



Review of the East-Asian genus *Reticulaphis* (Aphididae: Hormaphidinae), with two new species

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Abstract

Reticulaphis species (Aphididae: Hormaphidinae: Nipponaphidini) feed mainly on *Ficus* species as secondary hosts, and are endemic to eastern Asia. The fauna of this genus was surveyed in Taiwan, and material from East Asian countries borrowed from the Natural History Museum, London. Taxonomic problems associated with variation between samples are discussed, and as a result four subspecies of *R. distylii* (van der Goot) are recognized as independent species: *asymetrica* Hille Ris Lambers & Takahashi, *fici* (Takahashi), *foveolatae* (Takahashi), and *rotifera* Hille Ris Lambers & Takahashi. *R. distylii* subsp. *minutissima* Hille Ris Lambers & Takahashi is synonymised with *R. foveolatae* (Takahashi); the taxonomic position of subsp. *similis* remains 'incertae sedis'. Two new species are described based on apterous adult females: *R. inflata* sp.n. from Taiwan and Hong Kong, and *R. septica* sp. n. from Taiwan. An illustrated key is provided to the eight recognized species, but excluding the type species, *R. shiiae* Takahashi that remains known only from its description.

Key words: *Reticulaphis*, Hormaphidinae, Nipponaphidini, *Ficus*, new species

Introduction

Species of *Reticulaphis* are heteroecious, that is they alternate between a primary host, *Distylium stellare* (Hamamelidaceae), on which they are known to induce galls, and the leaves of their secondary hosts that are various species of *Ficus* (Moraceae) (Hille Ris Lambers & Takahashi, 1959). *R. distylii* is the only member known to induce conical or fingertip-like galls on *D. stellare* (Hille Ris Lambers & Takahashi, 1959), but detailed life cycles of the others are poorly known. However *D. stellare* is not recorded in Taiwan, we consider that host alternation is not necessary when the primary hosts are sparse, and alate adults can accommodate to suitable secondary hosts. Moreover, we suppose that other members of *Distylium* might be adequate primary hosts for different species of *Reticulaphis*, but this requires confirmation through further investigations.

On the secondary host, a newly emerged larva vigorously seeks a suitable feeding position, but later instars are less active. Apterous adult females are sessile and adhere to leaves usually near veins on the under surface of a leaf. The bodies of these adults are strongly sclerotized, and some species have waxy fringes around the body margin. Preparing such sclerotized individuals onto microscope slides for critical taxonomic study is difficult. In this study we have modified mounting techniques for rendering these aphids translucent without damaging subtle characters.

Reticulaphis was erected by Takahashi (1958) with *shiiae* as the type-species, and he also transferred *Thoracaphis fici* Takahashi, *T. fici* var. *foveolatae* Takahashi, and *T. mirabilis* Takahashi to this genus. Subsequently, Hille Ris Lambers and Takahashi (1959) transferred *Schizoneuraphis distylii* van der Goot to this

genus, and within this species considered a further five subspecies, two being previously named forms, and three being newly described from Java. Ghosh & Raychaudhuri (1973a, b) provided a key to one species and four subspecies of *Reticulaphis*, and Remaudière & Remaudière (1997) catalogued the genus as comprising the following three species and six subspecies: *R. distylii*, *R. distylii* subsp. *asymmetrica*, *R. distylii* subsp. *fici*, *R. distylii* subsp. *foveolatae*, *R. distylii* subsp. *minutissima*, *R. distylii* subsp. *rotifera*, *R. distylii* subsp. *similis*, *R. mirabilis*, and *R. shiiae*.

Aphids of this genus are found mainly in eastern Asia, and recent surveys have indicated that there is a considerable diversity of species in Taiwan. Previous authors have interpreted the recorded structural variation between populations of these essentially sessile aphids as representing several subspecies, and the suggestion has been made that the structural differences might represent clones whose significance should be assessed by breeding and more extensive sampling (Hille Ris Lambers & Takahashi, 1959; Ghosh & Raychaudhuri, 1973a, b). In contrast, we consider that some of these character states are stable, and therefore regard several named sub-species as valid species. In this paper we recognize eight species from Taiwan, including two new species. The apterous adult females are described and illustrated, and a key is provided to distinguish the species.

Researchers have recently stressed taxonomic and phylogenetic issues of the taxa in the tribes Cerataphidini and Hormaphidini (Stern, 1998; von Dohlen *et al.*, 2002), but rarely emphasized the tribe Nipponaphidini. Morpho-taxonomic problems among Nipponaphidini species are obstacles to further work, and we recommend that molecular data could be utilized to investigate these problems. Different molecular analytical methods can be applied to resolve the taxonomic affinities within life cycles and geographical discrepancies (Stern *et al.*, 1997; Fukatsu *et al.*, 2001). We suggest that molecular systematics may clarify not only taxonomic questions but also discordant morphologies within the life cycle of *Reticulaphis* species.

By our observations, apterous viviparous adults were found on mature, less-disturbed secondary hosts year round, but high population densities were found in late autumn to winter, and alate adults were only found at this time. Alate adults are scarce in populations, and we have collected only a few alate individuals of *R. distylii* and *R. mirabilis* in our studies. Although we compared morphological differences between these two species, the scarcity of alates should be complemented in ongoing studies.

Materials and methods

The heavily sclerotized apterous adults of *Reticulaphis* adhere firmly to leaves. They must be removed carefully to ensure the completeness of specimens, because the marginal (submarginal) setae of the prosoma and setae on abdominal tergite VIII are key characters for distinguishing species. Young and mature adults differ somewhat, and diagnostic features used here are based on mature adults. Some intraspecific variation in body length was observed, possibly due to environmental effects, and the body lengths given here are based on our specimens. High concentrations of KOH used for bleaching sometimes damages minute structures on specimens, we therefore used H₂O₂ for bleaching, and found that this rendered cuticle transparent without causing damage even at a high concentration (50%). This procedure was also quicker than the standard method that used KOH.

Aphids were collected into 90–95% ethanol. The surface wax was dissolved with carboxylene for 2–3 minutes, and the specimens then washed in ethanol. Specimens were bleached in 30% H₂O₂ at 50°C until the cuticle colour changed from black to light brown (ca 4–8 hours). Specimens were rinsed in ethanol, transferred to Essig's aphid fluid (75% lactic acid, 14% acetic acid, 7% phenol, 4% distilled water) for 48 hours, and mounted in Euparal.

Specimens were examined and photographed under Olympus BH-2 microscopes (2–40X). Images were prepared using Automontage (vers. 4.03) with an Olympus CAMEDIA C-7070 wide-zoom digital compact

camera.

Representative specimens of each species are deposited in: ANIC—Australian National Insect Collection, CSIRO—Entomology, Canberra, ACT, Australia; BMNH—Natural History Museum, London, UK; CDFCA—California Department of Food and Agriculture, Sacramento, CA, USA; NMNS- National Museum of Natural Science, Taichung, Taiwan; NTU—National Taiwan University, Taipei, Taiwan; TARIIC—Taiwan Agricultural Research Institute Insect Collection, Taichung, Taiwan; USNM—United States Department of Agriculture, Beltsville, MD, USA (Sternorrhyncha collections of the United States National Museum of Natural History, Washington DC)

We also examined 40 slides of *Reticulaphis* species from BMNH, including four cotype specimens of *R. distylii* subsp. *asymmetrica*, subsp. *minutissima*, subsp. *rotifera*, and subsp. *similis*.

***Reticulaphis* Takahashi**

Type species: *Reticulaphis shiiae* Takahashi, 1958: 11.

Generic diagnosis apterous adult female. Body flattened with strongly sclerotized cuticle; body shape elliptical, ovate to broadly ovate; body colors always black with purplish-blue-burnish in life, some species with waxy powder on margin of body. Prosoma (cephalothorax+abdominal tergite I) with reticulated pattern on dorsum. Antennae shorter than space between them, with L-shaped bend, 2 or 3 indistinct segments, with 2 minute rhinaria and 1 terminal seta near apices of antennae. Eyes submarginal to marginal with 2 or 3 facets. Five pairs of minute to stout setae on central axis of prosoma, 1st pair between eyes, 2nd on pronotum, 3rd on mesonotum, 4th on metanotum, and 5th on abdominal tergite I; prosoma with 10 pairs of marginal or submarginal setae, 3 pairs on head anterior to eyes, 1 pair on pronotum, 3 pairs on mesonotum, 2 pairs on metanotum, and 1 pair on abdominal tergite I; these setae short or long, with acute, blunt, fan-shaped, or serrated apices. Legs short, front and middle legs usually concealed under body, hind legs somewhat exposed; front and middle tibiae shorter than or equal to femora, but hind tibiae shorter or longer than femora; tarsi narrower than tibiae, longer than wide; 1 long fine capitate seta on dorsal front tarsi, 2 such setae each on middle and hind tarsi. Abdominal tergites II–VII fused, separated from posterior margin of prosoma; without siphunculi; along tergites converging sides with 6 pairs of minute setae. Abdominal tergite VIII an equilateral triangle with 2–4 setae. Cauda knobbed, constricted basally. Subanal plate deeply bilobed, each lobe with 4–7 setae.

Key to species of *Reticulaphis* (based on apterous adult females from Taiwan)

1. Marginal setae with distinctly acute apices2
- Marginal setae with blunt, serrated, or fan-shape apices, or not obvious3
2. Body nearly round; setae on central axis of dorsal prosoma stout; chaetotaxy - 2 setae between eyes, 2 (sometimes 3) setae on pronotum, 2 (sometimes 3) setae on mesonotum, 2 setae on metanotum, 2 setae on abdominal tergite I; pleural regions of prosoma often distinctly expanded *R. distylii*
- Body elliptical; setae on central axis of dorsal prosoma fine; chaetotaxy - 3 or 4 setae between eyes, 3 or 4 setae on pronotum, 4–6 setae on mesonotum, 3–5 setae on metanotum, 2–4 setae on abdominal tergite I; pleural regions of prosoma not expanded..... *R. fici*
3. Marginal setae stout with blunt apices; 2 thick, blunt apical dorsal setae between eyes, almost as long as marginal setae *R. mirabilis*
- Marginal setae with blunt, frayed, serrated, or fan-shape apices; dorsal setae between eyes fine, not obvious, distinctly shorter than marginal setae..... 4
4. Body ovate with 4 well-defined swellings, or body elliptical with long, thick, strongly curved marginal

- setae; marginal setae with acute, blunt, or frayed apices.....5
- . Body ovate without such swellings, or body elliptical without obvious marginal setae; marginal setae usually with fan-shaped or serrated apices.....6
5. Body ovate; prosoma with 4 well-defined swellings, largest one semi-oval, corresponding to position head+prothorax, median to meso- and metathorax, smallest to abdominal tergite I (sometimes swellings indistinct); marginal setae with acute or blunt apices, somewhat curved to rear*R. inflata* **sp. n.**
- . Body elliptical; prosoma without above-described swellings; marginal setae long, thick, usually strongly curved to rear, with blunt or frayed apices *R. foveolatae*
6. Body elliptical, length nearly twice as long as wide; pleural regions of prosoma very strongly expanded and produced; middle and hind legs distinctly visible from above; marginal setae not obvious
.....*R. asymmetrica*
- . Prosoma without expanded pleural regions, middle legs concealed under prosoma; marginal setae apparent, with serrated or fan-shaped apices.....7
7. Prosoma with 2 shrunken furrows at positions corresponding to front and middle legs; abdominal tergite VIII with 2 stout setae, nearly as long as marginal setae.....*R. septica* **sp. n.**
- . Prosoma broadly oval, no shrunken furrows; abdominal tergite VIII with 4 fine setae, obviously shorter than marginal setae *R. rotifera*

Descriptions of apterous viviparous females

Reticulaphis asymmetrica Hille Ris Lambers & Takahashi, stat.n.

(Fig. 1)

Reticulaphis distylii subsp. *asymmetrica* Hille Ris Lambers & Takahashi, 1959: 12.

Apterous adult female. Small species, body elliptical, black with purplish-blue burnish, marginal setae short inconspicuous, with fan-shaped or serrate apices, body margin without waxy powder. Body 0.46–0.57 mm long, about 1.72 (1.54–2.0) times as long as wide, pleural regions of prosoma very strongly expanded and produced like large sclerotic bladders. Antennae on front of head, L-shaped bend with 2 indistinct segments, long arm about 35–47.5 µm with 2 minute rhinaria and 1 terminal seta near apex. Eyes very close to margin of prosoma, with 2 facets. Prosoma distinctly reticulated with pale thin lines, dorsum with 4 pairs of oblong lower areas on median, which do not connect together; 5 pairs of minute setae on central axis of prosoma, 1st pair between eyes; prosoma with 10 pairs of marginal setae, but not obvious, these setae short and stout, with fan-shaped or serrated apices. Front legs short, middle and hind legs distinctly visible from above from coxae onwards; 1 long fine capitate seta on dorsal front tarsi, 2 such setae on middle tarsi, hind tarsi atrophied. Abdominal tergites II–VII about 120–160 µm wide and 52.5–82.5 µm long, also reticulated, without siphunculi and with 6 pairs of minute setae along converging sides of tergites. Abdominal tergite VIII an equilateral triangle, about 82.5–95 µm wide and 32.5–40 µm long, with 2 serrated apical setae. Cauda knobbed, constricted basally. Subanal plate deeply bilobed, each lobe with 5 or 6 setae.

Material examined. Taiwan: Gushan District, Kaohsiung City, 3-i-2005, 60 apterous adults from *F. septica* (on 8 microscope slides) (H.T.Yeh #309) (ANIC, BMNH, CDFA, NMNS, TARIIC, USNM); Liouguei Township, Kaohsiung County (Co.), 2-iv-2005, 16 apterous adults from *F. septica* (on 2 microscope slides) (H.T.Yeh #336); Hengchun Township, Pingtung Co., 4-viii-1980, 6 apterous adults from unknown host (W.C. Wu) (originally labeled as *R. fici*) (TARIIC). **Java:** Selatiga, 12 apterous adults from *Ficus* sp., 20-xii-1916 (P.v.d. Goot) (BMNH).

Remarks. This species has been found on less-disturbed hosts in the hills or lower mountainous areas, and like *R. septica* **sp. n.** it is sometimes found at high population densities. Two *Reticulaphis* species are

known to feed on *F. septica*; *R. asymmetrica* can be distinguished from *R. septica* **sp. n.** by the extremely expanded pleural regions of the prosoma, the middle and hind legs distinctly visible from above, and the less obvious marginal setae on the dorsal prosoma.

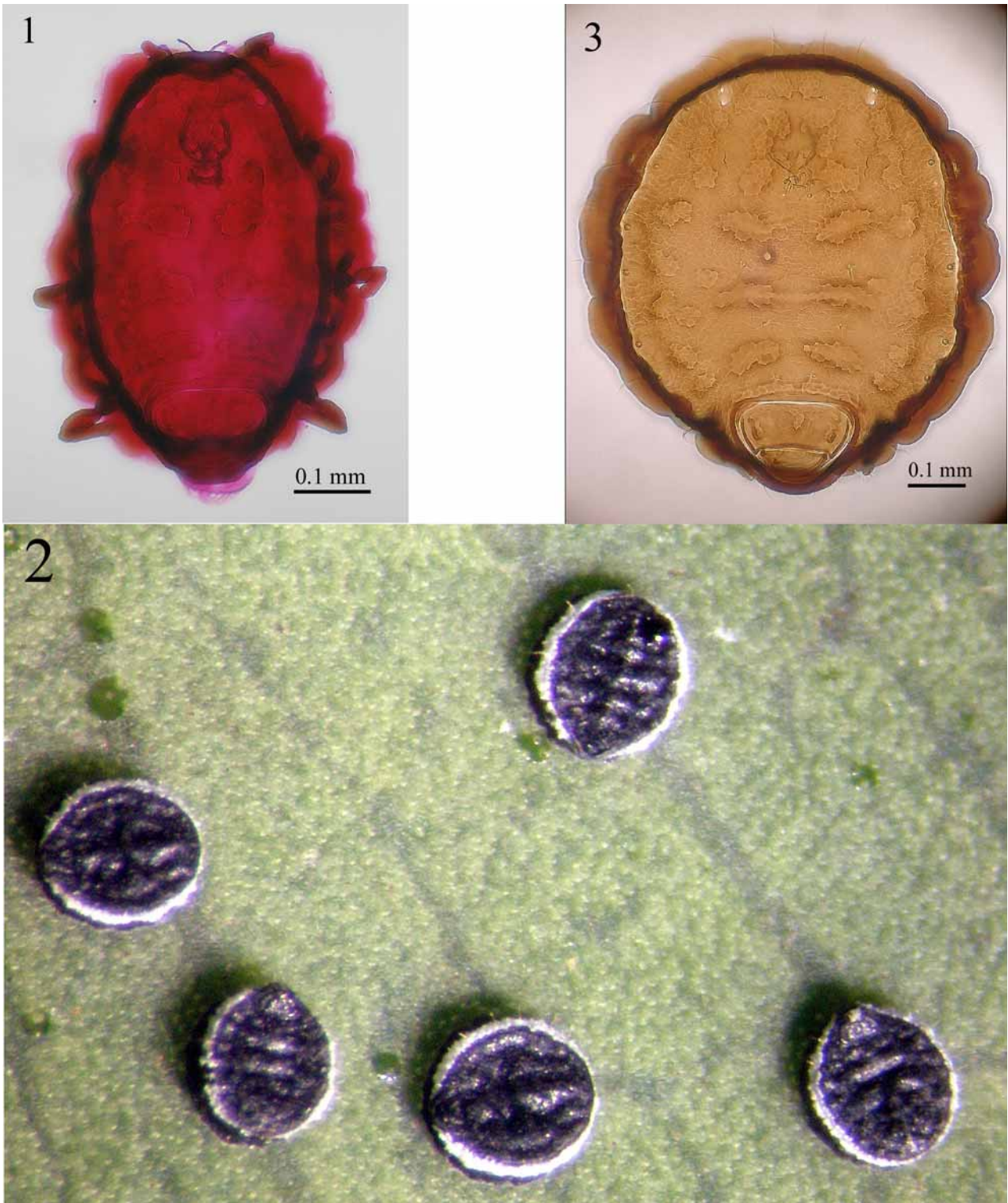


FIGURE 1–3. 1. Dorsal view of *Reticulaphis asymmetrica* apterous adult. 2, 3. *Reticulaphis distylii* apterous adults, (2) alive; (3) dorsal view.

***Reticulaphis distylii* (van der Goot)**

(Figs. 2, 3)

Schizoneuraphis distylii van der Goot, 1917: 247.

Reticulaphis distylii (van der Goot): Hille Ris Lambers & Takahashi, 1959: 9.

Apterous adult female. Small species, body broadly ovate, black with purplish-blue burnish, marginal setae long with acute apices, body margin with waxy powder. Body 0.62–0.75 mm long, about 1.25 (1.16–1.3) times as long as wide, sometimes pleural regions of prosoma somewhat expanded. Antennae located in front of head, shorter than space between them, L-shaped bend with 3 indistinct segments, long arm about 40–47.5 µm with 2 minute rhinaria and 1 terminal seta near apex. Eyes submarginal, with 3 facets, one of these located more laterally and ventrally. Prosoma distinctly reticulated with pale thin lines, dorsum with 3 deeply transverse ridges on median area and several rounded areas surrounding it; 5 pairs of stout setae on central axis of prosoma, 1st pair between eyes, 3rd pair (on mesonotum) sometimes with 3 setae; prosoma with 10 pairs of marginal setae, these setae long, with acute apices. Legs short, front and middle legs concealed under body, hind legs somewhat exposed; front and middle tibiae shorter than femora, hind tibiae longer than or equal to femora; tarsi narrower than tibiae, longer than wide; 1 long fine capitate seta on dorsal front tarsi, 2 such setae each on middle and hind tarsi. Abdominal tergites II–VII about 185–215 µm wide and 65–85 µm long, also reticulated, without siphunculi, with 6 pairs of minute setae along converging sides of tergites. Abdominal tergite VIII an equilateral triangle, about 105–127.5 µm wide and 45–55 µm long, with 4 setae, central two long, with acute apices, nearly as long as marginal setae of prosoma, but outer two very short, sometimes not obvious. Cauda knobbed, constricted basally. Subanal plate deeply bilobed, each lobe with 5 or 6 setae.

Material examined. Taiwan: Da-an District, Taipei City, 6-iii-2003, 6 apterous adults from *F. microcarpa*, (J.C. Liou and H.F. Hung #74); Taipei City, 5-vi-2007, 12 apterous adults from *F. microcarpa*, (A.K. Dubey #611); Taipei City, on 6-xi-2006, 6-i-2007 and 21-iv-2007, 43 apterous and 6 alate adults from *F. altissima*, (on 5 microscope slides) (T.C. Hsu #548, #572, #598 and #599, respectively). Hengchun Township, Pingtung Co., on 9-ix-2006, 9-x-2006, and 24-iii-2007, 73 apterous adults from *F. elastica*, (on 10 microscope slides) (H.T. Yeh #502, #518, and #585, respectively) (ANIC, BMNH, Cdfa, NMNS, TARIIC, USNM).

Remarks. This species is extensively distributed in urban areas and suburbs, and has diverse hosts. The population density on *F. altissima* is sometimes very high, and an excess of honeydews can cause sooty molds. This species resembles *R. fici*, but differs from it in having almost rounded body shape, the pleural regions of the prosoma somewhat expanded, the marginal setae of the prosoma comparatively thick, and usually 2 setae placed on the central axis of the prosoma.

***Reticulaphis fici* (Takahashi), stat.n.**

(Figs. 4, 5)

Astegopteryx fici Takahashi, 1923: 55, 146.

Thoracaphis fici (Takahashi): Takahashi, 1931: 92.

Reticulaphis fici (Takahashi): Takahashi, 1958: 11.

Reticulaphis distylii subsp. *fici*: Hille Ris Lambers & Takahashi, 1959: 12.

Apterous adult female. Body ovate, black with purplish-blue burnish, marginal to submarginal setae long, with acute apices, body margin with much waxy powder. Body 0.82–0.94 mm long, about 1.30 (1.25–1.42) times as long as wide, forehead slightly concave. Antennae on front of to beneath head, shorter than space between them, L-shaped bend with 3 indistinct segments, long arm about 50–75 µm with 2 minute rhinaria and 1 terminal seta near apex. Eyes submarginal, with 3 facets. Prosoma distinctly reticulated with pale thin

lines, dorsum with 3 lower transverse ridges on median area and several rounded areas surrounding it, but sometimes outline of these not well-defined; 5 rows of short setae on central axis of prosoma, 1st row with 2–4 setae between eyes, 2nd row on pronotum with 2–5 setae, 3rd row on mesonotum with 4–7 setae, 4th row on metanotum with 2–5 setae, and 5th row on abdominal tergite I with 2–4 setae; prosoma with 10 pairs of marginal or submarginal setae, these setae long, with acute apices. Legs short, front and middle legs concealed under body, hind legs exposed; front and middle tibiae shorter than femora, hind tibiae longer than or equal to femora; tarsi narrower than tibiae, longer than wide; 1 long fine capitate seta on dorsal front tarsi, 2 such setae on middle and hind tarsi. Abdominal tergites II–VII about 225–260 μm wide and 67.5–100 μm long, also reticulated, without siphunculi and with 6 pairs minute setae along converging sides of tergites. Abdominal tergite VIII an equilateral triangle, about 122.5–140 μm wide and 55–60 μm long, with 4 setae, central two long, with acute apices, nearly as long as marginal setae of prosoma, but outer two short. Cauda knobbed, constricted basally. Subanal plate deeply bilobed, each lobe with 5 or 6 setae.

Material examined. Taiwan: Da-an district, Taipei City, 25-x-2006, 6 apterous adults from *F. superba*, (A.K. Dubey #541); Taipei City, 27-xi-2006, 59 apterous adults from *F. superba*, (on 8 microscope slides) (T.C. Hsu #569) (ANIC, BMNH, CDFA, NMNS, TARIIC, USNM); Taihoku, Formosa, ii-1925, 4 apterous adults from *Ficus* sp. (R. Takahashi) (originally labeled as *Astegopteryx fici*) (BMNH); Taihoku, Formosa, ii-1927, 11 apterous adults from *Ficus* sp. (R. Takahashi) (BMNH). **Philippines:** College, Laguna, 19-i-1967, 6 apterous adults from *F. pseudopalma*, (V.J. Calilung) (BMNH). **China:** Central, Hong Kong, 23-xii-1979, 12 apterous and 3 alate adults from *Ficus* sp. (on 4 microscope slides) (J.H. Martin) (BMNH); Mai Po Marshes, Hong Kong, 15-x-1990, 14 apterous adults from *F. superba* (on 4 microscope slides) (J.H. Martin) (BMNH); slope of The Peak, above Pok Fu Lam Reservoir Road, 12-xi-1996, 10 apterous adults from *Ficus* sp. (on 2 microscope slides) (J.H. Martin) (BMNH); Macau, Taipa, 06-xii-2005, 8 apterous adults from *F. rumphii*, (J.H. Martin) (BMNH).

Remarks. This species is adapted to urban areas and suburbs, and can usually be found on mature or defoliating leaves. Sometimes the population density is high, and it is easy to find individuals which have been parasitized by parasitoids. This species is conspicuous for the number of setae on the central axis of the dorsal prosoma which is always greater than two, and differs from *R. distylii* in the ovate body shape, pleural regions of the prosoma not being expanded, and the marginal setae of prosoma being comparatively thin; and differs from *R. rotifera* in the comparatively thin marginal setae with acute apices of the prosoma.

***Reticulaphis foveolatae* (Takahashi), stat.n.**

(Figs. 6, 7)

Thoracaphis fici Takahashi, var. *foveolatae* Takahashi, 1935: 89.

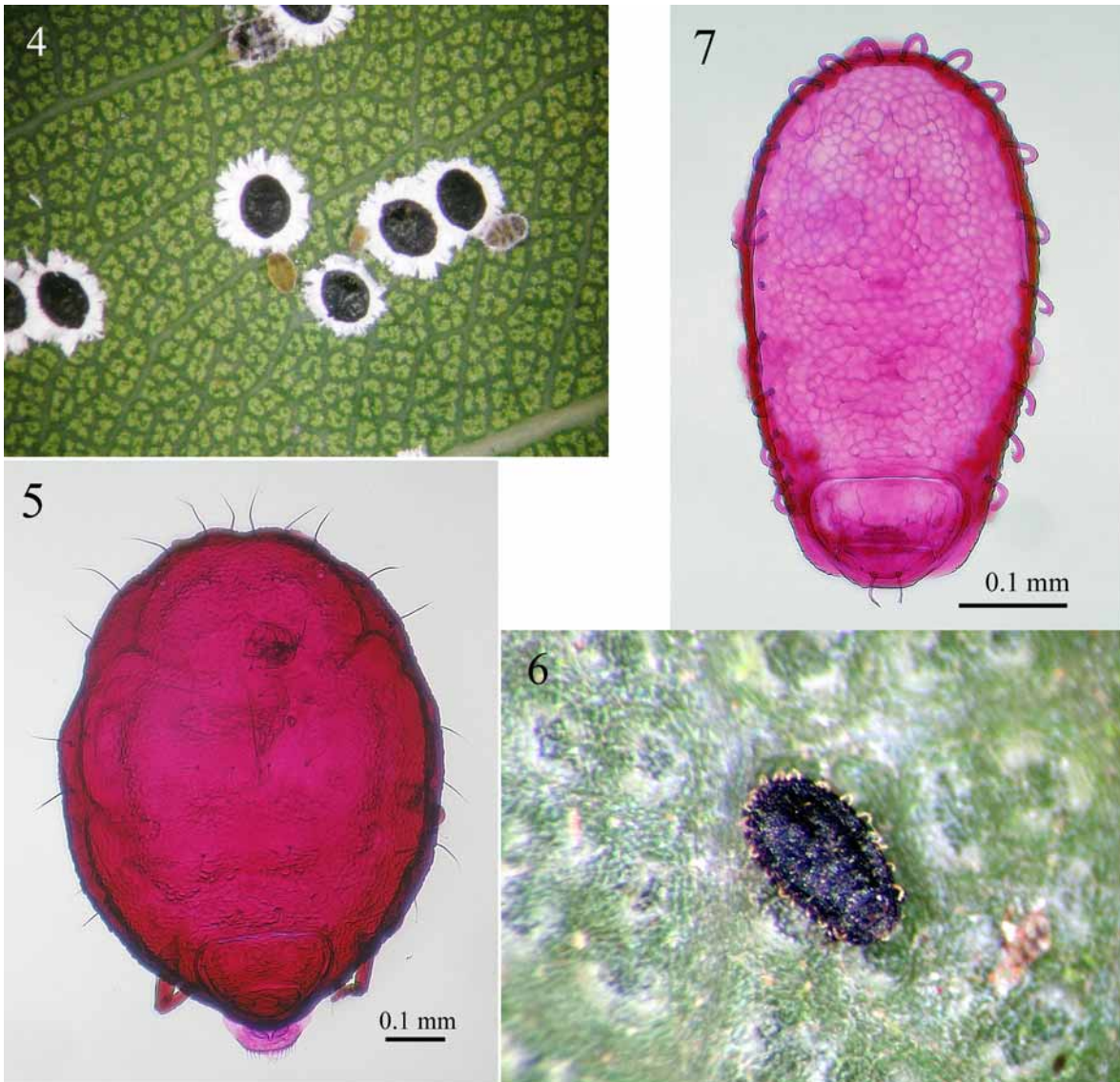
Reticulaphis fici foveolatae (Takahashi): Takahashi, 1958: 12.

Reticulaphis distylii foveolatae (Takahashi): Ghosh & Raychaudhuri, 1973: 489.

Reticulaphis distylii subsp. *minutissima* Hille Ris Lambers & Takahashi, 1959: 15. **Syn. n.**

Apterous adult female. A small species, body elliptical, black with purplish-blue burnish, marginal setae bent to rear, thick, yellow, with blunt, frayed or fan-shaped apices, body margin without waxy powder. Body 0.42–0.55 mm long, about 1.78 (1.7–1.85) times as long as wide, sometimes pleural regions of prosoma somewhat expanded. Antennae on front of to beneath head, shorter than space between them, L-shaped bend with 2 indistinct segments, long arm about 20–35 μm with 2 minute rhinaria and 1 terminal seta near apex. Eye submarginal, with 3 facets. Prosoma distinctly reticulated with pale thin lines, dorsum with 3 lower transverse ridges and several lower rounded areas at front part of prosoma; 5 pairs of minute setae on central axis of prosoma, 1st pair between eyes; prosoma with 10 pairs of marginal or submarginal setae, these setae thick, strongly bent to rear, with blunt or frayed apices. Legs short, front and middle legs concealed under body, hind

legs exposed; front and middle tibiae shorter than femora, but hind tibiae longer than or equal to femora; tarsi narrower than tibiae, longer than wide; 1 long fine capitate seta on dorsal front tarsi, 2 such setae on middle and hind tarsi. Abdominal tergites II–VII about 130–155 μm wide and 50–65 μm long, also reticulated, without siphunculi and with 6 pairs minute setae along converging sides of tergites, but not obvious. Abdominal tergite VIII an equilateral triangle, about 82.5–97.5 μm wide and 35–45 μm long, with 4 setae, central two long and thick with blunt apices, outer two short with point apices. Cauda knobbed, constricted basally. Subanal plate deeply bilobed, each lobe with 5–7 setae.



FIGURES 4–7. 4, 5. *Reticulaphis fici* apterous adults, (4) alive; (5) dorsal view. 6, 7. *Reticulaphis foveolatae* apterous adults; (6) alive; (7) dorsal view.

Material examined. Taiwan: Yuanshan Township, Ilan Co., 8-vii-2007, 75 apterous adults from *F. sarmentosa* (on 9 microscope slides) (H.T. Yeh #615) (ANIC, BMNH, Cdfa, NMNS, TARIIC, USNM); Rarasan, 31-vii-1933, 49 apterous adults from *Ficus* sp. (R. Takahashi) (originally labeled as *Thoracaphis foveolatae*) (TARIIC); Marikowan, Taichu-Shu, 12-viii-1934, 9 apterous adults from *Ficus* sp. (R. Takahashi) (originally labeled as *T. foveolatae*) (TARIIC); Kussha, 14-viii-1934, 38 apterous adults from *Ficus* sp. (on 2 microscope slides) (R. Takahashi) (originally labeled as *T. foveolatae*) (TARIIC). **Japan:** Kagoshima, 3-v-

1930, 11 apterous adults from *Ficus* sp. (R. Takahashi) (originally labeled as *T. foveolatae*) (TARIIC); Osaka, 28-iv-1957, 20 apterous adult from *F. foveolata* (on 2 microscope slides) (R. Takahashi) (BMNH). **Java:** Punten, end of iii-1950, 67 apterous from *F. benjamina* (on 2 microscope slides) (F. W. Rappard) (originally labeled as *R. distylii* subsp. *minutissima*) (BMNH).

Remarks. According to the original descriptions and illustration, the subspecies *minutissima* was conspicuous by its elongate body and curious marginal setae (Hille Ris Lambers & Takahashi, 1959), but these features could not be used to distinguish from *foveolatae*. After examining slides from the BMNH, we suggest that *R. distylii* subsp. *minutissima* Hille Ris Lambers & Takahashi is a junior synonym of *R. foveolatae*. This species is remarkable for the marginal setae strongly curved to the rear, and differs from *R. inflata* **sp. n.** in the slender body shape, 3 lower transverse ridges, several lower rounded areas at the front part of the dorsal prosoma, and the marginal setae with blunt, frayed to fan-shaped apices. The pleural regions of the prosoma of old mature adults are expanded to a extent, and can be distinguished from *R. asymmetrica* by the distinct curious marginal setae of the prosoma.

***Reticulaphis inflata* Yeh & Hsu sp. nov.**

(Figs. 8, 9)

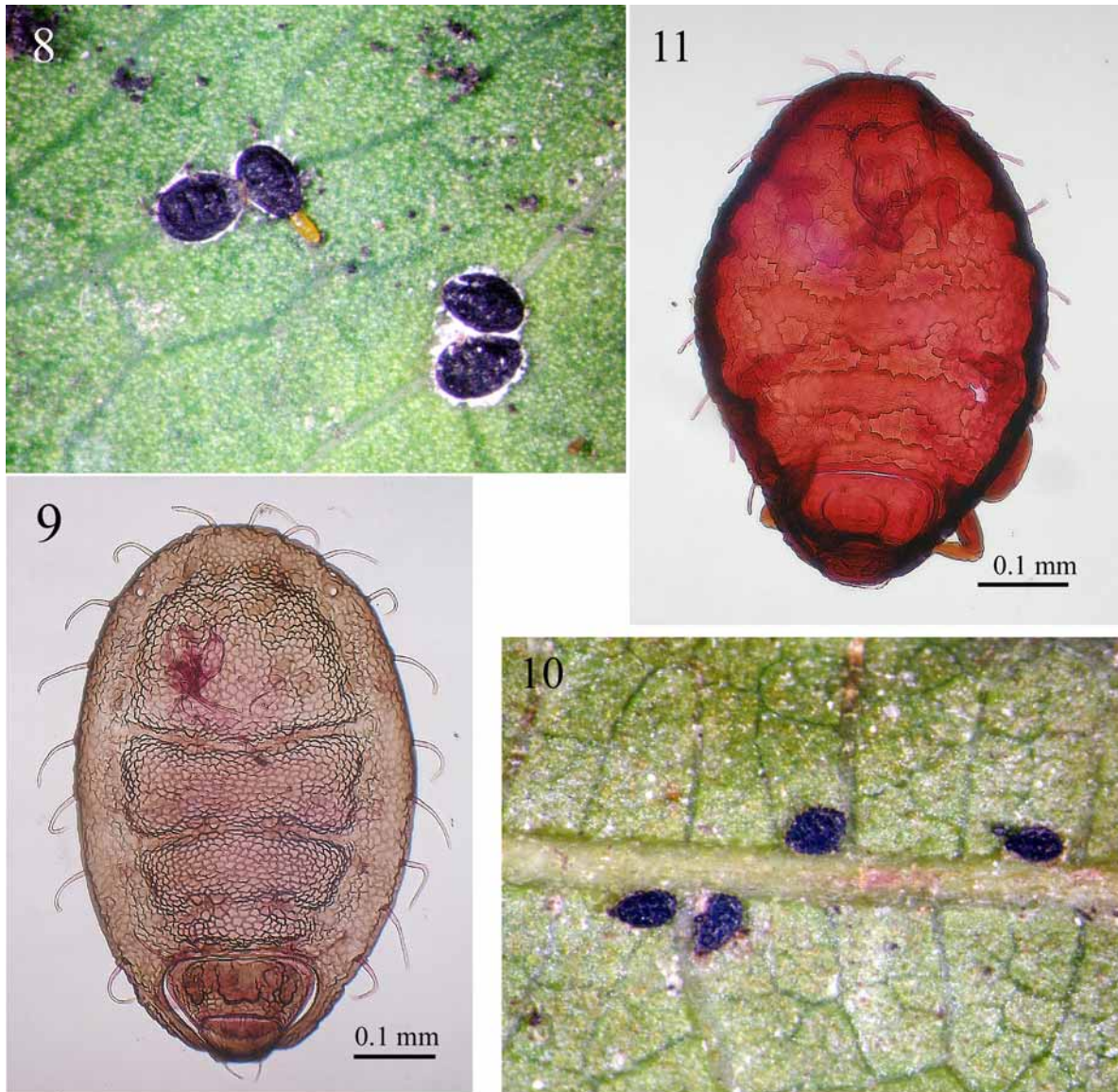
Apterous adult female. A small species, body ovate to elliptical, black with purplish-blue burnish, marginal setae long, some curved to rear, all with blunt to acute apices, body margin with some waxy powder. Body 0.51–0.66 mm long, about 1.45 (1.40–1.54) times as long as wide. Antennae beneath head, shorter than space between them, L-shaped bend without segmentation, long arm about 37.5–45 μm with 2 minute rhinaria and 1 terminal seta near apex. Eyes submarginal, with 3 facets, one located more laterally and ventrally. Prosoma distinctly reticulated with pale thin lines, dorsum with 4 well-defined swellings, largest one semi-oval, corresponding to position of head+prothorax, following two rectangular, corresponding to positions of meso- and metathorax, smallest at position of abdominal tergite I, but sometimes indistinct; 5 pairs of minute setae on central axis of prosoma, but not obvious, 1st pair between eyes; prosoma with 10 pairs of marginal or submarginal setae, some setae curved to rear, all setae long, with acute, blunt, or frayed apices. Legs well developed, front and middle legs concealed under body, hind legs somewhat exposed; front and middle tibiae shorter than or equal to femora, but hind tibiae longer than or equal to femora; tarsi narrower than tibiae, longer than wide; 1 long fine capitate seta on dorsal front tarsi, 2 such setae on middle and hind tarsi. Abdominal tergites II–VII about 170–200 μm wide and 57.5–75 μm long, also reticulated, without siphunculi and with 6 pairs minute setae along converging sides of tergites. Abdominal tergite VIII an equilateral triangle, about 90–100 μm wide and 40–50 μm long, with 4 setae, central two much longer than outer two. Cauda knobbed, constricted basally. Subanal plate deeply bilobed, each lobe with 4–6 setae.

Material examined. Holotype, Taiwan: Yijhu Township, Chiayi Co., on *Ficus microcarpa*, 5-ii-2007, C. C. Ko (#574). **Paratypes, Taiwan:** Yijhu Township, Chiayi Co., 25-iii-2007, 54 apterous adults from *F. microcarpa* (on 8 microscope slides) (C.C. Ko #589) (ANIC, BMNH, CDFA, NMNS, TARIIC, USNM); Fanlu Township, Chiayi Co., 7-iv-2007, 12 apterous adults from *F. microcarpa* (C.C. Ko #595); Takao, 25-iii-1934, 16 apterous adults from unknown host (R. Takahashi) (originally labeled as *Thoracaphis fici*) (TARIIC). **China:** Wanchai, Hong Kong, 3-iii-1990, 26 apterous adults from *F. microcarpa* (on 4 microscope slides) (J.H. Martin) (BMNH); Pok Fu Lam Country Park, Hong Kong, 10-xii-2001, 4 apterous adults from *Ficus ?microcarpa* (J.H. Martin) (BMNH).

Etymology. The species epithet is a Latin word, ‘*inflatus*’, meaning swollen, puffed up, emphasizing the conspicuous swellings on the dorsum.

Remarks. This species was first found on a slide produced by Takahashi (originally labeled as *T. fici*), but he had lumped it together with *R. fici*. This species can be distinguished from *R. fici* by conspicuous swellings

on the dorsum of the prosoma, and stout marginal setae curved to rear; and differs from *R. foveolatae* in the more-ovate body shape, conspicuous swellings on the dorsum of the prosoma, and the apices of marginal setae with acute to blunt or frayed ends.



FIGURES 8–11. **8, 9.** *Reticulaphis inflata* apterous adults, **(8)** alive; **(9)** dorsal view. **10, 11.** *Reticulaphis mirabilis* apterous adults, **(10)** alive; **(11)** dorsal view.

***Reticulaphis mirabilis* (Takahashi)**
(Figs. 10, 11)

Thoracaphis mirabilis Takahashi, 1939: 31.
Reticulaphis mirabilis (Takahashi): Takahashi, 1958: 13.

Apterous adult female. A small species, body ovate, black with purplish-blue burnish, marginal setae stout, with blunt or flattened apices, body margin without waxy powder. Body 0.53–0.65 mm long, about 1.43 (1.33–1.49) times as long as wide, widest part at front 1/2–1/3 of body. Antennae on front of to beneath head, shorter than space between them, L-shaped bend with 2 indistinct segments, long arm about 32.5–45 µm with

2 minute rhinaria and 1 terminal seta near apex. Eyes submarginal to marginal, with 2 or 3 facets. Prosoma distinctly reticulated with pale thin lines, dorsum with 3 pairs of oblong lower areas on median, sometimes connecting together to form lower transverse ridges and several rounded areas surrounding prosoma; 5 pairs of stout setae on central axis of prosoma, 1st pair between eyes noticeably thick, with blunt apices, as long as marginal setae of prosoma, the others short; prosoma with 10 pairs of marginal setae, these setae stout, with blunt or flattened apices. Legs short, front and middle legs concealed under body, hind legs exposed; tibiae of all legs shorter than femora; tarsi narrower than tibiae, longer than wide; 1 long fine capitate seta on dorsal front tarsi, 2 such setae on middle and hind tarsi. Abdominal tergites II–VII about 150–170 μm wide and 60–75 μm long, also reticulated, without siphunculi and with 6 pairs minute setae along converging sides of tergites. Abdominal tergite VIII an equilateral triangle, about 87.5–102.5 μm wide and 40–45 μm long, with 2 long blunt apical setae. Cauda knobbed, constricted basally. Subanal plate deeply bilobed, each lobe with 5 or 6 setae.

Material examined. Taiwan: Sinyi District, Taipei City, 26-xi-2006, 21-iv-2007, 58 apterous and 6 alate adults from *F. irisana* (on 8 microscope slides) (T.C. Hsu #568 and #597) (ANIC, BMNH, CDFA, NMNS, TARIIC, USNM); Hengchun Township, Pingtung Co., 26-v-2007, 12 apterous adults from *Ficus ?virgata* (H.T. Yeh #606); Dainano, Formosa, 19-x-1937, 15 apterous adults from *Ficus* sp. (R. Takahashi) (originally labeled as *Thoracaphis mirabilis*) (TARIIC).

Remarks. This species is always found on mature, defoliating leaves of hosts, and is adapted to hills or lower mountainous areas. This species is conspicuous by a pair of long, thick setae between the eyes on the dorsal prosoma, and differs from *R. septica* sp. n. in the comparatively longer marginal setae of the prosoma.

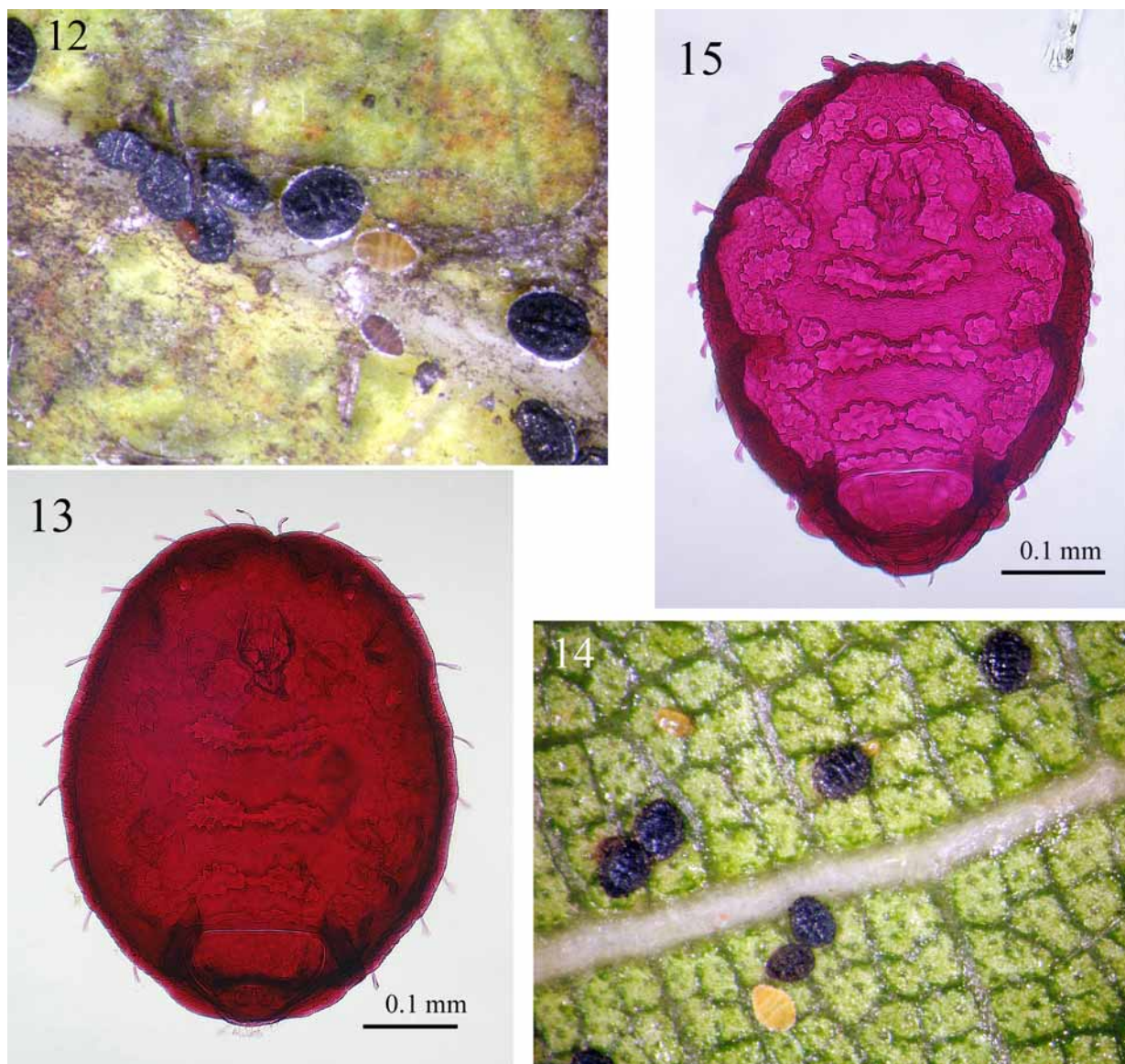
***Reticulaphis rotifera* Hille Ris Lambers & Takahashi, stat.n.**
(Figs. 12, 13)

Reticulaphis distylii subsp. *rotifera* Hille Ris Lambers & Takahashi, 1959: 12.

Apterous adult female. Small species, body broadly ovate, black with purplish-blue burnish, marginal or submarginal setae long, with fan-shaped or serrated apices, body margin with waxy powder. Body 0.48–0.55 mm long, about 1.23 (1.13–1.37) times as long as wide, forehead concave, prosoma with faintly crenulated margin. Antennae beneath head, shorter than space between them, L-shaped bend with 3 indistinct segments, long arm about 27.5–35 μm with 2 minute rhinaria and 1 terminal seta near apex. Eyes submarginal, with 2 facets. Prosoma distinctly reticulated with pale thin lines, dorsum with 3 deeply transverse ridges on median area and several rounded areas surrounding it; 5 pairs of minute setae on central axis of prosoma, 1st pair between eyes, 3rd pairs (on mesonotum) sometimes with 3 setae; prosoma with 10 pairs of marginal or submarginal setae, these setae long, with fan-shaped or serrated apices. Legs short, front and middle legs concealed under body, hind legs somewhat exposed; front and middle tibiae shorter than or equal to femora, but hind tibiae longer than or equal to femora; tarsi narrower than tibiae, longer than wide; 1 long fine capitate seta on dorsal front tarsi, 2 such setae on middle and hind tarsi. Abdominal tergites II–VII about 137.5–165 μm wide and 47.5–60 μm long, also reticulated, without siphunculi and with 6 pairs of minute setae along converging sides of tergites. Abdominal tergite VIII an equilateral triangle, about 80–90 μm wide and 30–40 μm long, with 4 setae, central two longer than outer two, but all shorter than marginal setae on prosoma. Cauda knobbed, constricted basally. Subanal plate deeply bilobed, each lobe with 5–7 setae.

Material examined. Taiwan: Hengchun Township, Pingtung Co., 18-xi-2006, 26-v-2007, 66 apterous adults from *F. virgata* (on 9 microscope slides) (H.T. Yeh #558, #604 and #605, respectively) (ANIC, BMNH, CDFA, NMNS, TARIIC, USNM). **Java:** Mandiku, 12-v-1950, 18 apterous adults from *Ficus ?pruniformis* (on 2 microscope slides) (F.W. Rappard) (BMNH).

Remarks. This species is found on mature, defoliating leaves of hosts, and is adapted to hills or lower mountainous areas. There are some differences between our materials and Rappard's: all setae on abdominal tergite VIII are thin and distinctly shorter than the marginal setae of prosoma in our materials, but the central 2 setae on the abdominal tergite VIII of Rappard's materials are thick and equal in length to the marginal setae. This species can be distinguished from *R. fici* by the comparatively thick marginal setae with fan-shaped apices of the prosoma, and the number of setae on the central axis of the dorsal prosoma is always two.



FIGURES 12–15. 12, 13. *Reticulaphis rotifera* apterous adults, (12) alive; (13) dorsal view. 14, 15. *Reticulaphis septica* apterous adults, (14) alive; (15) dorsal view.

***Reticulaphis septica* Yeh & Hsu sp. nov.**

(Figs. 14, 15)

Apterous adult female. A small species, body ovate, black with purplish-blue burnish, marginal setae short and stout, with fan-shaped apices, body margin without waxy powder. Body 0.47–0.53 mm long, about 1.33 (1.27–1.41) times as long as wide, widest part at position corresponding to front legs, 2 shrunken furrows from prosomal margin to submargin at positions corresponding to front and middle legs. Antennae much

shorter than space between them, L-shaped bend without segmentation, long arm about 25–37.5 µm with 1 minute rhinaria and 1 terminal seta near apex. Eyes submarginal, with 2 facets (some individuals with 3 facets). Prosoma distinctly reticulated with pale thin lines, dorsum with 3 deep transverse ridges on median area and several rounded areas surrounding it; 5 pairs of minute setae on central axis of prosoma, 1st pair between eyes; prosoma with 10 pairs of marginal setae, all marginal setae short and stout, almost as long as long arm of antennae, with fan-shaped or serrated apices. Legs short, hind legs somewhat exposed; front and middle tibiae shorter than femora, hind tibiae equal to or shorter than femora; tarsi narrower than tibia, longer than wide; 1 long fine capitate seta on dorsal front tarsi, 2 such setae on middle and hind tarsi. Abdominal tergites II–VII about 140–157.5 µm wide and 57.5–67.5 µm long, also reticulated, without siphunculi and with 6 pairs minute setae along converging sides of tergites, only base tubercles visible. Abdominal tergite VIII an equilateral triangle, about 75–85 µm wide and 30–40 µm long, with 2 blunt, stout apical setae, nearly as long as marginal setae. Cauda knobbed, constricted basally. Subanal plate deeply bilobed, each lobe with 4–6 setae.

Material examined. Holotype, Taiwan: Dashe Township, Kaohsiung Co., on *Ficus septica*, 9-iv-2006, H.T. Yeh (#476). **Paratypes, Taiwan:** Luodong Township, Ilan Co., 28-iii-2006, 22 apterous adults from *F. septica* (on 2 microscope slides) (Y.F. Chen #469); Baihe Township, Tainan Co., 8-iv-2007, 12 apterous adults from *F. septica* (C.C. Ko #596); Da-an District, Taipei City, 21-iv-2007, 14 apterous adults from *F. septica* (T.C. Hsu #600); Dashe Township, Kaohsiung Co., 27-v-2007, 48 apterous adults from *F. septica* (on 7 microscope slides) (H.T. Yeh #608) (ANIC, BMNH, CDFA, NMNS, TARIIC, USNM).

Etymology. The specific name ‘*septica*’ is derived from the associated host plant, *F. septica*.

Remarks. This species can be found in suburbs or hills, and feeds year round on new to mature leaves. The population density can be very high on mature leaves, and often causes serious sooty molds. This species differs from *R. mirabilis* in the pair of tiny setae between the eyes on the dorsal prosoma, and the comparatively stout marginal setae with distinctly fan-shaped apices of the prosoma; and differs from *R. asymmetrica* by the ovate body shape, and the pleural regions of prosoma not being expanded.

***Reticulaphis shiiae* Takahashi**

Reticulaphis shiiae Takahashi, 1958: 11.

This species was described from a holotype and two paratypes, collected at Tokyo, Japan, on the leaf of *Shiia cuspidata* (Fagaceae) (16-iii-1949, R. Takahashi). Unfortunately, the type depositary was not stated, and we have not been able to study the species. It is the only member of the genus in which the apterae are recorded from a plant other than *Ficus*.

Reticulaphis similis* Hille Ris Lambers & Takahashi, *incertae sedis

Reticulaphis distylii subsp. *similis* Hille Ris Lambers & Takahashi, 1959: 12.

This species was described on one sample from Gerengredjo, Java, on the underside of mature leaf of *F. benjamina* (28-i-1950, F. W. Rappard). Although the original publication described the body as more elongate than the main species *distylii* (Hille Ris Lambers & Takahashi, 1959), we think this is not likely to distinguish *similis* from *distylii* definitively. We examined three specimens of *similis* from BMNH, and observed that the marginal setae on the prosoma have acute apices, but other characters could not be studied due to the poor specimens. Therefore, we suggest that *similis* should currently be treated as species ‘*incertae sedis*’.

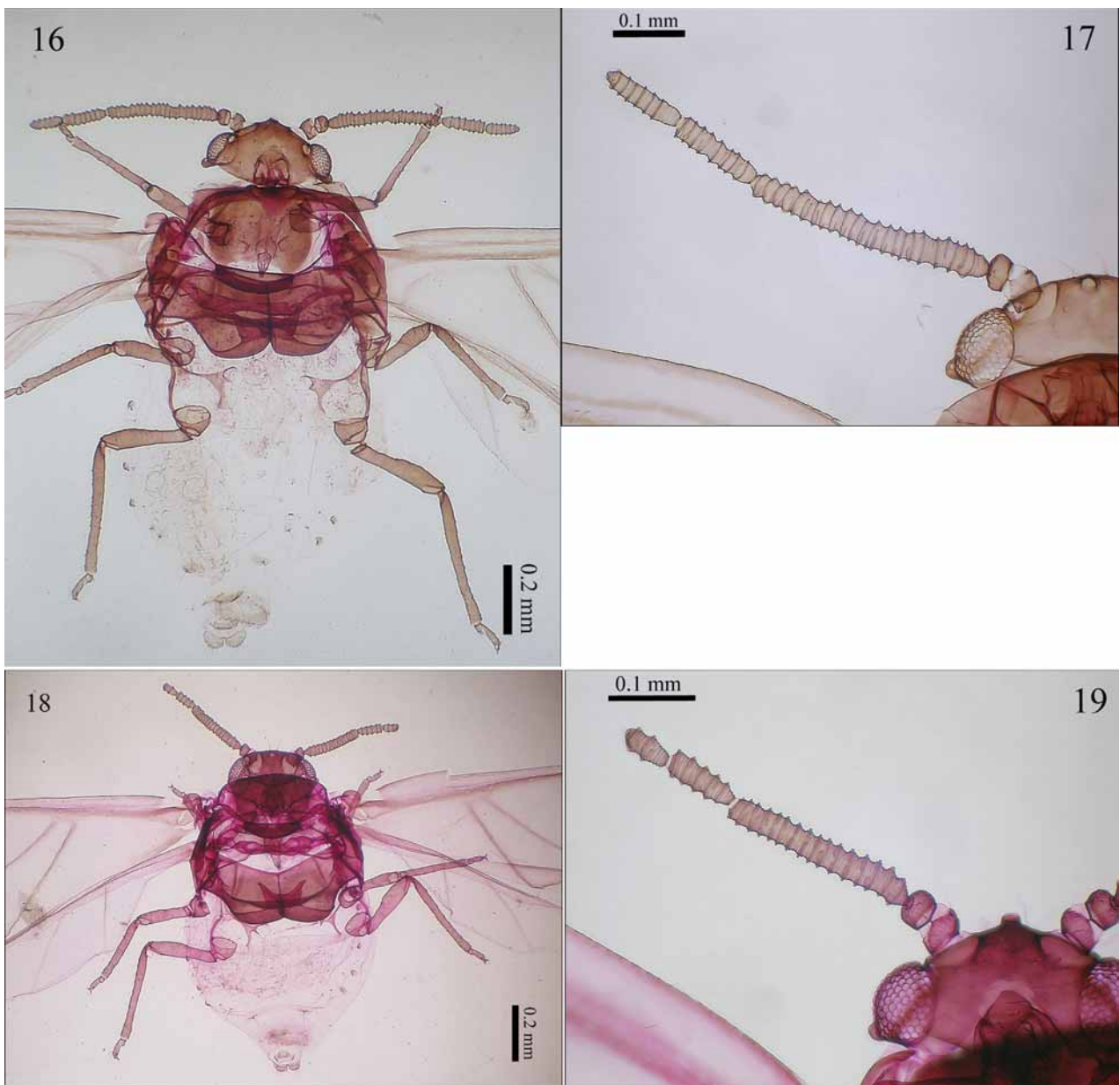
Descriptions of alate viviparous females

We have collected several alate adult females of *R. distylii* (Figs. 16, 17) and *R. mirabilis* (Figs. 18, 19) in recent years. The morphological features of *R. distylii* do not greatly differ from the descriptions by Noordam (1991: pp. 255–257). The main difference compared to Noordam's is the smaller body length (1.40–1.50 mm) in this study. Alate adult females of *R. mirabilis* are similar to those of *R. distylii* but could be distinguished as follows:

1. Body size. *R. mirabilis*: body length 1.14–1.34 mm; head width (distance between 2 apices of the ocular tubercles) 32.8–34.4 microns. *R. distylii*: body length 1.40–1.50 mm; head length 35.2–40.8 microns.

2. Ratio of antennae III–V length to head width. *R. mirabilis* 1.02–1.14; *R. distylii* 1.37–1.67.

3. Antennal secondary rhinaria: *R. mirabilis* - antenna III with 15–19, IV with 4 or 5, V with 2–4; *R. distylii* antenna III with 21–24, IV with 7–10, V with 4–6.



FIGURES 16–19. 16, 17. *Reticulaphis distylii* alate adult, (16) ventral view; (17) antenna. 18, 19. *Reticulaphis mirabilis* alate adult, (18) ventral view; (19) antenna.

Discussion

As recognized here, the genus *Reticulaphis* includes ten species, although two of these, *shiiiae* and *similis*, remain unsatisfactorily defined. It is believed that members of this genus are specialised for feeding on *Ficus*, and eight of these species are known from Taiwan. In contrast, *R. shiiiae* was described from *Shiia cuspidata*. We consider that the East Asian region is mostly concordant with the distribution of this genus of aphids, and more exploration is needed on taxonomic studies of this group including molecular approaches.

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