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Title	Revision of the genus <i>Parachaitophorus</i> Takahashi (Hemiptera: Aphididae: Drepanosiphinae), with descriptions of five morphs and biology of <i>P. spiraeae</i> (Takahashi, 1924) on <i>Spiraea Cantoniensis</i> (Rosaceae)
Author(s)	Sugimoto, Shun'ichiro; Sugimoto, Shun'ichiro
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**REVISION OF THE GENUS PARACHAITOPHORUS TAKAHASHI
(HEMIPTERA: APHIDIDAE: DREPANOSIPHINAE), WITH DESCRIPTIONS
OF FIVE MORPHS AND BIOLOGY OF *P. SPIRAEAE* (TAKAHASHI, 1924) ON
SPIRAEA CANTONIENSIS (ROSACEAE)**

By SHUN'ICHIRO SUGIMOTO

Abstract

SUGIMOTO, S., 2011. Revision of the genus *Parachaitophorus* Takahashi (Hemiptera: Aphididae: Drepanosiphinae), with descriptions of five morphs and biology of *P. spiraeae* (Takahashi, 1924) on *Spiraea cantoniensis* (Rosaceae). *Ins. matsum. n. s.* 67: 33–40, 10 figs.

The aphid genus *Parachaitophorus* Takahashi, 1937 was reviewed. The morphological study and rearing experiment of *P. spiraeae* (Takahashi, 1924) and *P. yamashitai* Sorin, 1979 appearing on *Spiraea cantoniensis* (Rosaceae) showed that the described morph of *P. sikhotealinicus* Pashtshenko, 1988 recorded from the Russian Far East corresponded to the fundatrix of *P. spiraeae*, and that the described morphs of *P. yamashitai* agreed with the gynopara and male of *P. spiraeae*. Moreover, a field observation suggests that *P. spiraeae* is a heteroecious species. In this paper I propose that *P. sikhotealinicus* and *P. yamashitai* should be treated as junior synonyms of *P. spiraeae*, and describe five morphs and biology of *P. spiraeae* appearing on *S. cantoniensis*.

Author's address. Kôbe Plant Protection Station, 1–1 Hatoba-chô, Chûô-ku, Kôbe, 650-0042 Japan.

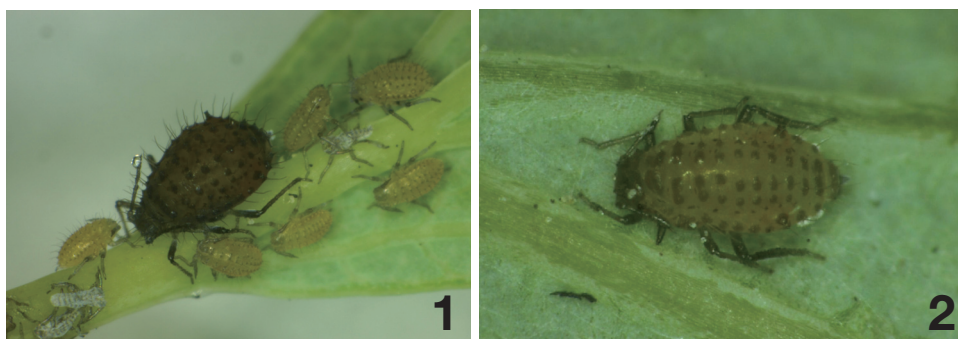
INTRODUCTION

The aphid genus *Parachaitophorus* was erected by Takahashi in 1937 for the type species *Patchia spiraeae* Takahashi, 1924 collected on *Spiraea cantoniensis* (Rosaceae) at Tadono in Wakayama Prefecture, western Japan. Up to now, three species have been known (Remaudière & Remaudière, 1997): *P. spiraeae* (Takahashi, 1924) from Japan and Korea (Paik, 1972), *P. yamashitai* Sorin, 1979 from Japan and *P. sikhotealinicus* Pashtshenko, 1988 from the Far East Russian. Although it is known that these three species live on *Spiraea* plants (Pashtshenko, 1988; Sorin, 1994; Takahashi, 1924, 1961), their biology have not been known, except for a short comment that *P. yamashitai* may be a heteroecious species and may be a synonym of *P. spiraeae* (Sorin 1994).

In the spring 2009, I found apterous viviparous females with three-faceted eyes, which accord with *P. sikhotealinicus*, and the same morphs of multi-faceted eyes, which should be identified with *P. spiraeae*, in the same colony on *S. cantoniensis* at Kôbe in western Japan. Moreover, in the autumn of the same year and at the same place, I found an alate viviparous female and two males of *P. yamashitai*. To clarify the relationship of these three *Parachaitophorus* species appearing on *S. cantoniensis* at Kôbe, I conducted a field observation at that place, reared some morphs in the laboratory, and examined the morphology of specimens taken from the field observation and the reared colony. In this paper, I propose that *P. sikhotealinicus* and *P. yamashitai* are junior synonyms of *P. spiraeae* based on the results, and describe five morphs and biology of *P. spiraeae* appearing on *S. cantoniensis*.

MATERIALS AND METHODS

A field observation for *Parachaitophorus* species was conducted at two hedges of about 60 and 80 *S. cantoniensis* plants at Kôbe City, Hyôgo Prefecture, western Japan in 2009 and 2010. Apterous and alate viviparous females, oviparous females, and males of *Parachaitophorus* species were collected there. The apterous and alate viviparous females were reared on the leaf disc or cut-shoot of *S. cantoniensis* under natural day conditions in the laboratory. All the specimens taken from the field observation and the reared colony were mounted on microscope slides by Martin's (1983) method to examine their morphology in detail. In the following text, morphological terms and a definition of each morph follow Miyazaki (1987a, b). A classification system of aphids follows



Figs. 1, 2. General aspects of apterous forms. 1: fundatrix and its larvae, 2: oviparous female.

that in Remaudière and Remaudière (1997) and Blackman and Eastop (1994, 2006) rather than that in Heie (1980). However I am inclined to the opinion that the genus *Parachaitophorus* should be placed not in the subfamily Parachaitophorinae (Remaudière & Remaudière 1997; Blackman & Eastop, 2006) nor the Aphidinae (Aphididae in Heie (1980)) but in the Drepanosiphinae (Drepanosiphidae in Heie & Wegierek, (2009a, b)) because of the morphological character of the oviparous female.

TAXONOMY

Family Aphididae
Subfamily Drepanosiphinae
Tribe Baltichaitophorini
Genus *Parachaitophorus*

Parachaitophorus Takahashi, 1937: 90.

Type species: *Patchia spiraeae* Takahashi, 1924.

This genus is characterized by the following features: In apterous morphs body oval with many long stout setae arising from conical tubercles; head not fused with pronotum; frontal tubercles absent; eye with three facets only in the fundatrix and oviparous female, and with multi facets and triommatidia in apterous viviparous female; antennae shorter than the body length, five- or six segmented; oviparous female with wax plates in lateroventral abdomen. In alate morphs antennae with oval protuberant secondary rhinaria; fore wing with twice-branched media; hind wing with one oblique vein. In all morphs siphunculi short, truncate, with flange at apex; anal plate bilobed; cauda elongate, rounded at apex.

Parachaitophorus spiraeae (Takahashi)
[Japanese name: Kodemari-ke-aburamushi]

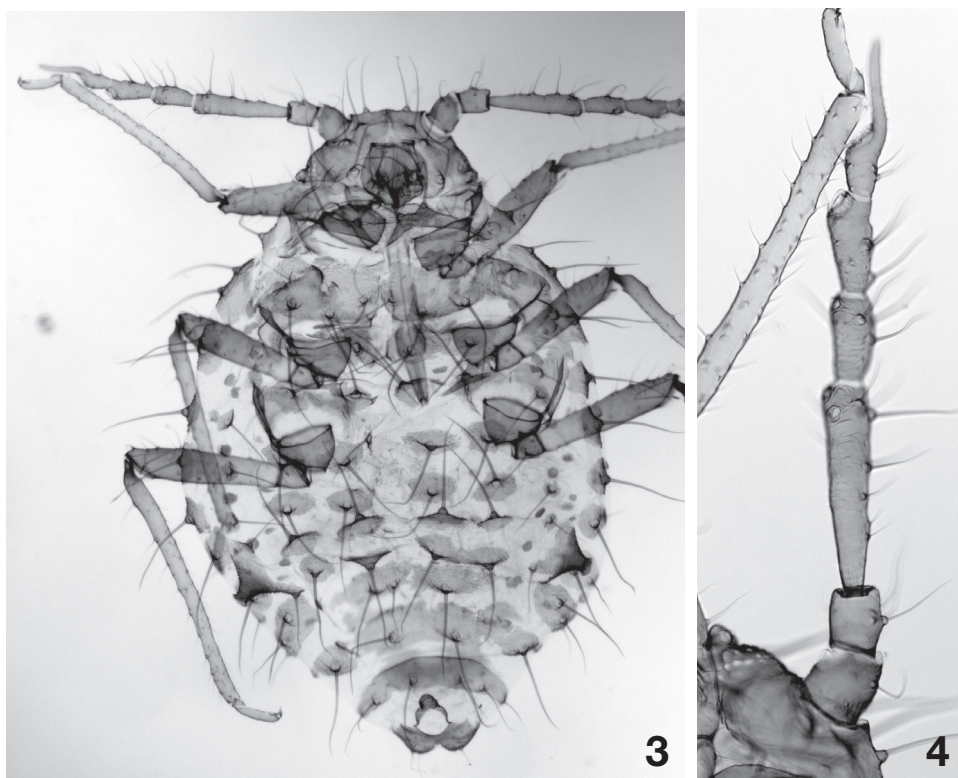
Patchia spiareae Takahashi, 1924: 114.

Parachaitophorus spiraeae: Takahashi, 1937: 90; 1961: 250; Higuchi, 1972: 102; Paik, 1972: 172; Sorin, 1977: 102; Blackman & Eastop, 2006: 1258.

Parachaitophorus sikhotealinicus Pashtshenko, 1988: 611. syn. nov.

Parachaitophorus yamashitai Sorin, 1979: 119. syn. nov.

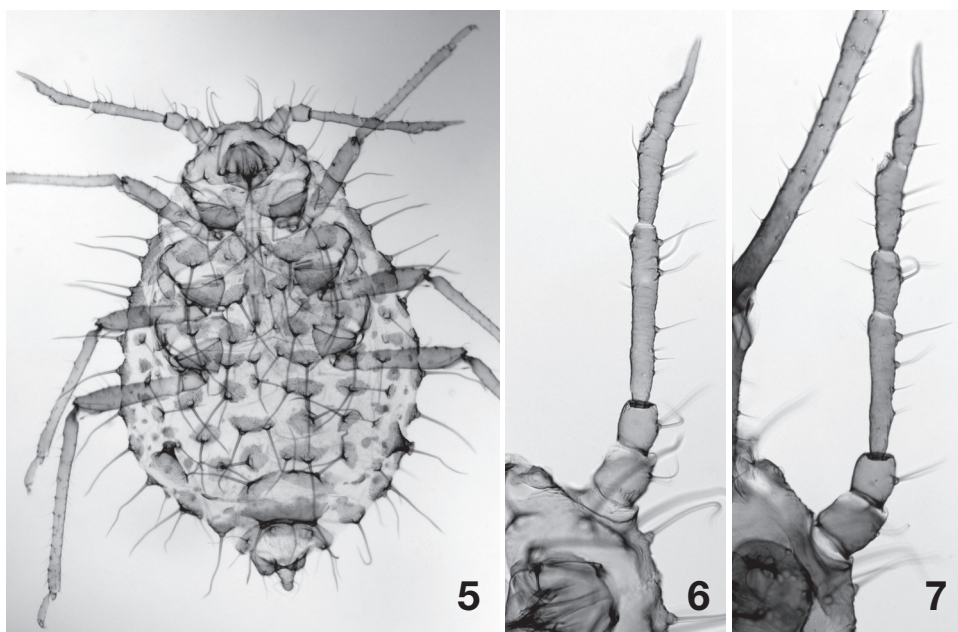
Remarks. Pashtshenko (1988) described *P. sikhotealinicus* based on apterous viviparous females collected from *Spiraea salicifolia* on 27 May 1982 in the Russian Far East. According to the original description and figures in Pashtshenko (1988), this species is characterized by having three-faceted eyes, six-segmented antennae, 1–4 and one secondary rhinarium on the segments III and IV, respectively, and short processus terminalis which is equal to the base of antennal segment VI in length. Apterous viviparous females with three-faceted eyes examined in this study had five- or six-segmented antennae. Their processus terminalis were almost equal to the base of apical segment in length. Some apterous viviparous females with three-faceted eyes and also with six-segmented antennae have one secondary rhinarium on antennal segments III and IV, respectively. These characters accorded well with the original description of *P. sikhotealinicus*. On the other hand, apterous viviparous females with three-faceted eyes were found alone or with young larvae late March through early April (Fig. 1). Their



Figs. 3, 4. Apterous viviparous female. 3: general aspect, 4: six-segmented antenna.

offspring had multi-faceted eyes as in the figure shown by Takahashi (1937), except in the first instar larvae which still had three-faceted eyes, and they were identified with *P. spiraeae* in adult stage. Thus I concluded that *P. sikhotealinicus* correspond to the fundatrix of *P. spiraeae* and should be treated as a junior synonym of *P. spiraeae*.

Sorin (1979) described *P. yamashitai* based on alate viviparous females and males collected on 2 November 1965 in Mie Prefecture, western Japan, and from 1 November to 2 December 1969 in Kanagawa Prefecture, central Japan, but not referred to the host plant. Later, Sorin (1994) recorded *S. cantoniensis*, *S. japonica* and *S. thunbergii* as its host plants, and suggested that *P. yamashitai* is a possible synonym of *P. spiraeae*. *P. yamashitai* is characterized by having onion-shaped swelling at the distal part of antennae. In the field survey on 27 October 2009, I found an alate viviparous female and two males of *P. yamashitai*, of which one male was mating with an oviparous female with normal-shaped antennae. Moreover, the rearing experiment of the alate viviparous female showed that the female produced two oviparous females with normal-shaped antennae (Fig. 2). In the next March, I found some fundatrices of *P. spiraeae* at the place where oviparous females and males were observed in 2009. No other aphid which should be identified with *Parachaitophorus* has been found from *S. cantoniensis* at that place. Thus I concluded that *P. yamashitai* is the gynopara and male of *P. spiraeae* and should be treated as a junior synonym of it.

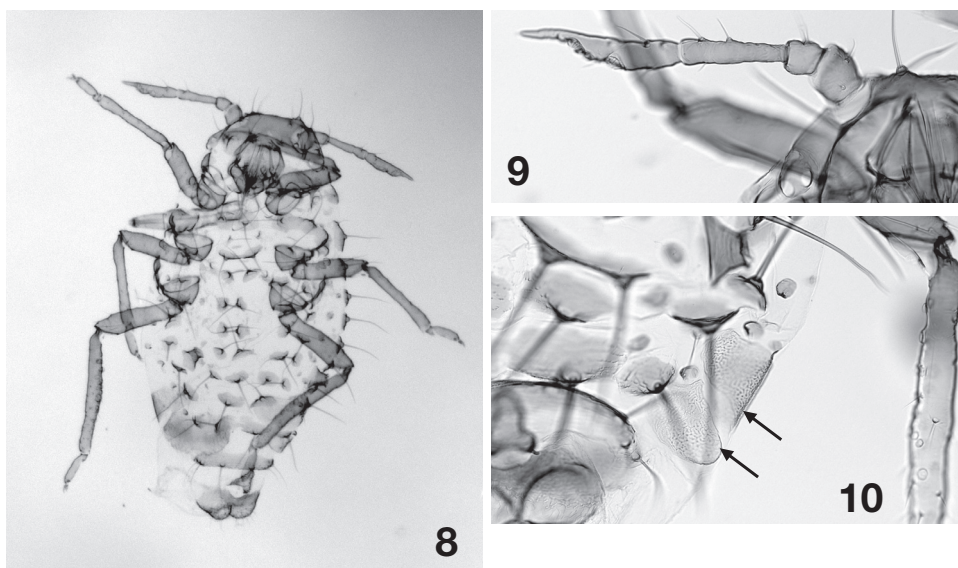


Figs. 5-7. Fundatrix. 5: general aspect, 6: five-segmented antenna, 7: six-segmented antenna.

Apterous viviparous female (n=15) (Figs. 3, 4). Body in life brown with head, antennae, legs, siphunculi, cauda and base of dorsal setae dark brown. Body oval and convex, 1.15–1.67 mm long. Eyes multi-faceted with triommatidia: in first instar larvae eyes with 3 facets only. Antenna six-segmented, 0.46–0.56 times as long as body length; segment III with one secondary rhinarium (rarely 0 or 2) near apex, and with 9–13 setae, of which the longest one is 4.00–5.50 times as long as basal width of the segment; segment IV with one secondary rhinarium (rarely 0) near apex and 3–5 setae; segments V and VI with primary rhinaria ciliated; processus terminalis 1.21–1.57 times as long as base of apical segment. Ultimate rostral segment 1.00–1.22 times as long as segment II of hind tarsus, with two pairs of secondary setae. Genital plate with 2–4 setae anteriorly and 9–14 setae along hind margin. Other characters are given in Takahashi (1924, 1937).

Fundatrix (n=14) (Figs. 1, 5–7). Similar to the apterous viviparous female, but differs from as follows: Eyes with 3 facets only. Antennae five- or six-segmented, 0.41–0.49 times as long as body length; in five-segmented individuals, segment III with one secondary rhinarium (sometimes 0) at apex and 5–10 setae; in six-segmented ones, segments III and IV each with one secondary rhinarium (sometimes 0) near apex, and with 5–7 and 3 or 4 setae, respectively; the longest seta on segment III 3.60–4.50 times as long as basal width of the segment; apical two segments often fused with each other; processus terminalis 0.86–1.14 times as long as base of apical segment. Genital plate with 2 setae anteriorly and 8–13 setae along hind margin. Other characters are given in Pashtshenko (1988).

Alate viviparous female (in spring) (n=12). Body in life purple with head, antennae, legs, siphunculi and cauda dark brown. Body 0.98–1.55 mm long. Antenna six-segmented, 0.63–0.75 times as long as body length; segment III with 17–26 secondary



Figs. 8-10. Oviparous female. 8: general aspect, 9: five-segmented antenna, 10: wax gland plates on lateroventral abdomen (arrows) and hind tibia.

rhinaria, and with 6–15 setae, of which the longest one is 2.68–4.68 times as long as basal width of the segment; segment IV with 6–10 secondary rhinaria and 4–7 setae; segment V with 1–6 secondary rhinaria and 2–6 setae; segments V and VI with primary rhinaria ciliated; processus terminalis 1.64–2.71 times as long as base of apical segment. Ultimate rostral segment 1.05–1.12 times as long as segment II of hind tarsus. Genital plate with 4–7 setae anteriorly and 9–14 setae along hind margin. Other characters are given in Takahashi (1961).

Alate viviparous female (in autumn) (n=10). Differs from the same morph in spring as follows: Antennae 0.83–0.98 times as long as body length; segment III with more secondary rhinaria (25–38) and shorter setae (the longest one is 1.67–2.33 times as long as basal width of the segment); primary rhinaria on segments V and VI not ciliated, but that on V indistinguishable in shape from secondary rhinaria; processus terminalis 2.70–4.00 times as long as base of apical segment; the distal part of processus terminalis with an onion-shaped swelling, of which the diameter is almost equal to the maximum width of apical segment. Genital plate with 2 setae anteriorly and 7–13 setae along hind margin. Other characters are given in Sorin (1979).

Oviaprous female (n=11) (Figs. 2, 8–10). This morph is described here for the first time. Differs from the apterous viviparous female as follows: Body in life yellow with head, antennae, legs, siphunculi, cauda and base of dorsal setae grayish brown, and with a pair of masses of white wax on abdominal segments VI and VII lateroventrally. Body small in size, 0.80–0.99 mm long. Eyes with 3 facets only. Antennae five-segmented, 0.41–0.49 times as long as body length; segment III without secondary rhinaria, and with 1–4 setae (rarely 0) on apical half, of which the longest one is 1.67–2.67 times as long as basal width of the segment; segment IV with 2 or 3 setae; apical two segments often fused with each other; processus terminalis 0.50–1.00 times as long as base of apical

segment. Hind tibiae with 12–25 protuberant scent plaques on the inside. Abdomen with two pairs of lateroventral wax gland plates (“subsiphuncular wax gland plate” in Stroyan (1977)) on segments VI and VII. Genital plate with 6–9 setae anteriorly and 9–14 setae along hind margin. Cauda with 2–4 setae.

Male (n=2). Similar to the alate viviparous female in autumn, but differs as follows: Antennae with 32–36, 10–15, and 2 or 3 secondary rhinaria on segments III–V, respectively; the longest seta on III about twice as long as basal width of the segment. Other characters are given in Sorin (1979).

Specimens examined. All collected from *Spiraea cantoniensis* at Hatoba-chô, Kôbe City, Hyôgo Prefecture, western Japan by S. Sugimoto, and are deposited in the Laboratory of Systematic Entomology, Graduate School of Agriculture, Hokkaido University. Fundatrix: 8 exs., 1.iv.2009; 5 exs., 17.iv.2009; 1 ex., 23.iii.2010. Apterous viviparous female: 2exs., 10.iv.2009; 8exs., 17.iv.2009; 1ex., 24.iv.2009; 4exs., 7.v.2009. Alate viviparous female in spring: 1ex., 10.iv.2009; 8exs., 17.iv.2009; 3ex., 11.v.2009. Alate viviparous female in autumn: 1ex., 27.x.2009; 9exs., 22.x.2010. Oviparous female: 1ex., 27.x.2009; 5exs., 1.xi.2009; 3exs., 14.xi.2010; 2exs., 23.xi.2010. Male: 2exs., 27.x.2009.

Host plants. *Spiraea cantoniensis*. *S. salicifolia* (Pashtshenko, 1988), *S. japonica* (Takahashi, 1961), *S. thunbergii* (Sorin, 1994), *Spiraea* sp. (Paik, 1972).

Distribution. Japan, Korea, the Russian Far East.

Biology. The fundatrix was found on the flower stalks and young shoots of *S. cantoniensis* from late March through middle April. Although the population of the apterous viviparous female increased until late April, it started to decrease middle May and completely disappeared from the host plant before early June. On the other hand, the population of the alate viviparous female also increased until middle May. But it completely disappeared from the host plant before late May probably by emigrating to unknown host plants. A brief rearing experiment using the cut-young shoot of *S. cantoniensis* in the laboratory showed that one fundatrix produced both apterous and alate viviparous females as the first generation (G1), and one apterous viviparous female of G1 generation also produced the both morphs as the second generation (G2). Moreover, none of the alate viviparous females of G1 and G2 generations produced their offspring on the cut-young shoot or settled on the plant. This suggests that these alate viviparous females are emigrants of host-alternating aphids. During summer, no morphs of this species were found from *S. cantoniensis* planted at the observation site. From late October to early November, the alate viviparous females and males were found on old leaves of *S. cantoniensis*, probably by immigrating from unknown secondary host. This suggests that *P. spiraeae* possibly is a heteroecious species, as already mentioned for *P. yamashitai* by Sorin (1994). Further studies on the host plant are needed to confirm the life cycle of *P. spiraeae*.

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