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Galls of *Cerataphis bambusifoliae* (Hemiptera, Aphididae) Found on *Styrax suberifolius* in Taiwan

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Utako Kurosu, Mayako Kutsukake, Shigeyuki Aoki, Chuan-Chan Wang, How-Jing Lee, and Takema Fukatsu (2008) Galls of *Cerataphis bambusifoliae* (Hemiptera, Aphididae) found on *Styrax suberifolius* in Taiwan. *Zoological Studies* **47**(2): 191-199. Hitherto unknown fig-shaped galls of a cerataphidine aphid were found on *Styrax suberifolius* in a mountainous region of Taiwan. The morphology of 1st-instar nymphs deposited by alates that had emerged from the galls accorded well with the morphology of 1st-instar nymphs of *Cerataphis bambusifoliae* on bamboo. The mitochondrial DNA sequences from the gall and bamboo aphids also supported the identity of the 2 generations. The gall-living aphids are therefore considered to be the primary host generation of *C. bambusifoliae*, and a description of the alates, apterous adults, and the 1st-instar nymphs is given. We also revealed that, like other cerataphidines, *C. bambusifoliae* produces many 2nd-instar, sterile soldiers in their galls. http://zoolstud.sinica.edu.tw/Journals/47.2/191.pdf

Key words: Cerataphidini, Hormaphidinae, Host alternation, Mitochondrial DNA, Soldier aphid.

The aphid genus *Cerataphis* (Hormaphidinae: Cerataphidini) comprises about 10 named species. The apterae of *Cerataphis* produced on the secondary host are dark brown in color, fringed with wax, and round, flattened, scale-like aphids with a pair of frontal horns, and some are notorious as pests of palms (Reinert and Woodiel 1974, Enobakhare 1994, Howard et al. 2001) or orchids (Zimmerman 1948, Sunde 1973). So far as is known, all species of the tribe Cerataphidini are associated with the plant genus *Styrax*, their primary host, on which galls of various shapes are formed (Blackman and Eastop 1994, Stern 1995, Stern and Foster 1996). Within the genus *Cerataphis*, 3 species have hitherto been reported to induce galls on *Styrax*: *C. brasiliensis* (Hempel) on *S. benzoin* (Stern et al. 1995), *C. vandermeermohri* (Hille Ris Lambers) on *S. subpaniculatus* (Kurosu and Aoki 1997, as *S.* "*serrulata*"), and *C. jamuritsu* (Takahashi) on *S. suberifolius* (Aoki et al. 1998, Kurosu et al. 2004). Herein we report that a 4th species, *C. bambusifoliae* Takahashi, forms galls on *S. suberifolius* in Taiwan.

Cerataphis bambusifoliae is peculiar among species of the genus in that its secondary hosts are plants of the Bambusoideae. This species, together with *C. vandermeermohri*, is also peculiar within the genus in not harboring an extracellular fungal symbiont, which is known from the other species of *Cerataphis* and the related genera *Tuberaphis* and *Glyphinaphis* (Fukatsu et al. 1994,

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Hongoh and Ishikawa 2000), but it does have the endocellular bacterial symbiont *Buchnera*, which is found in almost all aphid species. The secondary-host generation of *C. bambusifoliae* has been recorded from bamboo in Taiwan (Takahashi 1925, Liao 1976), Fuzhou, China (Takahashi 1930), and Uttar Pradesh, India (Saha and Chakrabarti 1988). The apterae infest culms and undersides of leaves of bamboo (Blackman and Eastop 1994). Kurosu et al. (1996) found alate sexuparae on *Pleioblastus* sp. in central Taiwan in Dec., but the primary-host generation has remained unknown to date. In 2004 and 2005 several fig-shaped aphid galls were found on *S. suberifolius* in a mountainous region of Taiwan. Having examined the insect mitochondrial (mt)DNA and the morphology of 1st-instar nymphs born by alate aphids emerging from these galls, we reached the conclusion that the galls were of *C. bambusifoliae*. We also found that the species produces 2nd-instar soldiers in the galls, like other cerataphidines (Aoki et al. 1977, Kutsukake et al. 2004, Kurosu et al. 2006a b). In this paper, we present evidence supporting the identity, describe the galls and the primary-host generation, and report the occurrence of sterile soldiers in *C. bambusifoliae*.

MATERIALS AND METHODS

Collection of materials

Galls of presumed *C. bambusifoliae* (Fig. 1) were found on trees of *S. suberifolius* at Hsi-Chung (1090 m in elevation), Taoyuan County, by the roadside between the villages of Mingchih and Siling, north-central Taiwan, on 10 and 11 June 2004 and 23 Apr. 2005. Aphid materials for

Fig. 1. A gall (no. 05015) of *Cerataphis bambusifoliae* on *Styrax suberifolius*. A number of soldiers are walking on the outer surface.

Table 1. Size and inhabitant composition of 5 galls of *Cerataphis bambusifoliae*

Gall	Date of collection	Gall size (length × diameter in mm)	Colony size	Percent soldiers	No. of alates
05013	23 Apr. 2005	73.3 × 30.8	7743	33.5	0
05014	23 Apr. 2005	42.0 × 23.2	2857	20.5	0
05015	23 Apr. 2005	64.2 × 26.9	7690	37.4	0
04269[a]	10 June 2004	92.5 × 34.4	9824	47.6	277
04278	11 June 2004	64.4 × 25.3	6586	37.7	138

[a]Tens of aphids used for DNA extraction were not included in the data.

sequencing DNA were sampled from 1 gall (no. 04269) collected on 10 June 2004 (DNA sample A) and another gall on 23 Apr. 2005 (sample B). Five galls listed in table 1 were submerged in 80% ethanol immediately or within the day of collection to examine the colony structure. Some alates taken out of gall 04269 were confined in 2 glass vials with sheets of tissue paper and a cotton plug to obtain their offspring. After some 1st-instar nymphs were seen walking on the paper, 80% ethanol was poured into the vials.

Aphid materials of the secondary-host generation for extracting DNA were collected from *Yushania niitakayamensis* at Habon, Nantou County, central Taiwan, on 20 Oct. 2002 (sample C) and from *Pleioblastus* sp. at Kuangyinshan near Puli, Nantou County, on 6 Nov. 1994 (sample D).

Examination of aphid morphology

The 5 galls preserved in 80% ethanol were dissected in the laboratory, and all the aphids were counted and sorted into soldiers and non-soldiers. Many aphids from gall 04269, including 1st-instar nymphs born by alates in the vials, were heated in 10% KOH solution, stained with either Evans' blue or acid fuchsin, and mounted in balsam on glass slides, and the morphology was examined under a light microscope. We mounted a total of 127 soldiers from this gall, and examined whether they had the next instar cuticle developing inside.

Observation of defensive behavior

To confirm defensive behavior by the soldiers, we placed 2 lepidopteran larvae (5 and 16 mm long) on the surface of a cut-off gall (no. 04278), where many soldiers were walking. Some soldiers were also placed on our hands to test whether they would pierce the human skin to cause irritation.

DNA sequencing

Mitochondrial DNA sequencing was performed essentially as previously described (Fukatsu et al. 2001). Total DNA was extracted from a fresh or fixed insect using a QIAamp tissue kit (QIAGEN, Hilden, Germany). From the insect

Table 2. Insect samples subjected to the molecular phylogenetic analysis

Insect sample	Collection locality	Collection date	Host plant	Accession no.[a]	Reference
Cerataphis bambusifoliae (A)	Hsi-Chung, Taoyuan Co., Taiwan	10 June 2004	*Styrax suberifolius*	AB301592	This study
Cerataphis bambusifoliae (B)	Hsi-Chung, Taoyuan Co., Taiwan	23 Apr. 2005	*Styrax suberifolius*	AB301593	This study
Cerataphis bambusifoliae (C)	Habon, Nantou Co., Taiwan	20 Oct. 2002	*Yushania niitakayamensis*	AB301594	This study
Cerataphis bambusifoliae (D)	Kuangyinshan, Nantou Co., Taiwan	6 Nov. 1994	*Pleioblastus* sp.	AB301595	This study
Cerataphis vandermeermohri	Tarutung, Sumatra, Indonesia	19 Feb. 1996	*Styrax subpaniculatus*	AB301596	This study
Cerataphis brasiliensis	Sun Moon Lake, Nantou Co., Taiwan	5 Nov. 1994	Unidentified palm	AB301599	This study
Cerataphis freycinetiae	Bogor, Java, Indonesia	18 Jan. 1997	Unidentified pandanus	AB301598	This study
Cerataphis jamuritsu	Hsinhua, Taitung Co., Taiwan	3 Nov. 1994	*Styrax suberifolius*	AB301597	This study
Pseudoregma bambucicola	Kagoshima, Kagoshima, Japan	28 Dec. 1997	*Bambusa multiplex*	AB035882	Fukatsu et al. (2001)
Psuedoregma koshunensis	Fukiage, Kagoshima, Japan	28 Dec. 1997	*Bambusa multiplex*	AB035871	Fukatsu et al. (2001)
Ceratovacuna japonica	Chiba, Chiba, Japan	10 Nov. 1994	*Pleioblastus chino*	AB035876	Fukatsu et al. (2001)
Ceratovacuna longifila	Kuangyinshan, Nantou Co., Taiwan	6 Nov. 1994	*Pleioblastus* sp.	AB035878	Fukatsu et al. (2001)
Chaitoregma tattakana	Kuangyinshan, Nantou Co., Taiwan	6 Nov. 1994	*Pleioblastus* sp.	AB035880	Fukatsu et al. (2001)
Neothoracaphis yanonis	Hongo, Tokyo, Japan	8 June 1996	*Distylium racemosum*	AB301600	This study

[a]Sequences deposited in the DDBJ (DNA Data Bank of Japan).

DNA, a 1.6 kb mtDNA segment, containing small subunit rRNA, tRNA-Val, and large subunit rRNA genes, was amplified by polymerase chain reaction (PCR) using primers MtrA1 (5'-AAWAAACTAGGA TTAGATACCCTA-3') and MtrB1 (5'-TCTTAATYCA ACATCGAGGTCGCAA-3'), under a temperature profile of 94°C for 2 min followed by 30 cycles of 94°C for 1 min, 48°C for 1 min, and 65°C for 3 min. The amplified DNA fragment was cloned and sequenced using 6 primers: MtrA1, MtrA2 (5'-ACA AAGTAARTGTACTGGAAAGTGT-3'), MtrA3 (5'-AT TTTYATCTGTTTAACAAAAACAT-3'), MtrB1, MtrB2 (5'-TTAATACAATGTTTTTGTTAAACAG-3'), and MtrB3 (5'-ACACTTTCCAGTACAYTTACTTTGT-3').

Molecular phylogenetic analysis

Aphid samples subjected to molecular phylogenetic analysis are listed in table 2. A multiple alignment of the nucleotide sequences was generated using the program package Clustal W (Thompson et al. 1994). Aligned nucleotide sites containing gaps were removed from the dataset, and the final alignment was inspected and corrected manually. A Neighbor-joining (NJ) tree, with 1000 bootstrap resamplings, was constructed by the program package Clustal W (Thompson et al. 1994).

RESULTS AND DISCUSSION

Identity

The alates confined in the 2 vials gave birth to many 1st-instar nymphs (Fig. 2A). A description of

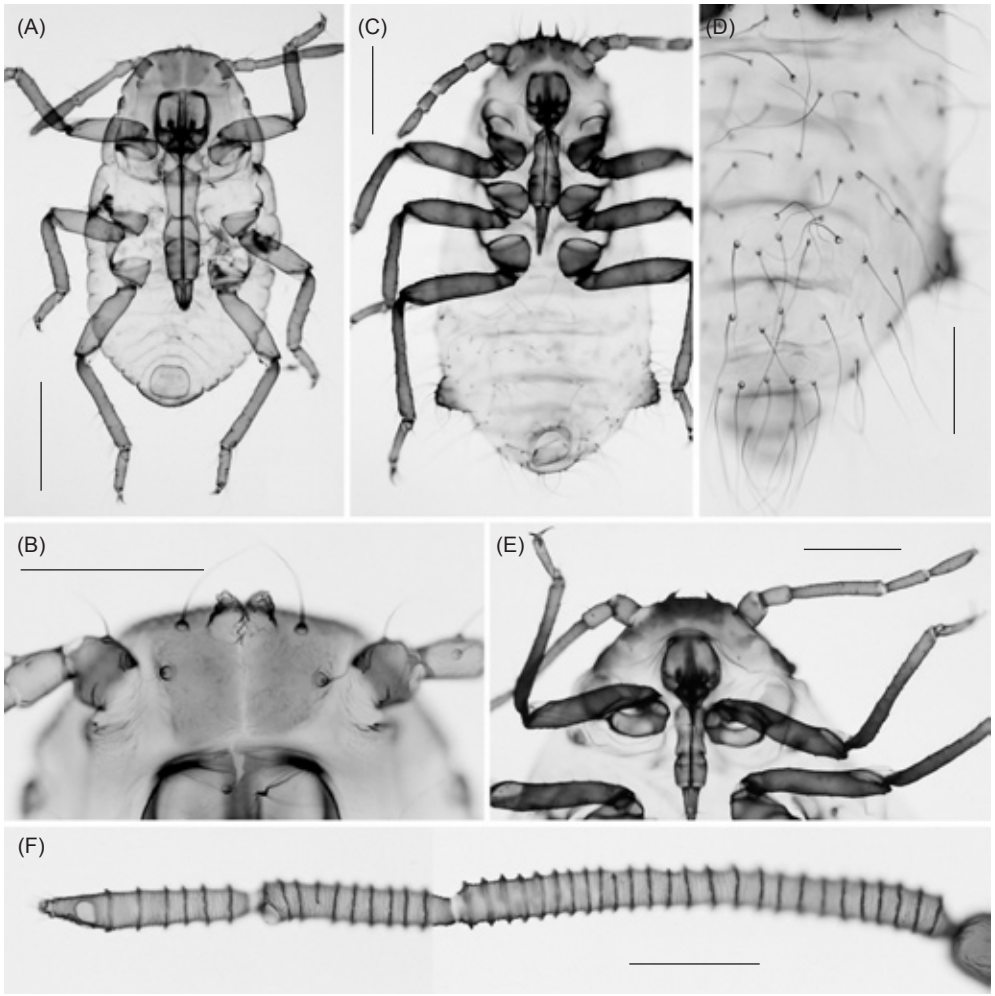

Fig. 2. Slide-mounted specimens of *Cerataphis bambusifoliae*. (A) First-instar nymph deposited by emigrant; (B) the same, its head indicating a pair of frontal horns and ventral setae; (C) soldier; (D) the same, its abdominal tergites with many, long setae; (E) head of apterous adult; (F) flagellum of alate emigrant. Scale bars: 0.2 mm for A, C, and E; 0.1 mm for B, D, and F.

these nymphs is given in the Description section. Their morphology accorded well with that of 1st-instar nymphs of *C. bambusifoliae* collected from bamboo, except for the smaller size. (In general, 1st-instar nymphs deposited by alates are smaller than those produced by apterae.) They had (1) the tergites which were wholly surrounded by marginal wax plates (Fig. 2A), (2) a pair of small, hairless, rugged and blunt horns (Fig. 2B), (3) no spine-like setae on the ventral side of the head (Fig. 2B), and (4) a spine-like seta on the apex of each hind tibia. The combination of these 4 characters is unknown from any other cerataphidine.

Molecular data also supported the genetic identity of the aphid samples. The DNA sequences of 1636 bp of the 2 insects from galls (samples A and B) and an insect from *Y. niitakayamensis* (sample C) were almost identical to each other: 99.9% between A and B; 99.8% between A and C; and 99.9% between B and C. An insect from *Pleioblastus* sp. (sample D) exhibited a very similar but slightly different sequence: 99.0% identity to each of A, B and C, respectively. A molecular phylogenetic analysis of cerataphidine aphids indicated that the samples A, B, C and D formed a distinct and coherent monophyletic group in the genus *Cerataphis* (Fig. 3), confirming the idea that these samples represent one and the same species, *C. bambusifoliae*.

Structure of the galls

Galls of *C. bambusifoliae* (Fig. 1) were elongated fig shaped with a single cavity, up to 9 cm in length, and open at the apex. The opening had probably been a small slit, but those of the 5 galls were widened to various degrees, possibly having been broken by some other insects. The gall wall was thin, and several longitudinal veins appeared on the outer surface. The outer surface, especially its apical part, was coated with wax due to the activity of soldiers. The inner surface of the wall was smooth, without projections. Some galls had broken parts somewhere in the wall. The 5 galls were located at the tips of lignified twigs, which were 2.5-3.7 mm in diameter. This suggests that the gall of *C. bambusifoliae* may be made of a terminal bud, but this requires confirmation.

The gall of *C. bambusifoliae* can easily be distinguished from those of *C. jamuritsu* on *S. suberifolius* (cf. fig. 1 in Aoki et al. 1998) and *C. brasiliensis* on *S. benzoin* (cf. fig. 1 in Stern et al. 1994) by its thinner wall.

Colony size

The 5 galls contained thousands of aphids, up to 9800 (Table 1). The galls collected in June 2004 contained many alates, while those collected in Apr. 2005 contained no alates but a number of 4th-instar wingpadded nymphs. All galls contained many 2nd-instar soldiers (Fig. 2C), which amounted to 47.6% of the colony size in the largest gall (Table 1).

Sterile soldiers

Morphological differences found between soldiers and "normal" 2nd-instar nymphs (reproductives-to-be) are summarized in table 3. First-instar nymphs of *C. bambusifoliae* could easily be recognized, because they had only 1 pair of long setae on each 1st tarsal segment, 5 apical setae on each antenna, 3 pairs of setae on the 1st to 5th abdominal tergites and no sclerotized cornicles, while the 2nd and later instar nymphs had 2 spine-like setae (sensory pegs) in addition to a pair of long setae on each 1st tarsal segment,

Table 3. Main morphological differences between soldiers and normal 2nd-instar nymphs of *Cerataphis bambusifoliae*. Morphometric data are based on 10 well-mounted specimens from gall 04269

Soldier	Normal 2nd-instar nymph
Body 0.81-1.01 (mean 0.92) mm long, 0.32-0.46 (0.42) mm wide; hind femorotrochanter 0.212-0.256 (0.242) mm long	Body 0.85-1.03 (0.93) mm long, 0.40-0.53 (0.46) mm wide; hind femorotrochanter 0.212-0.236 (0.226) mm long
Tergites sclerotized, with many, very long setae (Fig. 2D); longest seta on 3rd abdominal tergite 0.096-0.136 (0.118) mm	Tergites membranous, with several short setae; longest seta on 3rd abdominal tergite 0.024-0.038 (0.030) mm
Head with a pair of thick spine-like setae on frons (Fig. 2C), which are about 0.004-0.006 mm thick at base and 0.024-0.030 (0.027) mm long	Head with a pair of rather thick, spine-like setae on frons, which are about 0.002-0.003 mm thick at base and 0.012-0.018 (0.015) mm long
Cornicle distinctly protruded like a cone (Fig. 2C), 0.026-0.030 (0.028) mm in outer diameter at apex	Cornicle ring-like, only slightly protruded, 0.022-0.028 (0.025) mm in outer diameter

6 apical setae on each antenna, more than 6 setae on the 1st to 5th abdominal tergites, and distinct cornicles (Fig. 2C, D). We found some 1st-instar nymphs with a clear soldier cuticle developing inside and some with a normal 2nd-instar cuticle. Four out of 28 normal 2nd-instar nymphs had the next instar cuticle developing inside, while none of the 127 soldiers had such a cuticle. This indicates that soldiers of *C. bambusifoliae* do not molt past the 2nd instar and are sterile.

Behavior of soldiers

Before disturbing the galls for collection, we confirmed that a number of soldiers resided on the surface of at least one of the galls. Leaves below the galls were dirtied with wax and honeydew, on which sooty mold was growing. Because only a small number of cast-off skins and a little honeydew were found in the galls we dissected, there is little doubt that soldiers of *C. bambusifoliae* push cast-off skins and globules of honeydew out of their gall like those of other gall-forming aphids (Aoki and Kurosu 1989, Benton and Foster 1992, Pike et al. 2002, Shibao et al. 2006).

The 2 lepidopteran larvae placed on a gall were soon attacked by 11 and 2 soldiers. They were deposited in ethanol 3 and 4 min after being placed on the surface. Five of the 13 soldiers did not detach themselves from the larvae even after

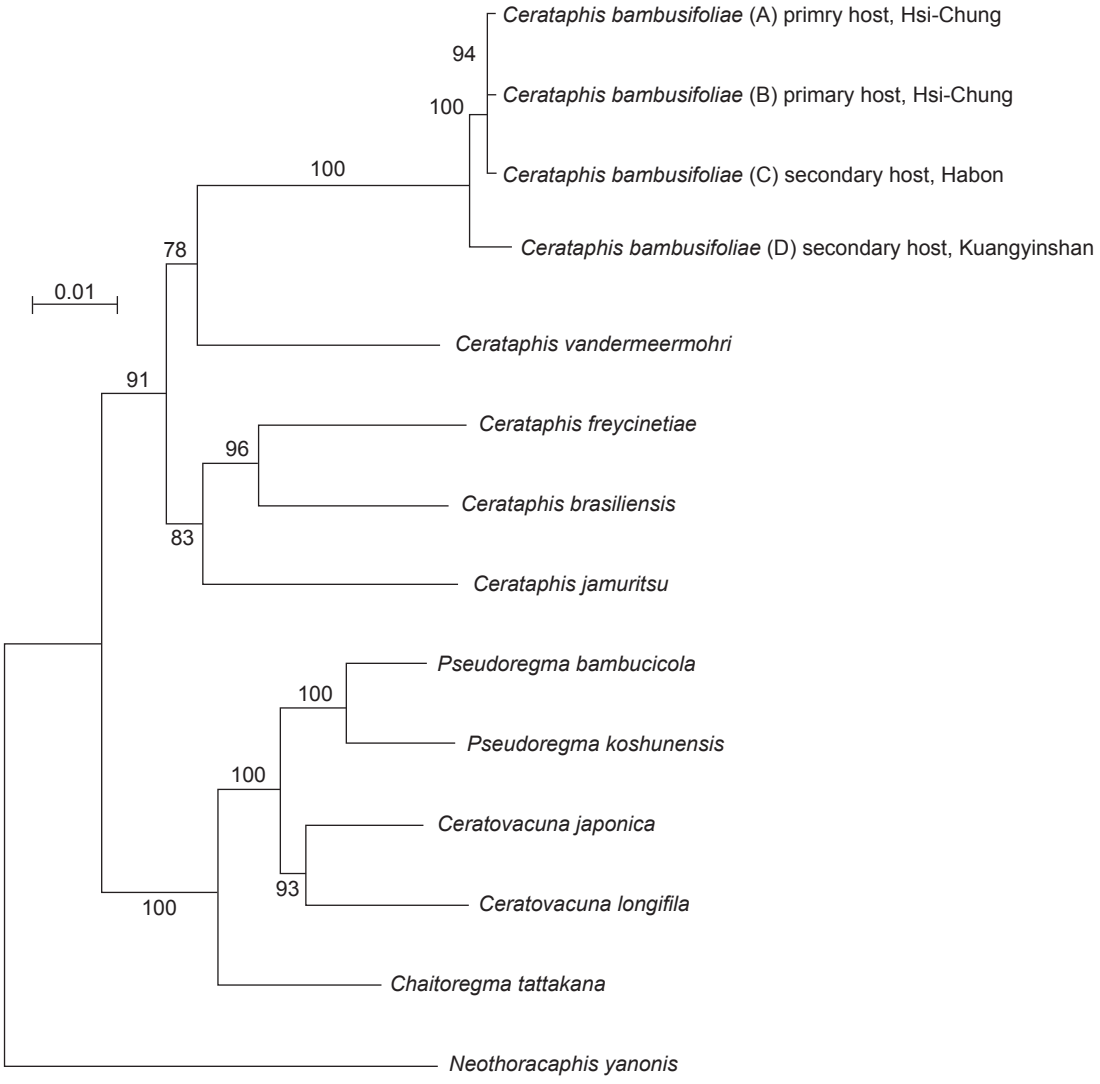

Fig. 3. Molecular phylogenetic analysis of *C. bambusifoliae* samples (A-D) collected from primary and secondary host plants at different localities, on the basis of their mitochondrial ribosomal RNA gene sequences. A Neighbor-joining phylogeny inferred from unambiguously aligned 1510 nucleotide sites is shown. Bootstrap values are indicated on the nodes.

being deposited in ethanol, and we confirmed under a dissecting microscope that 4 were piercing the larva with their stylets. Soldiers of *C. bambusifoliae* also pierced our hand, which caused a slight irritation. As expected from the colony size (Table 1), soldiers of *C. bambusifoliae* did not readily fall off the gall despite the fact that they bear many long setae on their tergites (cf. Aoki et al. 1977, Kurosu and Aoki 1997).

Predators

Of the 5 galls dissected (Table 1), 4 contained no predators. The remaining one (no. 05014) contained 1 larva, 1 pupa, and 1 pupal case of the pyralid *Assara formosana* Yoshiyasu, an often-found predator from cerataphidine galls (Yoshiyasu 1991, Aoki and Kurosu 1993, Kurosu et al. 2006b).

Life cycle

The present study revealed that alate emigrants of *C. bambusifoliae* appear from Apr. onward in Taiwan, and migrate to bamboo. As already mentioned, we found alate sexuparae on bamboo in Dec. (Kurosu et al. 1996), which would return to *S. suberifolius*. Wingpadded nymphs were also contained in sample C, which was collected from *Yushania niitakayamensis* on 20 Oct. It should be emphasized that the galls collected in Apr. already contained thousands of aphids (Table 1). It is unlikely that it took only a few cool months for these galls to grow to sustain such large aphid colonies. Galls of some cerataphidines (Aoki and Kurosu 1990, Kurosu and Aoki 1998a) and nipponaphidines (Kurosu and Aoki 1998b) are known to last for more than 1 yr. The same may be true for *C. bambusifoliae*, and this remains to be confirmed.

Symbionts

Unlike most other *Cerataphis* species (Fukatsu et al. 1994, Hongoh and Ishikawa 2000), the secondary-host generation of *C. bambuisfoliae* was reported to harbor the endocellular bacterial symbiont *Buchnera* instead of an extracellular fungal symbiont. In this study, histological examination confirmed the presence of *Buchnera* in apterous adults of the primary-host generation and also the absence of extracellular fungal symbiont (data not shown).

DESCRIPTION

Unless the sample size is indicated in parentheses, morphometric data for each morph in the following description are based on 10 specimens from gall 04269.

Apterous adult. Body 1.35-1.72 (mean 1.59) mm long (*n* = 9); thoracic and abdominal tergites membranous, without demarcated wax plates, but with numerous transversely elongated, indistinct plates that may produce wax. Head (Fig. 2E) with a pair of distinct spine-like setae, which are about 0.004 mm thick and 0.014-0.022 (0.017) mm long, along the frontal margin, with 2 (sometimes 3 or 4) smaller spine-like setae and several thinner setae ventrally between antennae, dorsally with a number of setae which are thinner yet much longer than the spine-like setae. Vertex slightly protruded forward in some specimens. Antenna 5-segmented, 0.44-0.54 (0.48) mm long, clearly longer than (approximately 1.5-1.8 times as long as) fore tibia; primary rhinaria on 4th segment spherical and 0.008-0.010 (0.010) mm in axial length, on the 5th consisting of a round rhinarium and a few accessory rhinaria, 0.014-0.018 (0.016) mm in axial length (including the accessory rhinaria); 5th segment weakly imbricate, 0.100-0.116 (0.107) mm long, with 6 setae at apex and 1 seta on basal 1/5 to 1/3. Ultimate rostral segment conical, 0.088-0.096 (0.092) mm long (*n* = 9), without secondary setae. Hind femorotrochanter 0.316-0.380 (0.353) mm long. Tarsi 2-segmented; 1st segment with a pair of setae and a pair of sense pegs on all legs; 2nd segment 0.110-0.124 (0.114) mm long on hind leg, dorsoapically with a pair of long, capitate setae (one of which is often reduced); empodial setae short and thin, not reaching apices of the claws. Cornicle ring-like, 0.038-0.048 (0.041) mm in outer diameter, slightly elevated on a round sclerite, encircled by 8-15 (10.7) setae on the sclerite. Eighth abdominal tergite with 7-10 (8.1) setae (*n* = 9). Cauda rounded, with 18-21 (19.2) setae. Anal plate not or incompletely bilobed, with 13-16 (14.2) setae. Genital plate with a pair of setae at middle and 17-25 (21.5) setae along posterior margin.

Alate (*emigrant*). Body 1.72-1.92 (1.80) mm long (*n* = 8). Head 0.45-0.47 (0.46) mm wide across compound eyes (*n* = 6), with a number of short, dorsal setae up to 0.020 mm long. Antenna 5-segmented; flagellum (Fig. 2F) longer than and approximately as thick as fore tibia; 3rd segment 0.39-0.45 (0.42) mm long, clearly longer than (1.20-1.37 times as long as) 4th and 5th together;

4th segment 0.14-0.17 (0.16) mm long, about as long as 5th segment, which is 0.15-0.18 (0.16) mm; processus terminalis short, with 6 setae at apex. Secondary rhinaria ring-like, encircling more than half the segment; 3rd, 4th, and 5th segments with 25-30, 8-13, and 6-9 ring-like rhinaria, respectively; apical 1 or 2 on 4th segment usually and apical 1 on 5th sometimes united with the primary rhinarium. Primary rhinarium on 4th segment large, spherical, 0.016-0.020 (0.019) mm in axial length, primary rhinarium on 5th about as large as that on 4th, but accompanied by a few small accessory rhinaria, 0.016-0.022 (0.019) mm in axial length. Clypeus ventrally with many indistinct oval swellings, but almost smooth. Ultimate rostral segment 0.080-0.088 (0.085) mm long, without secondary setae. Forewing with bifurcated media. Hind femorotrochanter 0.46-0.50 (0.47) mm long. Tarsi slightly imbricate; 1st segment with a pair of long setae and a pair of shorter sense pegs between the long setae on all legs; 2nd segment 0.120-0.132 (0.125) mm on hind tarsus, the dorsoapical setae long and capitate (one of which is often reduced); empodial setae capitate, extending beyond apices of the claws. Abdomen membranous but weakly sclerotized and dusky on 8th tergite, which bears 7-11 (8.8) setae (n = 9). Cornicle ring-like, 0.032-0.038 (0.035) mm in outer diameter, on a weakly sclerotized plate, encircled by 10-13 (10.9) short setae. Cauda rounded, with 22-25 (23.6) setae (n = 9). Anal plate divided mesially, with a total of 19-21 (20.0) setae (n = 7). Genital plate with 2-4 setae (n = 8) at middle and 24-31 (28.4) setae along posterior margin (n = 8).

First-instar nymph deposited by emigrant (Fig. 2A). Body (excluding horns) 0.66-0.70 (0.68) mm long. Head fused with prothorax. Tergites wholly surrounded by a row of prominent oval cells of marginal wax plates, except where they are interrupted by segmentation and eyes. Cephalothorax, marginal parts of meta- and mesothoracic tergites, and those of 1st to 7th abdominal tergites, 8th abdominal tergite and cauda sclerotized. Head dorsally with 2 pairs of setae along frontal margin, ventrally with a pair of setae between antennae and a pair of long setae along frontal margin which are clearly longer than the dorsal setae and 0.062-0.072 (0.066) mm long, without any spine-like seta. Frontal horns (Fig. 2B) small, hairless, rugged and blunt, 0.020-0.024 (0.021) mm long, located near mesial line between the long ventral setae. Antenna 4-segmented; 3rd and 4th segments spinose, 0.092-0.100 (0.095) and 0.106-0.110 (0.108) mm long, respectively; 1st to 3rd segments each with 2 setae; 4th segment with 5 apical setae and 1 longer seta which is located at basal 1/3 and 0.040-0.048 (0.045) mm long; primary rhinarium on 3rd segment 0.008 mm in axial length, on 4th segment composed of a spherical rhinarium and 1 or 2 smaller accessory rhinaria, 0.012-0.018 (0.014) mm in axial length. Rostrum long, extending beyond hind coxae, reaching 4th or 5th abdominal segment; ultimate segment truncated at apex, 0.062-0.064 (0.063) mm long, without secondary setae. Hind femorotrochanter 0.174-0.186 (0.177) mm long; hind tibia apically with a spine-like seta on inner side. Tarsi 2-segmented; 1st segment with a pair of setae which are 0.052-0.058 (0.055) mm long on hind leg; 2nd segment weakly imbricate, 0.076-0.080 (0.078) mm long on hind tarsus, with a pair of dorsal setae in middle, 3 pairs of setae apically, and a pair of setae on empodium, the dorsoapical setae long and capitate (but inner one on foreleg reduced), the empodial setae extending beyond apices of the claws and spatulate, the lateroapical setae also long and spatulate, the others pointed. Marginal wax plates on 3rd abdominal tergite consisting of 9-11 cells arranged in a row; 8th tergite with a large wax plate of 21-25 cells. First to 5th abdominal tergites each with 3 (1 spinal, 1 marginal and 1 pleural) pairs of short setae, of which marginal setae on 3rd tergite are 0.010-0.016 (0.013) mm long; 6th and 7th tergites each with 2 (1 spinal and 1 marginal) pairs of setae; 8th tergite and cauda each with a pair of setae; anal plate with 2 pairs of setae. Cornicle absent.

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