* RONDANI (MÖHN, 1955, 1966/1968). The present species, however, differs from the members of the genus *Ozirhincus* by having short, bulbous labella which are not elongate and styliform.

In addition, it should be mentioned here that this species is responsible for the leaf vein gall and requires one (univoltine) or more years (prolonged diapause) to complete its life history, while the majority of species in the genus *Lasioptera* are known to be responsible for stem galls and to repeat two or more generations a year (multivoltine).

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