BioOne COMPLETE

Six New Record Species of Whiteflies (Hemiptera: Aleyrodidae) Infesting Morus alba in China

Authors: Wang, Ji-Rui, Song, Zao-Qin, and Du, Yu-Zhou

Source: Journal of Insect Science, 14(136) : 1-5

Published By: Entomological Society of America

URL: https://doi.org/10.1093/jisesa/ieu136

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

Downloaded From: https://complete.bioone.org/journals/Journal-of-Insect-Science on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

RESEARCH

Six New Record Species of Whiteflies (Hemiptera: Aleyrodidae) Infesting *Morus alba* in China

Ji-Rui Wang,[1] Zao-Qin Song,[1,2] and Yu-Zhou Du[1,3]

[1]School of Horticulture Plant Protection & Institute of Applied Entomology, Yangzhou University, Yangzhou 225009, China
[2]Crop Cultivation and Technology Promotion Stations of Yizheng, Yizheng 211400, China
[3]Corresponding author, e-mail: yzdu@yzu.edu.cn

Subject Editor: Marc De Meyer

J. Insect Sci. 14(274): 2014; DOI: 10.1093/jisesa/ieu136

ABSTRACT. To determine the species of whiteflies occurring on mulberry, *Morus alba* L. (Rosales: Moraceae) in China, we collected samples in more than 87 sites in 16 provinces of China from 2008 to 2011. In total, 10 species, representing seven genera of the subfamily Aleyrodinae, were identified. Of these, six species are newly recorded on mulberry in China, namely, *Aleuroclava ficicola* Takahashi, *Aleuroclava gordoniae* (Takahashi), *Aleurotrachelus camelliae* (Kuwana), *Bemisia afer* (Priesner & Hosny), *Bemisia tabaci* Gennadius, and *Pealius machili* Takahashi. Information on the taxonomy, distribution, and host plants of the whitefly species found on mulberry in China, along with a brief description and illustrations of each species are provided.

Key Words: mulberry pest, ESEM, description, puparium, taxonomy

Mulberry trees, *Morus alba* L. (Rosales: Moraceae), are widely cultivated in south China and other Asian countries, and their leaves are used to feed silkworms, *Bombyx mori* L. As in most commercial plantations and field crops, mulberry is prone to the attack of a diverse complex of pest species belonging to a large number of insect order (Bandyopadhyay et al. 1999). Whiteflies are an economically important group of insects infesting a wide range of host plant (Mound and Halsey 1978). Nymphs and adults are found primarily on the underside of mulberry leaves. They feed by sucking the plant phloem, which cause yellowish speckles on the leaves, gradually causing them to curl, wither, and fall off. The decreased quality of the leaves results in poor growth and development of the *B. mori*, and subsequent loss of silk production. Whiteflies are not only injurious to their host plants through feeding but also capable of transmitting numerous of plant viruses. In addition, whitefly nymphs secrete the honeydew on the leaves in the lower parts of the tree canopy, which induce sooty mold disease, affecting the quality of mulberry leaves (Song et al. 2011). Sericulture is very important in Asia, so the quality of mulberry is directly related to the development of sericulture.

Mulberry is a favor host plant for whiteflies. There are a total 17 species (Table 1) of whiteflies recorded from mulberry worldwide including 8 species from India (Bandyopadhyay et al. 1999, David and Ragupathy 2004). The majority of these species are widely distributed and considered to be economically important. Since 1991, *Pealius mori* (Takahashi) has become a major pest in mulberry, and outbreaks of the pest often occur in southwestern and eastern China (Xiong et al. 2011). To determine the identity and incidence of whitefly species on mulberry in China, a survey was conducted from 2008 to 2011 in locations in 16 provinces of China.

Materials and Methods

Specimens were collected in mulberry groves in 16 provinces of China (Heilongjiang, Liaoning, Jilin, Beijing, Shandong, Shanxi, Anhui, Zhejiang, Jiangxi, Hubei, Guangdong, Guangxi, Guizhou, Yunnan, Sichuan, and Chongqing) by Z-.Q. Song and J-.R. Wang Specimens were mounted by using the method suggested by Martin (1987) and examined with an MZ APO Leica microscope (Wetzlar, Germany). Some specimens were prepared and observed with the environmental scanning electron microscope (ESEM), and digital images were taken. Mulberry leaves infested with whitefly puparia were cut into small squares, which were then attached with a black carbon conductive adhesive and placed on the sample stage. They were then examined using a Philips XL30-ESEM (Amsterdam, Nederland) at 20 kV per EHT and 66.7–120 Pa between 150× to 1,600× to observe them and take digital images.

As for the identification, J-.R. Wang identified the whitefly specimen preliminary to genus, through referring to the literature of all the species of this genus and made sure what species the specimen was. They were sent to A. K. Dubey (Forest Entomology Division, Forest Research Institute, New Forest, Dehradun, India) and B. V. David (International Consultant [GLP], 76/2 A Sree Ramulu st., Madanandapuram) for confirmation of identification.

Taxonomic Accounts. In total, 10 species representing 7 genera of the subfamily Aleyrodinae were identified, including 6 new record species of whiteflies in mulberry, namely, *Aleuroclava ficicola* Takahashi, *Aleuroclava gordoniae* (Takahashi), *Aleurotrachelus camelliae* (Kuwana), *Bemisia afer* (Priesner & Hosny), *Bemisia tabaci* Gennadius, *Pealius machili* Takahashi, and other 4 recorded species in mulberry, namely, *Aleuroclava psidii* (Singh), *Aleurolobus marlatti* (Quaintance), *Pealius mori* (Takahashi), and *Parabemisia myricae* (Kuwana). The pest status, illustrations, brief descriptions and information on the taxonomy, distribution worldwide, and hosts found in China of each of these six newly recorded species is provided. The result provides a detailed key for field identification of the whiteflies in mulberry from China. The illustrations also act as an additional tool for the identification of whitefly species.

***Aleuroclava ficicola* Takahashi** (Figs. 1 and 2).

Aleurotuberculatus ficicola Takahashi, 1932: 24.
Aleuroclava ficicola (Takahashi); Martin, 1999: 31.

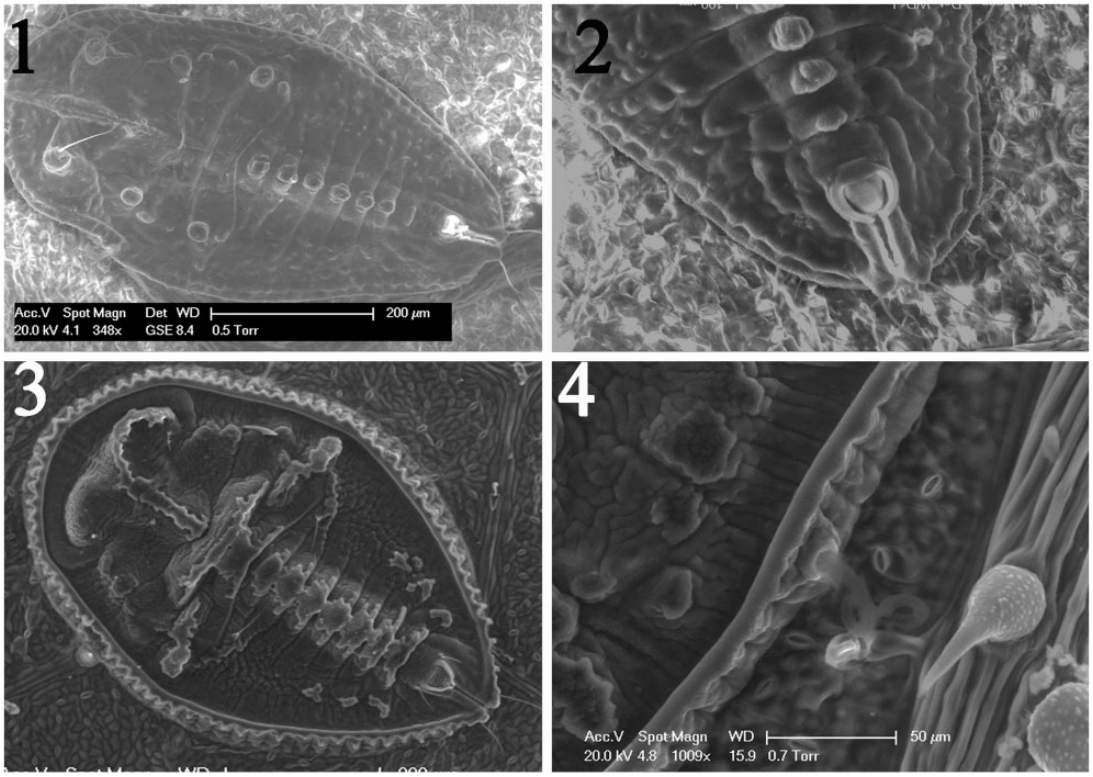
Diagnosis. Puparium pale yellowish white, body oval, elevated along midline, broadest across first abdominal segment, slightly constricted on the thoracic tracheal clefts. Cephalothorax with five pairs of short blunt tubercles, of which the anterior pair is the largest and bears a pair of setae. Longitudinal molting suture reaches the anterior margin, while transverse molting suture not reaching the lateral margin. Median abdominal tubercles present on segments one to seven. Vasiform orifice nearly as long as wide, rounded, much expanded on the front margin, with a small notch at the hind end. Operculum almost covers completely the vasiform orifice. Lingula not observed; caudal furrow well defined.

© The Author 2014. Published by Oxford University Press on behalf of the Entomological Society of America.
This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (http://creativecommons.org/licenses/by-nc/4.0/), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited. For commercial re-use, please contact journals.permissions@oup.com

Downloaded From: https://complete.bioone.org/journals/Journal-of-Insect-Science on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

Table 1. The whitefly recorded from mulberry in the world

Species	Distribution	Citation
1 *Acaudaleyrodes rachipora* (Singh)	India, Iran, Iraq, and Israel	Evans (2008)
2 *Aleurocanthus lobulatus* Jesudasan & David	India	David and Ragupathy (2004)
3 *Aleuroclava aucubae* (Kuwana)	China and Japan	Martin (1999)
4 *Aleuroclava davidi* (Qureshi)	Pakistan	Martin (1999)
5 *Aleuroclava pentatuberculata* Sundararaj & David	India	David and Ragupathy (2004)
6 *Aleuroclava psidii* (Singh)	India	David and Ragupathy (2004)
7 *Aleurodicus dispersus* Russell	India	David and Ragupathy (2004)
8 *Aleurolobus marlatti* (Quaintance)	India	David and Ragupathy (2004)
9 *Aleuroplatus alcocki* (Peal)	India	David and Ragupathy (2004)
10 *Aleuroplatus pectiniferus* Quaintance & Baker	India, Pakistan, and Sri Lanka	Martin and Mound (2007)
11 *Aleurotrachelus ishigakiensis* (Takahashi)	Japan	Evans (2008)
12 *Asterobemisia dentata* Danzig	Tadzhikistan	Evans (2008)
13 *Bemisia shinanoensis* Kuwana	Japan	Kuwana (1922)
14 *Dialeuropora decempuncta* (Quaintance & Baker)	India	Bandyopadhyay et al. (1999)
15 *Parabemisia myricae* (Kuwana)	Japan	Evans (2008)
16 *Pealius mori* (Takahashi)	China and India	Takahashi (1932) and David and Ragupathy (2004)
17 *Tetraleurodes mori* (Quaintance)	The United States	Quaintance and Baker (1914)



Figs. 1–4. (1–2) *A. ficicola*—(1) puparium and (2) vasiform orifice and caudal furrow. (3–4) *A. gordoniae*—(3) puparium and (4) marginal teeth.

Material examined. Six puparia, China, Quzhou (28.58° N, 118.52° E), Zhejiang Province, from *M. alba*, 15 × 2010, Collector Z-.Q. Song and J-.R.Wang, deposited in Yangzhou University.

Distribution. China (Zhejiang, Taiwan).

Host plants. *Boehmeria zollingeriana* Weddell, *Eriobotrya japonica* (Thunberg), *Ficus microcarpa* L., *M. alba,* and *Maesa japonica* (Thunb) Morizi & Zoll. in China.

***Aleuroclava gordoniae* (Takahashi)** (Figs. 3–5).

Aleurotuberculatus gordoniae Takahashi, 1932: 21.

Aleuroclava gordoniae (Takahashi); Martin, 1999: 31.

Diagnosis. Puparium black, without wax secretion. Oval, markedly narrowed on both anterior and posterior margin. Longitudinal and transversal molting sutures reaching the margin; abdominal segments distinct on the median area. Dorsal disk with many small granules except on the median area of abdomen and the margin area, some minute circular pores, and many lineal markings on the marginal area. Submarginal with many transverse ridges which are rounded. Thoracic tracheal folds faintly discernible, the clefts small, not forming a pore; caudal furrow distinct. Vasiform orifice small, wider than long. Operculum nearly filling the orifice. Lingula not exposed.

Material examined. Ten puparia, China, Huai'an (33.30° N, 119.09° E), Jiangsu Province, from *M. alba*, 15. viii.2010, Coll. Z-.Q. Song and J-.R. Wang, deposited in Yangzhou University.

Distribution. China (Jiangsu, Hong Kong, Taiwan).

Host plants. *Schefflera octophylla* (Lour.) Harms, *Cinnamomum camphora* (L.) J. Presl, *Cinnamomum japonicum* Siebold, *Ficus retusa*

Downloaded From: https://complete.bioone.org/journals/Journal-of-Insect-Science on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

L., *Gordonia anomala* (Roxb. ex Ker Gawl.) D. Dietr., *Liquidambar formosana* Hance, *M. alba,* and *Pourthiaea bethamiana* in China.

***Aleurotrachelus camelliae* (Kuwana)** (Figs. 6 and 7).

Aleyrodes camelliae Kuwana, 1911: 625.

Aleurotrachelus camelliae (Kuwana); Quaintance and Baker, 1914: 103.

Diagnosis. Puparium shiny black, outline almost octagonal, and covered by a thin transparent wax. Cephalothorax with anterior margin pointed and widest at the level of the transverse molting suture. A smooth area presents around the thoracic segments on thoracic. Vasiform orifice subcordate, inner margin without teeth, posterior outer margin slightly divided, operculum similarly shaped, and filling orifice.

Material examined. Six puparia, China, Zhenjiang (32.11° N, 119.27° E), Jiangsu Province, on *M. alba,* 10.v.2011, Coll. Z-.Q.S., deposited in Yangzhou University.

Distribution. China (Jiangsu, Hong Kong), Japan.

Host plants. *Camellia japonica* L., *Camellia sinensis* (L.) O. Ktze., *C. sinensis* var. *sinensis* (L.) O. Ktze., *M. alba* L. in China. Other host plants listed in Evans (2008) and Kuwana (1911).

***Bemisia afer* (Priesner & Hosny)** (Figs. 8 and 9).

Dialeurodoides afer Priesner & Hosny, 1934: 6.

Bemisia afer (Priesner & Hosny); Habib and Farag, 1970: 8.

Bemisia (Neobemisia) afra [sic] (Priesner & Hosny); Visnya, 1941: 8.

Bemisia hancocki Corbett, 1936: 20.

Bemisia (Neobemisia) hancocki Corbett; Visnya, 1941: 8.

Diagnosis. Puparium colourless or yellowish. Body shape varying but generally oval with little wax secretion. Margin almost smooth with, marginal setae present. Transverse molting suture not reaching the margin. Cephalic, first abdominal and eighth abdominal, and caudal setae elongate. Posterior spiracles recessed slightly, many short striaes extend from margin to center. Vasiform orifice triangular, pointed at the end. Operculum subcircular, filling about one third of vasiform orifice. A pair of setae at the apex of the lingua. Caudal furrow distinct. Vasiform orifice as long as, or shorter than length of caudal furrow; caudal setae usually stout, shorter than length of vasiform orifice whose sides are usually distinctly concave (Suh and Hodges 2008).

Material examined. Twelve puparia, China, Beijing (39.55° N, 116.24° E), from *M. alba*, 10.ix.2010, Coll. J-.R. Wang, deposited in Yangzhou University.

Distribution. Brazil, Egypt, France, Iran, Israel, Italy, Sicily, and Spain; Cameroon, Chad, Congo, Guinea, Ivory Coast, Kenya, Madagascar, Malawi, Niger, Nigeria, Sierra Leone, South Africa, Sudan, Uganda, Zaire, China (Beijing, Shaanxi), Korea, India, Pakistan, Australia, and New Guinea (Evans 2008).

Host plants. *Lonicera* sp., *M. alba* L., *Robinia pseudocacia* L., *Rosa chinensis* Jacq., and *Rosa multiflora* Thunb. in China. In addition, 20 plant families are reported as hosts in Europe and Mediterranean countries (Mound and Halsey 1978; Evans 2008).

***Bemisia tabaci* Gennadius** (Figs. 10 and 11).

Aleurodes tabaci Gennadius, 1889: 1–3.

Diagnosis. Puparium oval, margin finely crenate, marginal setae present, and tracheal pore areas not differentiated from margin. Submargin not separate from the dorsal disc. Vasiform orifice triangular, with some posterior tubercles. Operculum semicircular, filling about one half of vasiform orifice, lingual elongate with tip exposed. Caudal ridges and furrow present. Vasiform orifice longer than length of caudal furrow; caudal setae always stout at least as long as length of vasiform orifice whose sides are almost straight (Suh and Hodges 2008).

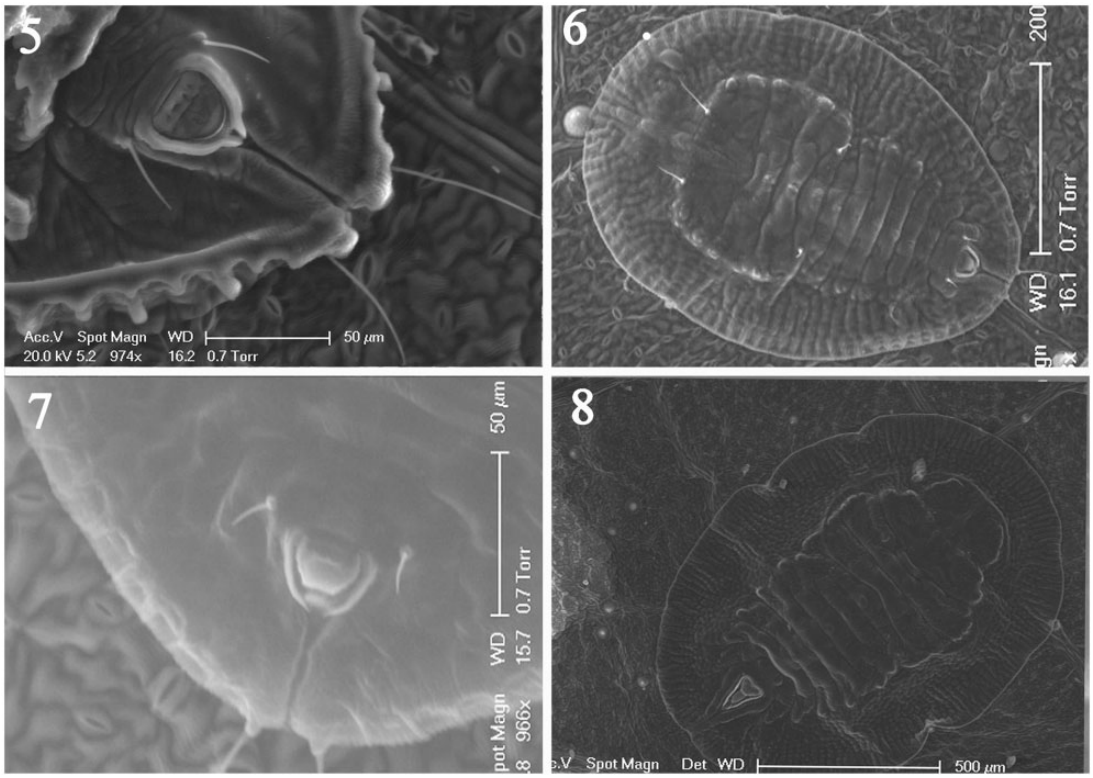
Material examined. Six puparia, China, Shangrao (28.27° N, 117.58° E), Jiangxi Province, from *M. alba*, 15 × 2010, Coll. J-.R. Wang, deposited in Yangzhou University.

Distribution. Worldwide.

Host plants. Hundreds of plant species including many kinds of vegetables.

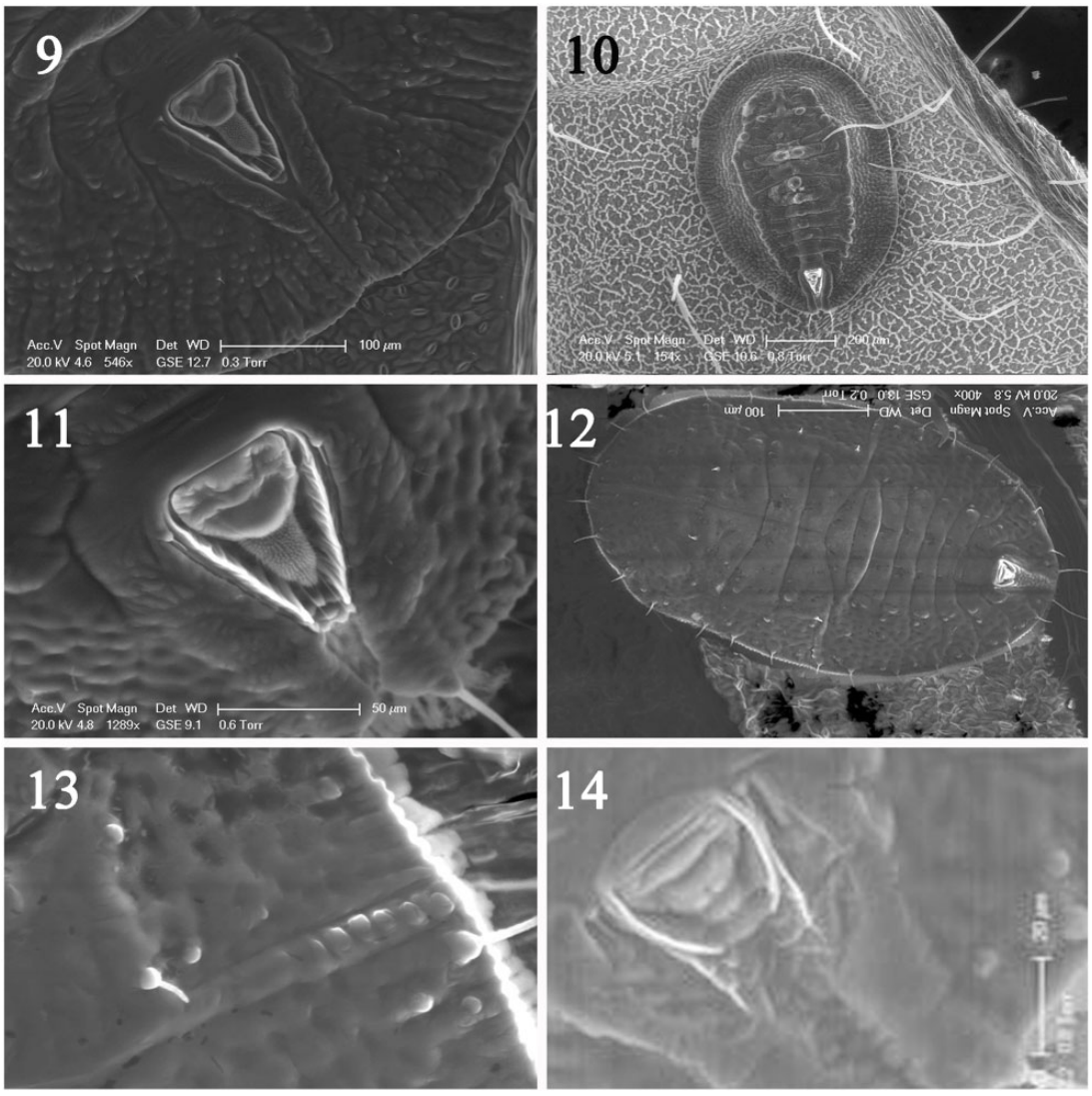
***Pealius machili* Takahashi** (Figs. 12–14).

Pealius machili Takahashi, 1935: 62.



Figs. 5–8. (5) *A. gordoniae*, vasiform orifice and caudal furrow. (6–7) *Aleurot. camelliae*—(6) puparium and (7) vasiform orifice and caudal furrow. (8) *B. afer,* puparium.

Downloaded From: https://complete.bioone.org/journals/Journal-of-Insect-Science on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use



Figs. 9–14. (9) *B. afer;* vasiform orifice and caudal furrow. (10–11) *B. tabaci*—(10) puparium and (11) vasiform orifice and caudal furrow. (12–14) *P. machili*—12, puparium; (13) transverse molting suture; and (14) vasiform orifice and caudal furrow.

Diagnosis. Puparium white, elliptic, with a very narrow secretion along the margin. Sixteen pairs of setae along the margin, all subequal in length, each arising from a small tubercle. Midthoracic and transverse molting sutures reaching the margin, many very small rounded papillae joining the lateral part of transverse molting suture. Meso- and metanota, base of abdominal segments I–VI each with a pair of markings in the median area. Vasiform orifice nearly rectangular, operculum semicircle, filling two thirds of vasiform orifice. Lingula exposed and extends to the bottom of the vasiform orifice. Caudal furrow distinct, longer than the vasiform orifice, granulated.

Material examined. Five puparia, China, Shaoguan (24.48° N, 113.37° E), Guangdong Province, from *M. alba*, 30.viii.2010, Coll. Z-.Q. Song and J-.R. Wang, deposited in Yangzhou University.

Distribution. China (Jiangxi, Taiwan).

Host plants. *Machilus thunbergii* Sieb. et Zucc., *M. alba* in China.

A key to the whitefly species on mulberry in China

1. Puparium black.....2
-. Puparium white or yellowish.....4
2. Eye spots crescent shaped distinct; margin rim marked by a large number of light transparent sutures extending beyond the margin; vasiform orifice triangular.....*Aleurol. marlatti*
-. Eye spots indistinct; margin rim without the light transparent sutures extending beyond the margin; vasiform orifice subcordate 3
3. Puparium outline almost octagonal and covered by a thin transparent wax.....*Aleurot. camelliae*
-. Puparium oval and not covered by a thin transparent wax .....*A. gordoniae*
4. With many pairs of short setae in a row along the whole margin.....5
-. With many pairs of short setae in a row along the whole margin 7
5. With transparent secretions extending from case margin all around; dorsum without any small circular pores ..... *Pa. myricae*
-. Without transparent secretions extending from case margin all around; dorsum without some small circular pores 6
6. Sixteen pairs of setae along the margin, transverse suture with many very small rounded papillae in a row on the lateral part... *P. machili*
-. Fourteen pairs of setae along the margin, transverse suture without any very small rounded papillae in a row on the lateral part .....*P. mori*

Downloaded From: https://complete.bioone.org/journals/Journal-of-Insect-Science on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

7. Puparium with T-shaped tubercle on cephalothorax, dorsum with numerous very small papillae and granules ..... *A. psidii*
-. Puparium without T-shaped tubercle on cephalothorax, dorsum without numerous very small papillae and granules 8
8. Cephalothorax with five pairs of short blunt tubercles, median abdominal tubercles present on segments one to seven, vasiform orifice rounded ....*A. ficicola*
-. Cephalothorax without short blunt tubercles, median abdominal tubercles absent on segments one to seven, vasiform orifice triangular.....9
9. Vasiform orifice longer than length of caudal furrow; caudal setae always stout at least as long as length of vasiform orifice whose sides are almost straight .... *B. tabaci.*
-. Vasiform orifice as long as, or shorter than length of caudal furrow; caudal setae usually stout shorter than length of vasiform orifice whose sides are usually distinctly concave ....*B. afer.*

Acknowledgments

We express our deep gratitude to the Testing Center of Yangzhou University for using the Philips XL30-Environmental Scanning Electron Microscope. This research was supported by Special Fund for Agro-Scientific Research in the Public Interest of China (201303019 and 200803005).

References Cited

Bandyopadhyay, U. K., S. K. Raina, N. Chakraborty, M. V. Santhakumar, S. K. Sen, and B. Saratchandra. 1999. New record of a Homopteran pest on mulberry (*Morus alba*). Sericologia 39: 319–321.

Corbett, G. H. 1936. New Aleurodidae (Hem.). Proc. R. Entomol. Soc. Lond. B 5: 18–22.

David, B. V., and E. Ragupathy. 2004. Whiteflies (Homoptera: Alyerodidae) of mulberry, *Morus alba* L., in India. Pestology 28: 24–33.

Evans, G. A. 2008. The whiteflies (Hemiptera: Aleyrodidae) of the world and their host plants and natural enemies. (http://www.sel.barc.usda.gov:591/1WF/whitefly_catalog.htm).

Gennadius, P. 1889. Disease of tobacco plantations in the Trikonia. The aleurodid of tobacco [in Greek]. Ellenike Georgia 5: 1–3.

Habib, A., and F. A. Farag. 1970. Studies on nine common aleurodids of Egypt. Bulletin de la Societe Entomologique d'Egypte 54: 1–41.

Kuwana, I. 1911. The whiteflies of Japan. Pomona Coll. J. Entomol. 3: 620–627.

Kuwana, I. 1922. *Bemisia shinanoensis* n. sp. A new whitefly from Japan. J Plant Prot. 9: 461–464.

Martin, J. H. 1987. An identification guide to common whitefly pest species of the world (Homoptera: Aleyrodidae). Trop. Pest Manag. 33: 298–322.

Martin, J. H. 1999. The whitefly fauna of Australia (Sternorrhyncha: Aleyrodidae). A taxonomic account and identification guide, pp. 1–197. vol. 38, Technical paper. Division of Entomology, Commonwealth Scientific and Industrial Research Organization, Canberra, Australia.

Martin, J. H., and L. A. Mound. 2007. An annotated check list of the world's whiteflies Insecta: Hemiptera: Aleyrodidae. Zootaxa 1492: 1–84.

Mound, L. A., and S. H. Halsey. 1978. Whitefly of the world, pp. 340. British Museum (Natural History)/John Wiley & Sons, Chichester, Britain.

Priesner, H., and M. Hosny 1934. Contributions to a knowledge of the whiteflies (Aleurodidae) of Egypt (III). Bull. Minist. Agric. Egypt Technol. Sci. Serv. 145: 1–11.

Quaintance, A. L., and A. C. Baker. 1914. Classification of the Aleyrodidae part II, pp. 95–109. vol., 27, Technical series. Bureau of Entomology, United States Department of Agriculture, Washington, United States.

Song, Z. Q., X. Y. Ji, and Y. Z. Du. 2011. The ultrastructure of five mulberry whiteflies from China. Chin. J. Appl. Entomol. 48: 65–69.

Suh, S. J., and G. Hodges. 2008. Key to the Korean species of whiteflies (Hemiptera: Aleyrodidae). J. Asia Pac. Entomol. 11: 123–131.

Takahashi, R. 1932. Aleyrodidae of Formosa, part I, pp. 1–57. vol. 59, Report. Department of Agriculture, Government Research Institute, Formosa, China.

Takahashi, R. 1935. Aleyrodidae of Formosa, part IV, pp. 39–65. vol. 66, Report. Department of Agriculture, Government Research Institute, Formosa, China.

Visnya, A. 1941. Vorarbeiten zur Kenntnis der Aleurodiden-Fauna von Ungarn, nebst systematischen Bemerkungen uber die Gattungen Aleurochiton, *Pealius* and *Bemisia* (Homoptera). Fragmenta Faunistica Hungarica 4 (Suppl): 1–19.

Xiong, J., W. J. Zheng, and S. L. Yao. 2011. Research situations of occurrence, damage of *Pealius mori* (Homoptera: Aleyrodidae) and its integrated pest management in China. Guizhou Sci. 29: 85–91.

Received 15 November 2013; accepted 17 March 2014.

Downloaded From: https://complete.bioone.org/journals/Journal-of-Insect-Science on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use