

## *Trijuba oculata* (Hemiptera: Coccoomorpha: Coccidae)— first record genus and species to China

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**Abstract:** The genus *Trijuba* De Lotto, 1975 is recorded from China for the first time. This newly recorded species, *Trijuba oculata* (Brain, 1920) also represents a new record for this genus to China and is redescribed, photographed and illustrated based on adult females and nymphs. This species was found on four newly recorded plants: *Calliandra haematocephala* Hassk, *Erythrophleum fordii* Oliv, *Neolamarckia cadamba* (Roxb.) Bosser and *Saraca dives* Pierre from Yunnan and Guangxi Province. Tables document the hosts of this species and illustrate the distribution of the genus *Trijuba* in various zoogeographical regions around the world.

**Key words:** soft scale; new record; taxonomy

中国新记录属、种——三鬃蜡蚧属眼三鬃蜡蚧（半翅目：蚧次目：蜡蚧科）

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**摘要：**记述中国 1 新记录属：三鬃蜡蚧属 *Trijuba* De Lotto, 1975，以及该属 1 新记录种：眼三鬃蜡蚧 *Trijuba oculata* (Brain, 1920)，并对雌成虫和若虫进行详细描述、拍照与绘图。记述该属 4 种新寄主植物：朱樱花 *Calliandra haematocephala* Hassk、格木 *Erythrophleum fordii* Oliv、团花 *Neolamarckia cadamba* (Roxb.) Bosser 和中国无忧花 *Saraca dives* Pierre。提供了该属寄主植物统计表与世界分布统计表。

**关键词：**蜡蚧；新记录；分类

### Introduction

The soft scale insects (Hemiptera: Coccoomorpha: Coccoidea) are the third largest family in the Coccoidea, following the Diaspididae (armored scales) and the Pseudococcidae (mealybugs) (García Morales *et al.* 2017). Soft scales are widespread throughout the world and are important pests on agricultural and horticultural crops, and on ornamental plants (Henderson & Hodgson 2005). In China they are also important pests on these plants (Yang 1982). The species *Trijuba oculata* was first described by Brain under the genus *Saissetia* in 1920. In 1935, Hall revised the combination and described this species as *Lecanium oculata*. Green & Mamet described *Lecanium dorsociliatum* in 1938, but this was a junior synonym of Brain's species. Mamet introduced the combination *Coccus oculatus* in 1954. The genus *Trijuba* was first erected by De Lotto in 1975.

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The genus *Trijuba* only consists of one species *Trijuba oculata* (Brain) and has not been previously reported from China. In this study, we redescribe and illustrate this species. The discovery of this species is the first record of the occurrence of the genus *Trijuba* in China. The host-plants of the species are listed in Table 1 according to the scale insect database, ScaleNet (García Morales *et al.* 2017) and Williams & Williams (1988). In addition, their distribution in various zoogeographical regions are illustrated in Table 2. We also provide the description and illustration of the nymph.

## Material and methods

Scale insect samples were collected from branches, twigs and leaves of *Calliandra haematocephala*, *Erythrophleum fordii*, *Neolamarckia cadamba* and *Saraca dives* in Yunnan and Guangxi Province of China. Samples were stored in envelopes. Specimens were immersed in chloroform to remove wax secretions before the preparation of slides. Slides were mounted using methods described by Hodgson and Henderson (2000). The morphology of the specimens was observed under an EVOS digital inverted microscope. The illustration of the adult female (Fig. 2) was drawn with an Olympus BH-2 stereoscopic microscope. In the illustration, the dorsum is depicted on the left side and the venter on the right side, with important characters shown around the main illustration. Photographs of nymph and some important characters of the adult female (Figs. 3, 4) were taken by an OLYMPUS PM-10 AD microscope, and were superposed and compiled by an Auto-montage imaging system attached to a QIMAGING Retiga 4000R digital camera (CCD). The appearance in life (Fig. 1) of the adult female was photographed by a Canon 80D camera. All measurements were made using NIT-Elements D software and are given in micrometers ( $\mu\text{m}$ ) or millimeters (mm).

All specimens were deposited in the Northwest A&F University, Yangling, Shaanxi, China (NWAUFU).

## Taxonomy

### Genus *Trijuba* De Lotto, 1975, new record to China

*Trijuba* De Lotto, 1975: 62.

Ben-Dov, 1993: 333.

Hodgson, 1994: 580.

Generic diagnosis. Adult female. Body elongate oval. Derm membranous; submarginal tubercles present on submarginal area; anal plates each triangular, together quadrate; anal ring bearing 8 setae; two types of dorsal setae, including (1) very long, spinose and pointed dorsal setae present medially in three distinct lines; (2) short, toothed, frayed and fimbriate setae mainly present in a submarginal band sparsely. Stigmatic cleft shallow but distinct, usually with 3 stigmatic spines; two types of marginal setae, including (1) spinose, slender, each with a pointed apex and a well-developed basal socket; (2) slender, each with a branched, frayed and fimbriate apex and a well-developed basal socket. Antennae 8 segmented; legs well developed, each with a well-developed tibiotarsal articulatory scleriosis; claw without a denticle; Spiracles normal, each with a sclerotic plate; most spiracular disc-pores each have 5 loculi in the outer

ring; pregenital disc-pores each have 10 loculi, present in vulvar area and on anterior abdominal segments.

***Trijuba oculata* (Brain, 1920)** (Figs. 1–4), new record to China

*Saissetia oculata* Brain, 1920: 13.

*Lecanium oculata* Hall, 1935: 76.

*Lecanium dorsociliatum* Green & Mamet, 1938: 126, junior synonym of *S. oculata*.

*Coccus dorsociliatus* Mamet, 1949: 23.

*Coccus oculatus* Mamet, 1954: 260; De Lotto, 1957: 305.

*Trijuba oculata* De Lotto, 1975: 62; Hodgson, 1994: 580; Joshi & Rameshkumar, 2017: 632.

**Specimens examined.** China, 40 adult females and nymphs. Pu'er, Yunnan Province, 05-VII-2018, on *Calliandra haematocephala* and *Erythrophleum fordii*; Ruili, Yunnan Province, 26-VII-2018, on *Neolamarckia cadamba*; Nanning, Guangxi Province, 12-VIII-2019, on *Saraca dives*, Tong CAO & Na ZHANG leg. (NWAFU).

Appearance in life. Body elongate oval, moderately convex medially, broadest in thorax of abdomen. Fresh insects are yellowish to brown, dark brown grid present posteriorly in the middle of mature adult females. Margin brown to dark brown around the body. Anal plate dark brown to almost black.

Slide-mounted adult female. Body elongate oval, slightly narrow anteriorly and posteriorly, broadest in thorax; body length 5–8 mm, width 3–5 mm. Anal cleft approximately 1/6–1/5 of the body length. Stigmatic clefts not deep but distinct.

Dorsum. Derm membranous, with cell-like clear areas at maturity, dorsal microducts present in them. Three distinct lines of dorsal setae present medially with two types of medial setae, slightly scattered anteriorly and posteriorly, including (1) very long and pointed spinose setae, each with a pointed apex and a well-developed basal socket, about 113.6–138.4  $\mu\text{m}$  long; (2) setae shorter than type I but much longer than type III, each with a slightly frayed and fimbriate apex, always present anteriorly and posteriorly, about 60.1–68.7  $\mu\text{m}$  long. There is another type of dorsal setae, (3) very short and toothed with a distinctly frayed and fimbriate apex, sparsely and submarginally distributed around the body, about 11.8–20.3  $\mu\text{m}$  long. Submarginal tubercles numbering 12 to 15 in total around body, 4 to 6 between anterior stigmatic clefts, 0 or 1 between anterior and posterior stigmatic clefts, 3 to 5 between each posterior stigmatic cleft and anal cleft. Preopercular pores circular, present or absent. Anal plates each triangular, 274.8–299.2  $\mu\text{m}$  long, 115.3–122.4  $\mu\text{m}$  wide, together quadrate, anterolateral margin 121.0–133.0  $\mu\text{m}$  long, posterolateral margin 216.6–232.7  $\mu\text{m}$  long, posterior margin longer than anterior margin, outer angle slightly obtuse; each plate with a well-developed supporting bar, a discal setae and 4 apical setae. Anogenital fold with 2 or 3 pairs of anterior marginal setae, and 3 lateral marginal setae. Anal ring subcircular, with 8 anal ring setae.

Margin. Marginal setae each with a well-developed basal socket, 108.2–138.5  $\mu\text{m}$  long, two types present: (1) slender, slightly curved or straight, each with a simple pointed apex; (2) slender, slightly curved or straight, each with a frayed and fimbriate apex; with 61–81 setae between anterior stigmatic clefts, 18–25 setae between anterior and posterior stigmatic clefts on each side, and 55–68 setae between each posterior stigmatic cleft and anal cleft. Stigmatic clefts not deep but distinct, each cleft containing 3 slender, tapered and bluntly spinose

stigmatic spines, each with a well-developed basal socket; median spine longest, about 39.5–73.3  $\mu\text{m}$  long, 1.4–3 times as long as the lateral spines, each 27.4–36.9  $\mu\text{m}$  long. Eyespots present on margin.



Figure 1. Appearance in life.

Venter. Derm membranous. Antennae each with 8 segments, total antennal length 490.1–592.3  $\mu\text{m}$ ; segment 3 is longest. Antennal bases usually with 2 or 3 pairs of inter-antennal setae present between. Submarginal setae present in a single row around body. Legs well-developed, each with tibio-tarsal articulation and a well-developed tibiotarsal articular sclerite, tibia 184.5–217.8  $\mu\text{m}$  long, longer than tarsus, which is 115.4–123.0  $\mu\text{m}$  long. Claw without denticle; claw digitules broad and expanded at apex, each about 26.9–38.1  $\mu\text{m}$  long. Tarsal digitules longer than claw digitules, slender, knobbed, expanded at apex, each about 39.5–58.1  $\mu\text{m}$  long. Spiracles normal, each with a sclerotic plate. Spiracular disc-pores with 5 loculi in the outer ring; spiracular pore bands narrow, each 2–4 rows wide. Anterior spiracular pore band with 33–49 pores, posterior spiracular pore band with 45–73 pores. Pregenital disc-pores each primarily with 10 loculi, present around vulva, becoming progressively less frequent anteriorly, a few present across mediolateral of abdominal segments, absent laterad to each coxa.

Slide-mounted nymph. Body elongate oval, body length about 3 mm, width 1.5–1.8 mm. Margin irregular; marginal setae each with a well-developed basal socket, similar with the marginal setae in the adult female; stigmatic clefts very deep and distinct, each with 3 spinose stigmatic spines. Dorsal setae of two types present medially in three distinct lines, the same with adult female; type III dorsal setae mostly present on submarginally posterior dorsal segments; submarginal tubercles numbering 8 to 11 in total around body, 3 to 4 between anterior stigmatic clefts, 0 or 1 between anterior and posterior stigmatic clefts, 3 to 4 between each posterior stigmatic cleft and anal cleft. Anal plates are similar to those in the adult female. Antennae each with 8 segments. Legs well developed, each also with tibio-tarsal articulation and a well-developed tibiotarsal articular sclerite. Spiracles normal, but each without a sclerotic plate. Spiracular disc-pores number less, each with 5 loculi, anterior spiracular pore

band with 11–23 pores, posterior spiracular pore band with 24–34 pores.

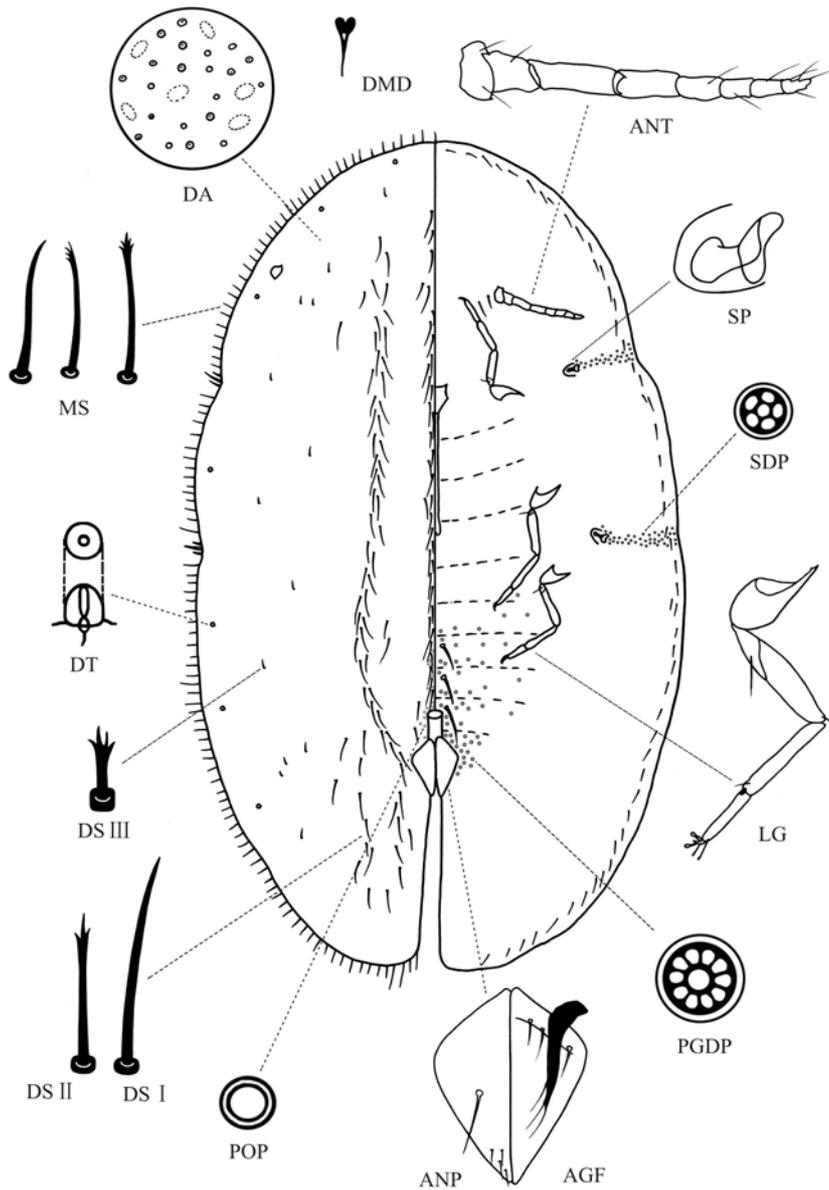


Figure 2. *Trijuba oculata* (Brain), adult female. The dorsal surface is depicted on the left side and the ventral surface on the right side, with some important characters shown enlarged around the main illustration. AGF – ano-genital fold; ANP – anal plates; ANT, antenna; DA – dermal areolations; DMD – dorsal microduct; DS – dorsal setae of type I–III; DT – dorsal tubercles; LG – tibio-tarsus of hind leg; MS – marginal setae; PGDP – pregenital disc-pore; POP – preopercular pores; SDP – spiracle disc-pore; SP – spiracle.

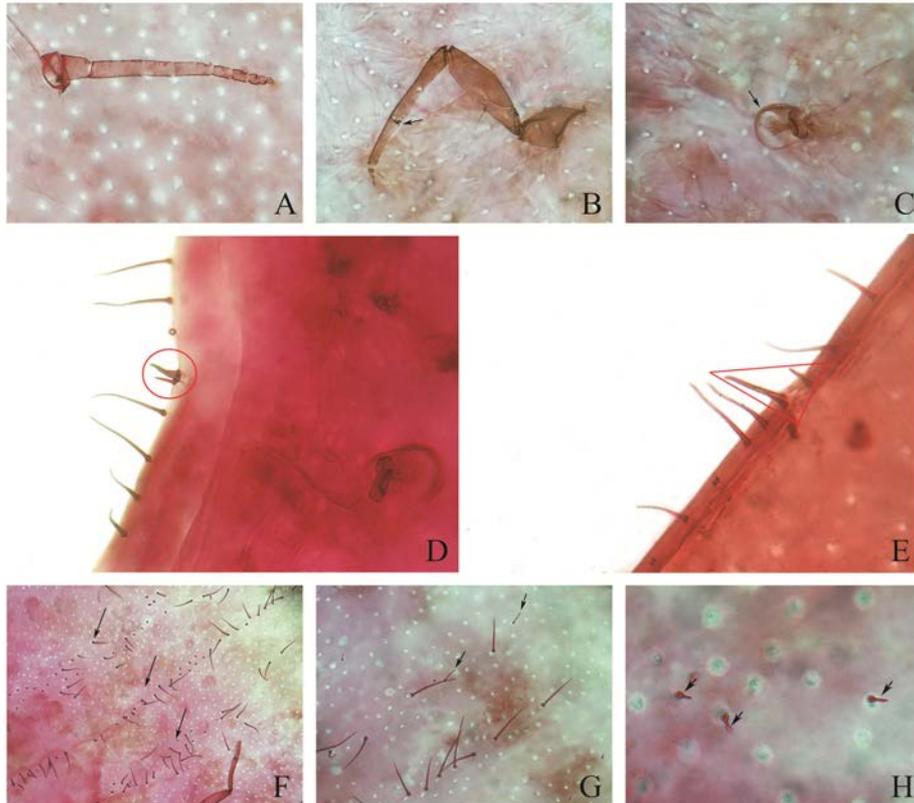


Figure 3. Some important diagnostic characters of mounted adult female. A. Antenna; B. Leg; C. Spiracle; D. Stigmatic spines (median spine is slightly longer than lateral spine); E. Stigmatic spines (median spine is much longer than lateral spine); F. Three distinct lines of dorsal setae; G. Dorsal setae of type I–II; H. Dorsal setae of type III.

Host plants. *Calliandra haematocephala* Hassk.; *Erythrophleum fordii* Oliv.; *Neolamarckia cadamba* (Roxb.) Bosser; *Saraca dives* Pierre.

Distribution. China (Pu'er and Ruili, Yunnan Province; Nanning, Guangxi Province).

Our observations of this genus *Trijuba* with the species *Trijuba oculata* agree well with those of De Lotto (1975) and Joshi & Rameshkumar (2017).

Host plants of *Trijuba oculata* (Table 1). Table 1 is based on information from ScaleNet and some published articles. The bold fonts are newly recorded host plants (*Calliandra haematocephala*, *Erythrophleum fordii*, *Neolamarckia cadamba* and *Saraca dives*) of this species. We can see that *T. oculata* prefers feeding on Fabaceae plants. *T.*

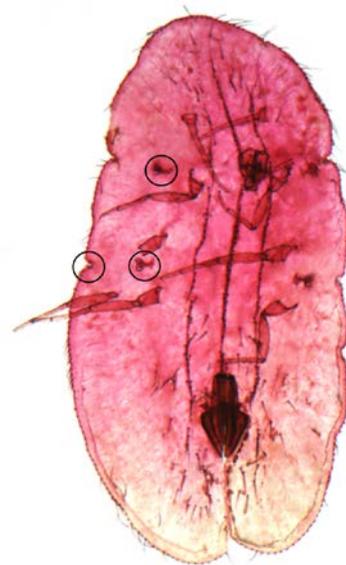


Figure 4. *Trijuba oculata* (Brain), nymph.

*oculata* is considered to be an urban pest in China because of the damage it causes to these plants. However, the host plants' range needs to be more thoroughly investigated in future studies.

**Table 1. Host plants of *Trijuba oculata***

Family	Genus/Species						
Annonaceae	<i>Annona</i>	<i>Annona</i>	<i>Polyalthia</i>				
	<i>muricata</i>	<i>reticulata</i>	<i>longifolia</i>				
Fabaceae	<i>Bauhinia</i>	<i>Caesalpinia</i>	<i>Mucuna</i>	<i>Prosopis</i>	<i>Calliandra</i>	<i>Erythrophleum</i>	<i>Saraca</i>
	<i>purpurea</i>			<i>juliflora</i>	<i>haematocephala</i>	<i>fordii</i>	<i>dives</i>
Moraceae	<i>Ficus</i>	<i>Ficus sur</i>					
Myrtaceae	<i>Callistemon</i>						
Nephrolepid- aceae	<i>Nephrolepis</i>						
	<i>cordifolia</i>						
Proteaceae	<i>Grevillea</i>						
	<i>robusta</i>						
Vitaceae	<i>Vitis vinifera</i>						
Rubiaceae	<i>Neolamarckia</i>						
	<i>cadamba</i>						

World distribution of *Trijuba oculata* (Table 2). Table 2 is based on information from ScaleNet. There is only one currently known species known to occur around the world. All records are from the Ethiopian and Oriental Regions. In China, *T. oculata* is distributed in Pu'er and Ruili in Yunnan Province and Nanning in Guangxi Province (Oriental Region); other distribution regions are also listed in this table.

**Table 2. *Trijuba oculata* around the World: an elementary checklist of the distribution in various zoogeographical regions**

Species	Et	Or	Pa	Au	Na	Nt
<i>T. oculata</i>	Kenya	India (Kamataka)	-	-	-	-
	Mauritius	China (Yunnan and Guangxi Province)				
	Reunion					
	Rodrigues Island					
	South Africa					
	Zimbabwe					

Abbreviations: Et – Ethiopian; Or – Oriental; Pa – Palaearctic; Au – Australian and Oceanic; Na – Nearctic; Nt – Neotropical.

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