

**Descriptions of Adults and Nymphs of the Taro Planthopper,
Tarophagus proserpina taiwanensis ssp. n.,
from Taiwan (Homoptera: Delphacidae)¹**

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Abstract.—A new subspecies of taro planthopper, *Tarophagus proserpina taiwanensis* Wilson, is described for specimens from Taiwan. Male and female genitalia and first through fifth instar nymphs are described and illustrated. Features useful in separating nymphal instars include differences in body size and proportions, spination of metatibiae, metatibial spurs, and metatarsomeres, and number of metatarsomeres and body pits.

The taro planthopper, *Tarophagus proserpina* (Kirkaldy), has been reported from Hawaii south to Tahiti and west to Guam, Japan, Philippine Islands, Taiwan, northern Australia, Indonesia, Vietnam, and Malaysia (Fennah, 1978; Metcalf, 1943; Mitchell and Maddison, 1983; Wu and Yang, 1985; Zimmerman, 1948). It is a major pest of taro (*Colocasia esculenta* (L.) Schott) causing yellowing and stunting of leaves by adult and nymphal feeding and oviposition damage to stems (Mitchell and Maddison, 1983) and has been implicated as the vector of Alomae and Bobone rhabdoviruses in the Pacific Islands (Francki et al., 1981; Mitchell and Maddison, 1983; Ooka, 1983).

The biology of the taro planthopper has been studied by Fullaway (1937) who made some brief remarks about its life history in the Philippines and Matsumoto (1964) who reared it, studied the field biology of it and its egg predator *Cyrtorhinus fulvus* Knight (Hemiptera: Miridae) in Hawaii, and provided very brief descriptions of eggs and nymphs. Wu and Yang (1985) briefly described the fifth instar of *T. proserpina* and seven other delphacid species.

This paper presents descriptions and illustrations of male and female genitalia, and 1st through 5th instar nymphs of *T. proserpina taiwanensis* ssp. n. from Taiwan.

DESCRIPTIONS

Specimens were preserved in 70% ethyl alcohol. The adult male and female genitalia and the 5th instar are described in detail but only major differences are described for preceding instars. Measurements are given in mm as mean \pm SD. Length was measured from apex of vertex to terminus of abdomen, thoracic length along the midline from anterior margin of the pronotum to posterior margin of the metanotum, and width across the widest part of the body. One specimen of each

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nymphal instar was cleared in 6% KOH in order to examine distribution and number of body pits.

The collecting data for specimens used for description are: REPUBLIC OF CHINA: Taiwan, Tsao-Tun, Taichung, 1 October 1986, coll. J. H. Tsai, ex. taro (2-1st instars, 21-2nd, 5-3rd, 4-4th, 8-5th, 3♂♂ 9♀♀ brachypterous adults). Holotype ♂ and allotype of subspecies in Bernice P. Bishop Museum, Honolulu, Hawaii. Paratypes (2♂, 8♀) and nymphs in collection of S. W. Wilson.

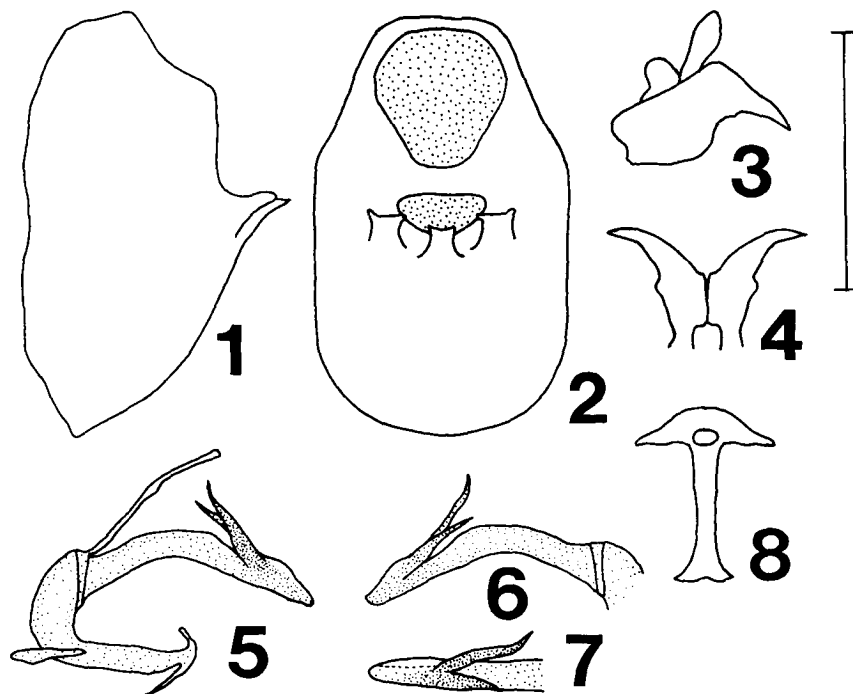
***Tarophagus proserpina taiwanensis* Wilson, NEW SUBSPECIES**

Adult.—Kirkaldy (1907) described and illustrated the head, and genital capsule of *T. proserpina* from Fiji. Zimmerman (1948) provided illustrations of the adult habitus of a brachypter, head, antenna, forewing from a macropter, and several views of the male genitalia and very brief descriptions of Hawaiian specimens. Matsumoto (1964) included body measurements and a short description of specimens from Hawaii. Fennah (1965) described macropterous *T. proserpina australis* Fennah from Queensland, Australia; this subspecies differs from the nominate subspecies in features of the vertex and male genitalia. In describing *T. p. australis* Fennah (1965) suggested that *T. proserpina* is polytypic in the form of the lobes of the pygofer, the major distinguishing feature of *T. p. taiwanensis*. *T. p. taiwanensis* agrees with the detailed description of *T. p. australis* given by Fennah (1965) except for the number of teeth on the metatibial spur (18–23 in *T. p. taiwanensis*, 36 in *T. p. australis*) and features of the male genitalia. Descriptions and illustrations of female genitalia have not been published.

Male genitalia—(Figs. 1–8). Pygofer subcylindrical; 1 median and 2 lateral caudodorsally directed quadrate processes; median process narrower than lateral ones. Anal tube subcylindrical, 1 acute process on either side extending from caudoventral angle. Styles widest in middle, apices diverging, acute. Aedeagus laterally compressed, curved, elongate; gonopore on dorsal aspect near apex; 2 sinuate acute processes extending anterodorsally from posterior $\frac{1}{3}$, left process longer than right. Aedeagal chamber with wings T-shaped (see Asche, 1985 for terminology).

T. proserpina taiwanensis differs from specimens described and illustrated by Kirkaldy (1907) and Zimmerman (1948) in the width and shape of the lateral lobes of the pygofer—in *T. p. taiwanensis* the lobes are at most $2\times$ the width of the median lobe and are quadrate; in *T. p. proserpina* (Kirkaldy and *sensu* Zimmerman) the lateral lobes are much more than $2\times$ the width of the median lobe and are subtriangular. Additional differences include the shape of the median lobe of the pygofer (quadrate in *T. p. taiwanensis*, rounded in *T. p. proserpina*), the length of anal tube spines (longer in *T. p. taiwanensis*), and apices of the styles (acute in *T. p. taiwanensis*, blunt in *T. p. proserpina*). *T. p. taiwanensis* differs from *T. p. australis* in the shapes of the pygofer median and lateral lobes (median lobe knoblike and lateral lobes subacute in *T. p. australis*) and aedeagus (processes equal in *T. p. australis*).

Female genitalia—(Figs. 9, 10). Segment 9 extending anteroventrally, slightly swollen, longer than wide. Anal tube cylindrical. Valvifer 1 strongly sinuate on inner margin, terminating in strong hook like ventrally directed process anteriorly. Valvula 3 elongate, slender, widest in basal $\frac{1}{3}$. Valvula 2 elongate, saber shaped, minute teeth on dorsal aspect. Genital scale ovoid, strong medial notch giving appearance of two plates.

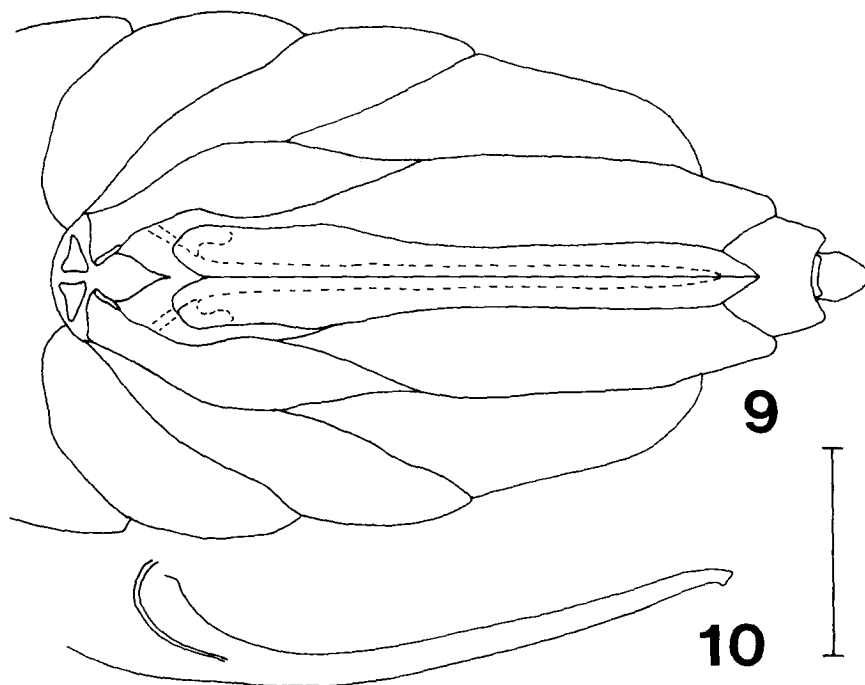


Figures 1–8. *T. proserpina taiwanensis* holotype male genitalia. 1. Pygofer, left lateral view of pygofer. 2. Pygofer, ventro-caudal view. 3. Anal tube, left lateral view. 4. Styles. 5. Aedeagus and anal tube and style connectives, left lateral view. 6. Aedeagus, right lateral view. 7. Aedeagus, dorsal view of apex. 8. Aedeagal chamber, anterior view. Bar = 0.5 mm.

Fifth instar—(Figs. 11–13, 18). Length 3.0 ± 0.23 ; thoracic length 0.9 ± 0.05 ; width 1.3 ± 0.11 ($N = 8$).

Form elongate, subcylindrical, slightly flattened dorsoventrally, widest across mesothoracic wingpads. Body mottled light to dark brown and cream, legs pale with dark brown apices.

Vertex quadrate, length subequal to width at base, posterior margin convex; carina on each side extending anteromedially from inner margin of compound eye and continuing onto frons as inner carina; with weak, shallow v-shaped transverse carina between lateral carinae, one shallow depression just anterior to transverse carina and two shallow depressions posterior to carina. Frons subrectangular; widest in upper $\frac{1}{3}$, width ca. $0.75 \times$ length; carinate lateral margins slightly convex, these outer carinae extending from vertex to near clypeal border and paralleled by pair of inner carinae; 9 pits between each inner and outer carina and 4 pits between each outer carina and eye; small ocellus or blemma ventral to posteroventral pit. Clypeus narrowing distally, consisting of subconical basal postclypeus and cylindrical distal anteclypeus. Beak extending almost to bases of metacoxae; 3-segmented, segment 1 obscured by anteclypeus, segment 2 slightly longer than 3; apex of segment 3 dark brown. Eyes red. Antennae 3-segmented; scape cylindrical, slightly longer than wide; pedicel subcylindrical, ca. $2 \times$ longer than wide and ca. $2 \times$ length of scape, with 10 pitlike sensoria; flagellum bulbous basally, with elongate, bristle-like extension distally, bulbous base ca. $0.25 \times$ length of pedicel.



Figures 9–10. *T. proserpina taiwanensis* female genitalia. 9. Complete genitalia, ventral view. 10. Valvula 2, left lateral view. Bar = 0.5 mm.

Thoracic nota divided by middorsal line into three pairs of plates. Pronotal plates subrectangular; anterior margin following posterior margin of head, posterior border sinuate; each plate with slightly curved, oblique posterolaterally directed carina originating on anterior margin in median $\frac{1}{3}$ and terminating in middle of plate, carina bordered along inner margin by row of 7 pits extending posterolaterally to lateral border of plate (lateralmost pits not visible in dorsal view). Mesonotal median length ca. $1.5\text{--}2\times$ that of pronotum; each plate bearing an elongate lobate wingpad extending nearly to apex of metanotal wingpad in macropter or covering lateral half of metanotal wingpad in brachypter; with posterolaterally directed carina originating on anterior margin in median $\frac{1}{4}$ and terminating on posterior margin; 2 pits, one on each side of carina and 3 pits in lateral $\frac{1}{3}$. Metanotal median length ca. $0.7\times$ that of mesonotum; each plate bearing an elongate lobate wingpad extending almost to anterior margin of tergite 4 in macropter and tergite 3 in brachypter; with weak longitudinal carina originating on anterior margin in median $\frac{1}{4}$ and terminating on posterior margin; 1 pit just lateral to carina. Pro- and mesocoxae elongate, posteromedially directed; metacoxae fused to sternum. Metatrochanter subcylindrical, with row of many minute teeth on posteromedial aspect. Metatibia with 2 black-tipped spines on lateral aspect of shaft, an apical transverse row of 5 black-tipped spines on plantar surface and a subtriangular, flattened movable spur with row of 15–19 teeth on lateral aspect. Pro- and mesotarsi with 2 dark brown tarsomeres; tarsomere 1 wedge-shaped; tarsomere 2 subconical, curved, and with pair of apical claws and median membranous pulvillus. Metatarsi with 3 tarsomeres;

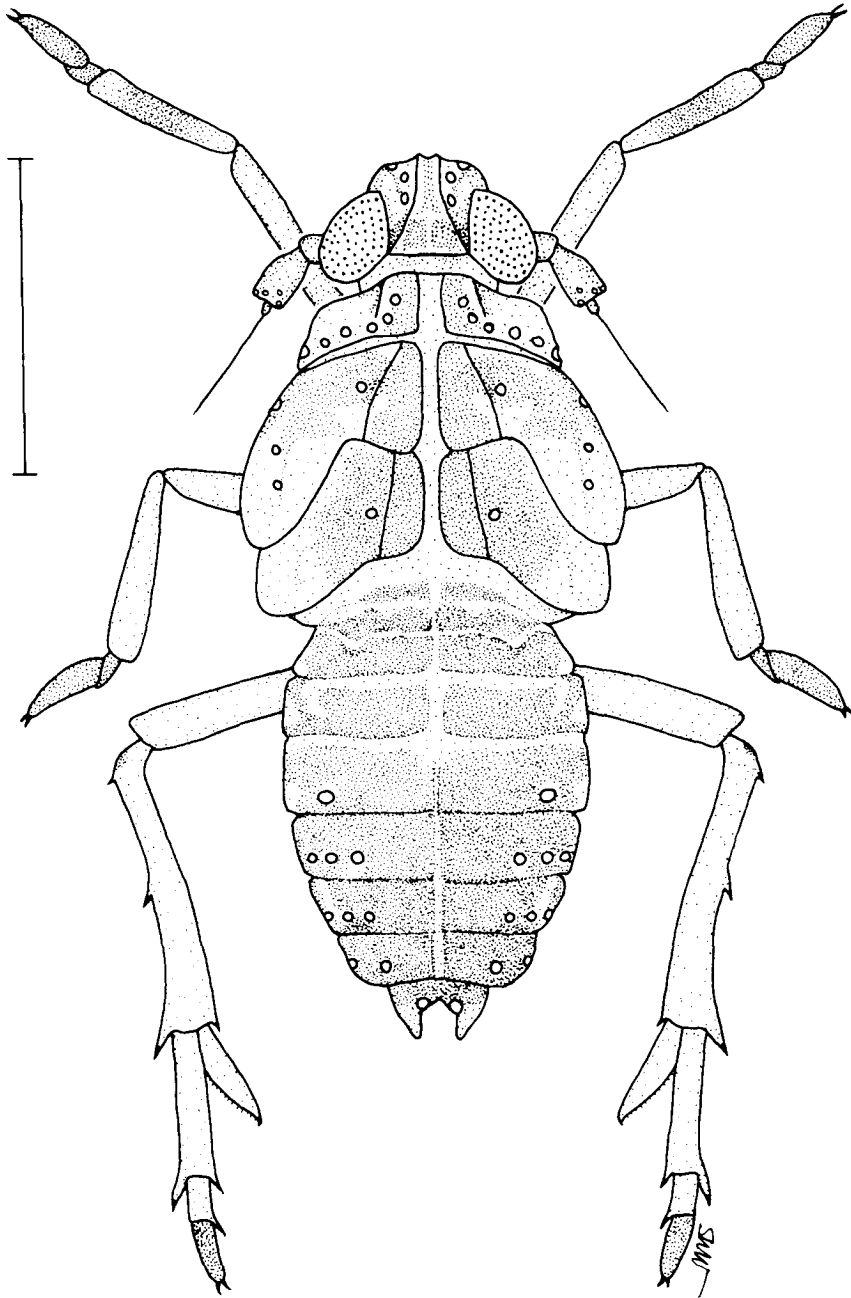
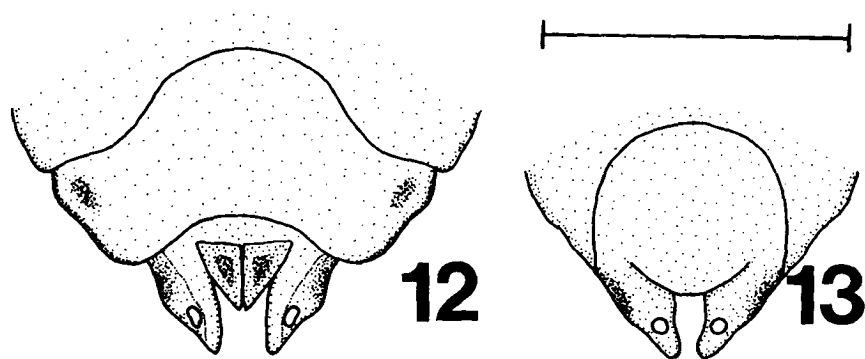


Figure 11. *T. proserpina taiwanensis* fifth instar. Bar = 1 mm.

tarsomere 1 cylindrical with apical transverse row of 7 black-tipped spines on plantar surface; tarsomere 2 cylindrical, ca. $0.25 \times$ length of tarsomere 1, with apical transverse row of 4 black-tipped spines on plantar surface; tarsomere 3 subconical, similar to terminal tarsomere of other legs.



Figures 12–13. *T. proserpina taiwanensis* fifth instar. 12. Ventral view of apex of abdomen of female. 13. Ventral view of apex of abdomen of male. Bar = 0.5 mm.

Abdomen 9 segmented; slightly flattened dorsoventrally, widest across segments 4 and 5. Tergites 1 and 2 reduced; tergite 5 with 1 pit and tergites 6–8 each with 3 pits on either side of midline (lateralmost pits not always visible in dorsal view). Segment 9 surrounding anus; with 3 pits on each side; female with 1 pair of subacute dark brown processes extending caudally from juncture of sternites 8 and 9; males lacking processes.

In their description of the 5th instar nymph, Wu and Yang (1985) indicate only 8 pits between each outer and inner carina on the frons. Nine pits are present on our specimens; one of the pits is in the anterolateral corner of the frons and is difficult to find unless the specimen is cleared and oriented correctly. In his extensive study of delphacid nymphs, Vilbaste (1968) also described 9 pits on the frons.

Fourth instar—(Figs. 17, 18). Length 2.1 ± 0.16 ; thoracic length 0.7 ± 0.03 ; width 0.9 ± 0.04 (N = 4).

Beak with segment 2 ca. $1.5 \times$ length of 3. Antennal pedicel with 7 pitlike sensoria.

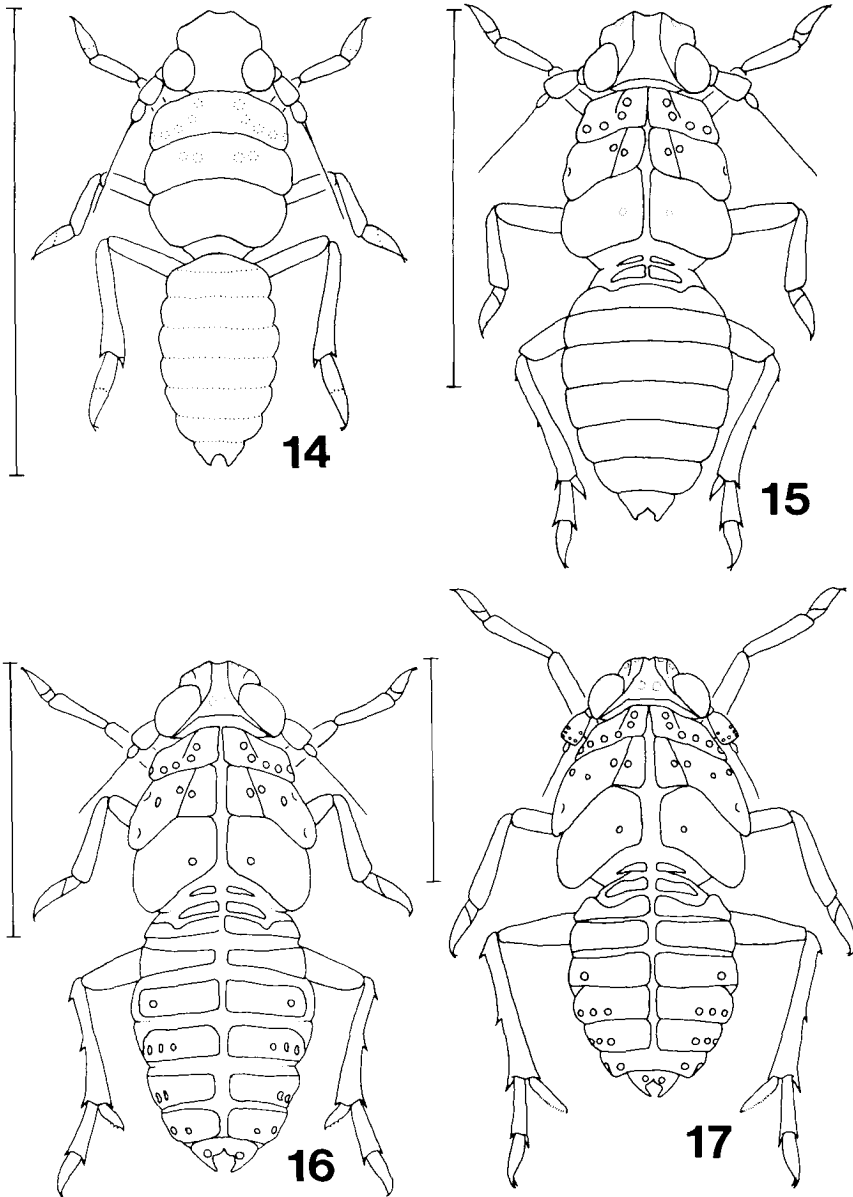
Mesonotal median length ca. $1.5 \times$ that of pronotum; wingpad covering lateral half of metanotal wingpad in all specimens. Metanotal median length subequal to that of mesonotum. Metatibial spur convex on both sides, with row of 7–11 teeth on lateral aspect. Metatarsi with 2 tarsomeres; tarsomere 1 with apical transverse row of 6 black-tipped spines on plantar surface; tarsomere 2 subconical, similar to terminal tarsomere of other legs, ca. $0.5\text{--}0.7 \times$ length of tarsomere 1, partially subdivided in middle, with transverse row of 3 very weak black-tipped spines in middle on plantar surface.

Abdominal subacute processes of female concolorous with sternum, poorly developed.

Third instar—(Figs. 16, 18). Length 1.7 ± 0.16 ; thoracic length 0.6 ± 0.03 ; width 0.7 ± 0.2 (N = 5).

Antennal pedicel with 4 very weak pitlike sensoria; bulbous portion of flagellum ca. $0.33 \times$ length of pedicel.

Pronotal plates each with row of 6 pits. Mesonotal wingpads weakly developed, covering metanotal wingpad laterally at base. Metatibia with apical transverse row of 4 black-tipped spines on plantar surface; spur with row of 2–4 teeth on lateral aspect



Figures 14–17. *T. proserpina taiwanensis* first through fourth instars. 14. First instar. 15. Second instar. 16. Third instar. 17. Fourth instar. Bars = 1 mm.

and 1 apical tooth. Metatarsomere 1 with apical transverse row of 5 black-tipped spines on plantar surface; tarsomere 2 lacking spines in middle.

Abdominal subacute processes of female apparently absent.

Second instar—(Figs. 15, 18). Length 1.4 ± 0.13 ; thoracic length 0.4 ± 0.03 ; width 0.5 ± 0.02 (N = 21).

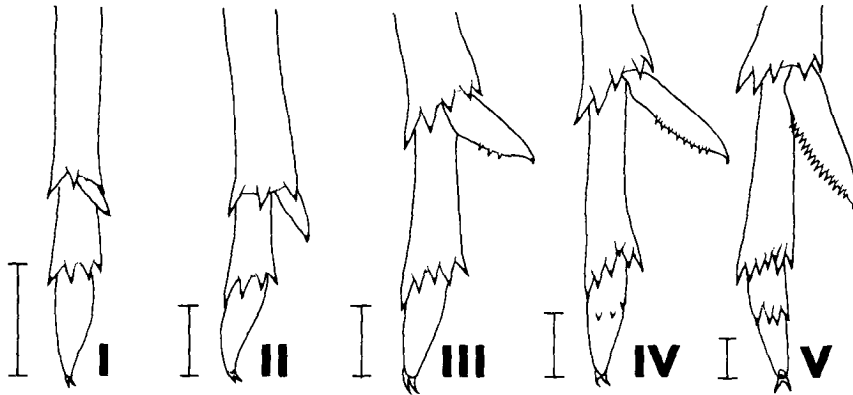


Figure 18. *T. proserpina taiwanensis* apices of metathoracic legs, plantar surface. I–V = nymphal instars. Bars = 0.1 mm.

Body white, occasionally with very light brown markings; apices of legs white to light brown.

Head with 3 pits between outer carina of frons and eye. Antennal pedicel with pits not apparent.

Mesonotal wingpads not developed, not covering metanotum laterally. Metatibia with apical transverse row of 3 black-tipped spines on plantar surface; spur with spike like, ca. 2X length of longest tibial spine, bearing 1 terminal black-tipped tooth. Metatarsomere 1 with apical transverse row of 4 black-tipped spines on plantar surface.

First instar—(Figs. 14, 18). Length 1.15–1.20; thoracic length 0.35; width 0.35–0.45 (N = 2).

Body and legs white; pits very obscure.

Antenna with bulbous portion of flagellum ca. 0.5X length of pedicel.

Metatibia lacking lateral spines on shaft; spur weakly developed, slightly longer than longest tibial spine.

KEY TO NYMPHAL INSTARS

1. Metatarsi with 3 tarsomeres or with tarsomere 2 partially subdivided and bearing 3 weak spines in middle on plantar surface (Fig. 18 IV, V) 2
 Metatarsi with 2 tarsomeres; tarsomere 2 lacking spines (Fig. 18 I–III) 3
2. Metatibial spur with 15 or more teeth; metatarsi with 3 tarsomeres, tarsomere 1 with apical transverse row of 7 spines, tarsomere 2 with apical transverse row of 4 spines (Fig. 18 V) Fifth instar
 Metatibial spur with fewer than 12 teeth; metatarsi with 2 tarsomeres, tarsomere 1 with apical transverse row of 6 spines, tarsomere 2 partially subdivided and with 3 weak spines in middle (Fig. 18 IV) Fourth instar
3. Metatibial spur with 2 or more marginal teeth and 1 apical tooth; metatarsomere 1 with apical transverse row of 5 spines (Fig. 18 III) Third instar
 Metatibial spur lacking marginal teeth, with 1 apical tooth; metatarsomere 1 with apical transverse row of 4 spines (Fig. 18, I, II) 4

4. Metatibial spur ca. $2 \times$ length of longest metatibial spine (Fig. 18 II); metatibia with 2 lateral spines on shaft (Fig. 15) Second instar
 Metatibial spur less than $2 \times$ length of longest metatibial spine (Fig. 18 I); metatibia lacking lateral spines on shaft (Fig. 14) First instar

ACKNOWLEDGMENTS

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