

A new eriophyid mite species (Acari, Eriophyidae) in the genus *Tegonotus* Nalepa infesting Chinese white olive, *Canarium album*, in Fujian Province, southeastern China

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ABSTRACT — A new mite species belonging to the genus *Tegonotus* Nalepa (Eriophyidae, Phyllocoptinae, Tegonotini), *Tegonotus canaris* n. sp. Xu, Chen, Xue, from Fuzhou, Fujian Province, southeastern China, is described and illustrated. This new species causes discoloured buds, curled leaf edges and necrosis on its host plant, *Canarium album* (Lour.) DC. (Chinese white olive) (Burseraceae). The character of divided empodium observed in this new species is presented for the first time in the genus *Tegonotus*.

KEYWORDS — phytophagous mite; *Tegonotus canaris*; Phyllocoptinae; taxonomy; Asia; Burseraceae

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INTRODUCTION

Chinese white olive, *Canarium album* (Lour.) DC. (Burseraceae), commonly called gan lan, "qing guo" in China, is indigenous to the southeast area of China (Fujian, Guangdong and Yunnan Provinces and Guangxi Autonomous Region) (Wei *et al.* 1999). Wild Chinese white olive tree is up to 25-35 meters tall, having a wide range of adaptability, e.g. sustainable at low temperatures (6 – 7°C) in winter, high temperatures (almost 40°C) in summer and poor soils and rocky hillsides (He and Xia 2007). Its fruits often used in Chinese folk medicine can be eaten raw, cooked or dried (Zhang *et al.* 2009) and are quite similar to the Mediterranean olive (*Olea europaea* L.) in the shape (fusiform), anatomy and

taste (strong bitter and astringent), but mainly different at low oil contents (He *et al.* 2009). Nowadays this plant is widely cultivated in Fujian and Guangdong Provinces (e.g. more than 10 thousand hm² in Fujian Province, Chen *et al.* 2011). Due to its diversified economy values, Chinese white olive has been introduced and extensively cultivated in other Asian tropical and semi-tropical countries (e.g. Vietnam, Malaysia and Japan) (Wei *et al.* 1999).

During field surveys in 2011, an eriophyoid mite species was found infesting Chinese white olive and recently determined to be new to science belonging to the genus *Tegonotus* Nalepa (Phyllocoptinae, Tegonotini). This new eriophyoid mite species mainly affects the twigs with serious damage occur-



FIGURE 1: Symptoms caused by *Tegenotus canaris* n. sp.: A-B – twigs with leaf edges curved and darkened; C-D – twigs brown and dry; E – bud discoloured red; F – healthy bud and leaves.

TABLE 1: Eriophyoid mites associated with *Canarium* plants.

Taxa	Host plant	Relation to plant host	Known distribution
<i>Eriophyes reijnvaanae</i> Nalepa, 1923	<i>C. littorale</i> Blume	Erineum gall	Indonesia (Java)
<i>Phyllocoptes canarii</i> Nalepa, 1923	<i>C. littorale</i> Blume	Gall inquiline	Indonesia (Buitenzorg)
<i>Phyllocoptes heterozonus</i> Nalepa, 1923	<i>C. littorale</i> Blume	Gall inquiline	Indonesia (Java)
<i>Sakthirhynchus canariae</i> Umapathy & Mohanasundaram, 1999	<i>C. strictum</i> Roxb.	Vagrant	India (Tamil Nadu)
<i>Dichopelmus canarii</i> Kuang, Xu & Zeng, 2002	<i>C. album</i> (Lour.) DC.	Vagrant	China (Guangdong)
<i>Tegonotus canaris</i> n. sp.	<i>C. album</i> (Lour.) DC.	Vagrant	China (Fujian)

ring in spring and autumn. At first, the buds and new growths become reddish (Fig. 1E). Then the edges of tender and young leaves curl and darken (Fig. 1A, 1B). Hereafter, the entire twigs turn brown and dry (Fig. 1C, 1D). For a long time the local people believed the symptoms were caused by a plant disease and sprayed fungicide to try control it, but failed. At present, no effective control measures are known for this new eriophyoid mite species.

To date, the host plant genus *Canarium* includes 88 accepted taxa (The Plant List 2013) of median to large-sized canopy trees, distributed in tropical and subtropical regions of Africa, Asia, and Oceania (Weeks 2009). Based on published records in the literature, only five eriophyoid species have so far been reported infesting *Canarium* spp. (Table 1). Herein, a new eriophyoid mites of the genus *Tegonotus* is reported for the first from host plant genus *Canarium* and from family Burseraceae. The character of divided empodium observed in the new species is presented for the first in the genus *Tegonotus* and the tribe Tegonotini. A key to eriophyoid mites associated with *Canarium* spp. is provided.

MATERIALS AND METHODS

Eriophyoid specimens collected from plant material were prepared and slide mounted according to the methods of Amrine and Manson (1996). Slides were mounted in a modified Berlese medium without adding additional fibers. The morphological terminology used herein follows Lindquist (1996), internal female genitalia nomenclature follows Chetverikov (2014) and the generic classification is made according to Amrine *et al.* (2003). Specimens were measured following de Lillo *et al.* (2010).

They were examined with the aid of a Zeiss A2 (Germany) research microscope with phase contrast and semi-schematic drawings were made. Micrographs were taken with a Zeiss A2 (microphoto camera AxioCam MRC) research microscope with phase contrast using 10× eyepieces at 100× oil magnification, connected to a computer using Axiovision image analysis software. For each species the holotype female measurement precedes the corresponding range for paratypes (given in parentheses). For males, only range measurements are given. All measurements are in micrometers (μm) and are lengths when not otherwise specified.

RESULTS

Family Eriophyidae Nalepa, 1898
Subfamily Phyllocoptinae Nalepa, 1891
Tribe Tegonotini Bagdasarian, 1978
Genus *Tegonotus* Nalepa, 1890

Tegonotus canaris* **n. sp.*
(Figures 2–6)

Zoobank: [B7475FC4-4433-4D10-838D-9D659E928623](https://zoobank.org/B7475FC4-4433-4D10-838D-9D659E928623)

Diagnosis — *Tegonotus canaris* **n. sp.** differs from all the other *Tegonotus* species in having divided empodium; prodorsal shield with a depressed hollows pattern: four hollows present at basal 2/3, one bottle-like hollow and four open hollows present at basal 1/3, some additional open hollows present at anterior and lateral margins; opisthosoma with irregular, broad and “thickening” dorsal annuli, a slight and irregular dorsal ridge maybe present, all dorsal annuli with lateral projections except posterior 3 to 4 annuli, lateral view of dorsal annuli with irregular “fissures”.

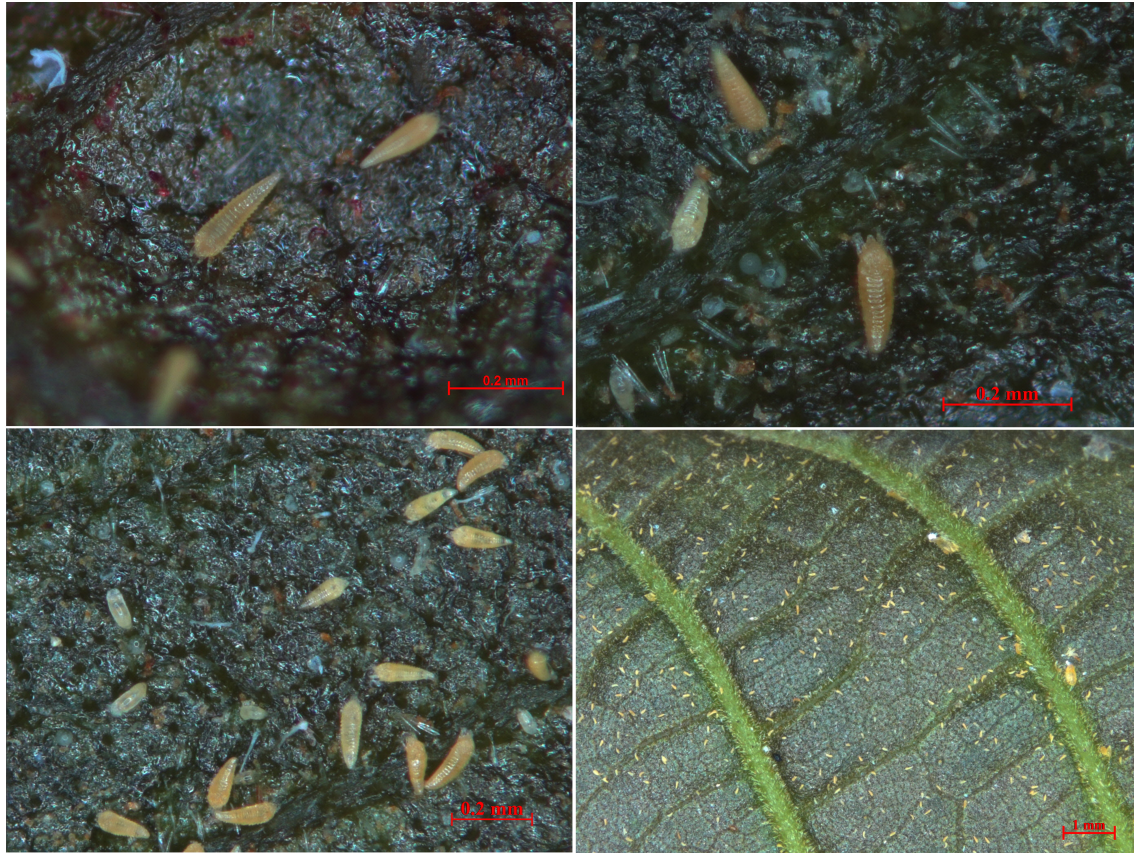


FIGURE 2: *Tegonotus canaris* n. sp. on leaf under surfaces.

Female ($n = 21$) — Body fusiform, 249 (231 – 253), 72 (72 – 73) wide, 62 (60 – 62) thick; light yellow in colour (Figure 2).

Gnathosoma — 20 (20 – 21), projecting obliquely downwards, pedipalp coxal setae (*ep*) 2 (2 – 3), dorsal pedipalp genual setae (*d*) simple, 14 (14 – 15), cheliceral stylets 13 (13 – 14).

Prodorsal shield 45 (44 – 46), 62 (62 – 63) wide, pattern of four depressed hollows present at basal 2/3, one bottle-like hollow and four open hollows present at basal 1/3, some additional hollows present at anterior and lateral margins; anterior shield lobe broad, 4 (4 – 5). Scapular tubercles ahead of rear shield margin, 3 (2 – 3), 20 (18 – 20) apart, projecting transverse to the body longitudinal axis; scapular setae (*sc*) 10 (10 – 11), projecting centrad and upwards.

Coxal plates — with elongated granules and short irregular lines; anterolateral setae on coxister-

num I (*lb*) 10 (10 – 11), 17 (17 – 18) apart; proximal setae on coxisternum I (*1a*) 18 (18 – 20), 8 (7 – 8) apart; proximal setae on coxisternum II (*2a*) 31 (31 – 35), 28 (28 – 30) apart. Prosternal apodeme 10 (10 – 11).

Legs — with usual series of setae present. Leg I 43 (43 – 45), femur 13 (13 – 14), basiventral femoral seta (*bv*) 11 (11 – 12); genu 5 (5 – 6), antaxial genual seta (*l''*) 26 (25 – 27); tibia 15 (15 – 16), paraxial tibial seta (*l'*) 5 (5 – 6), located at 1/3 from dorsal base; tarsus 8 (7 – 8), seta *ft'* 15 (14 – 16), seta *ft''* 17 (15 – 18), seta *u'* 3 (3 – 4); tarsal empodium (*em*) 6 (5 – 6), divided, 2-rayed at each side, tarsal solenidion (ω) 7 (7 – 8), knobbed. Leg II 40 (40 – 42), femur 12 (12 – 13), basiventral femoral seta (*bv*) 14 (14 – 15); genu 6 (6 – 7), antaxial genual seta (*l''*) 6 (6 – 7); tibia 12 (12 – 13); tarsus 8 (8 – 9), seta *ft'* 6 (6 – 8), seta *ft''* 20 (18 – 20), seta *u'* 3 (3 – 4); tarsal empodium (*em*) 5 (5 – 6), divided, 2-rayed at each side, tarsal solenidion (ω) 9

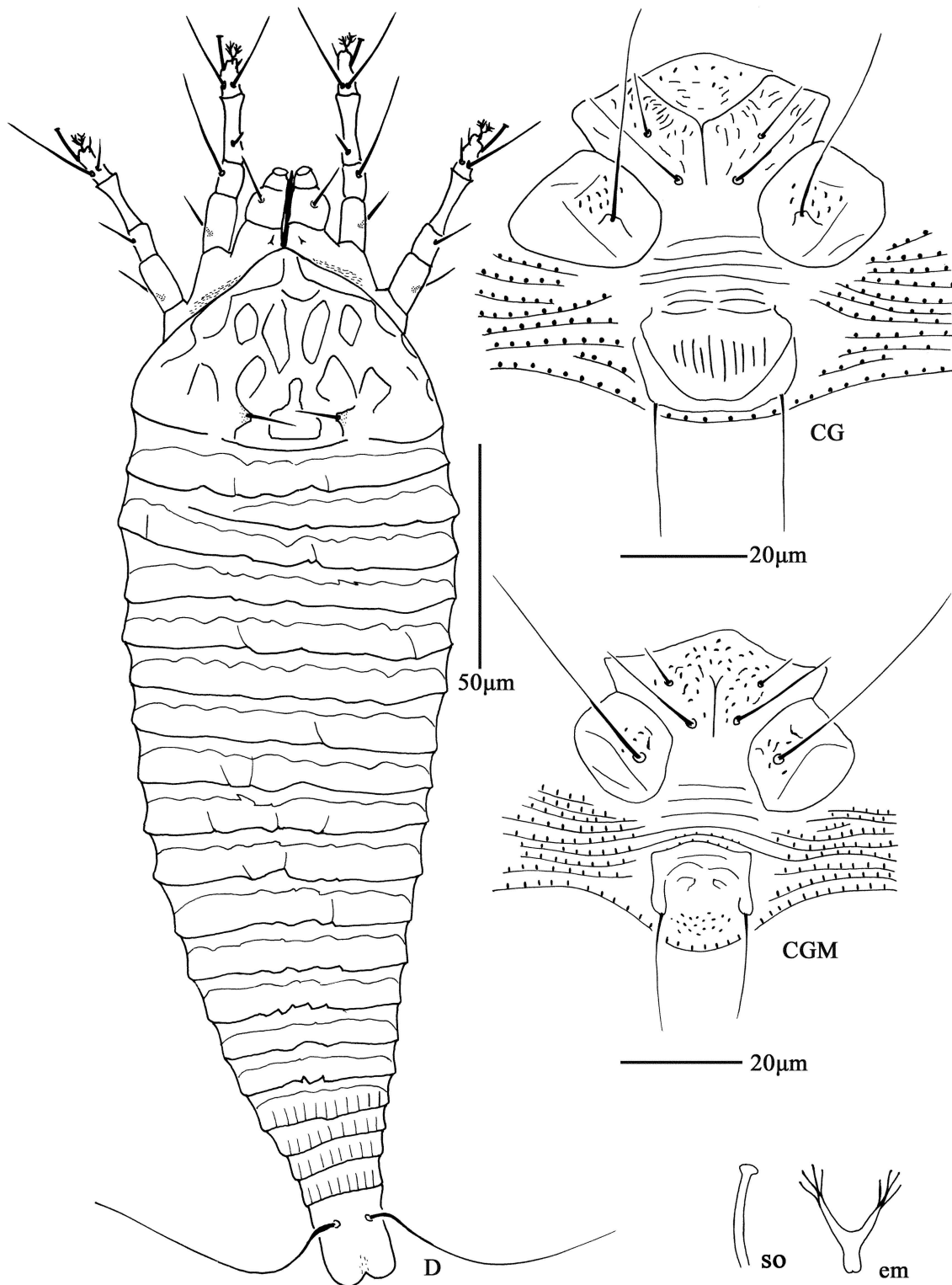


FIGURE 3: *Tegenotus canaris* n. sp.: D – dorsal view of female; CG – female genitalia and coxae; CGM – male genitalia and coxae; so – solenidion; em–empodium.

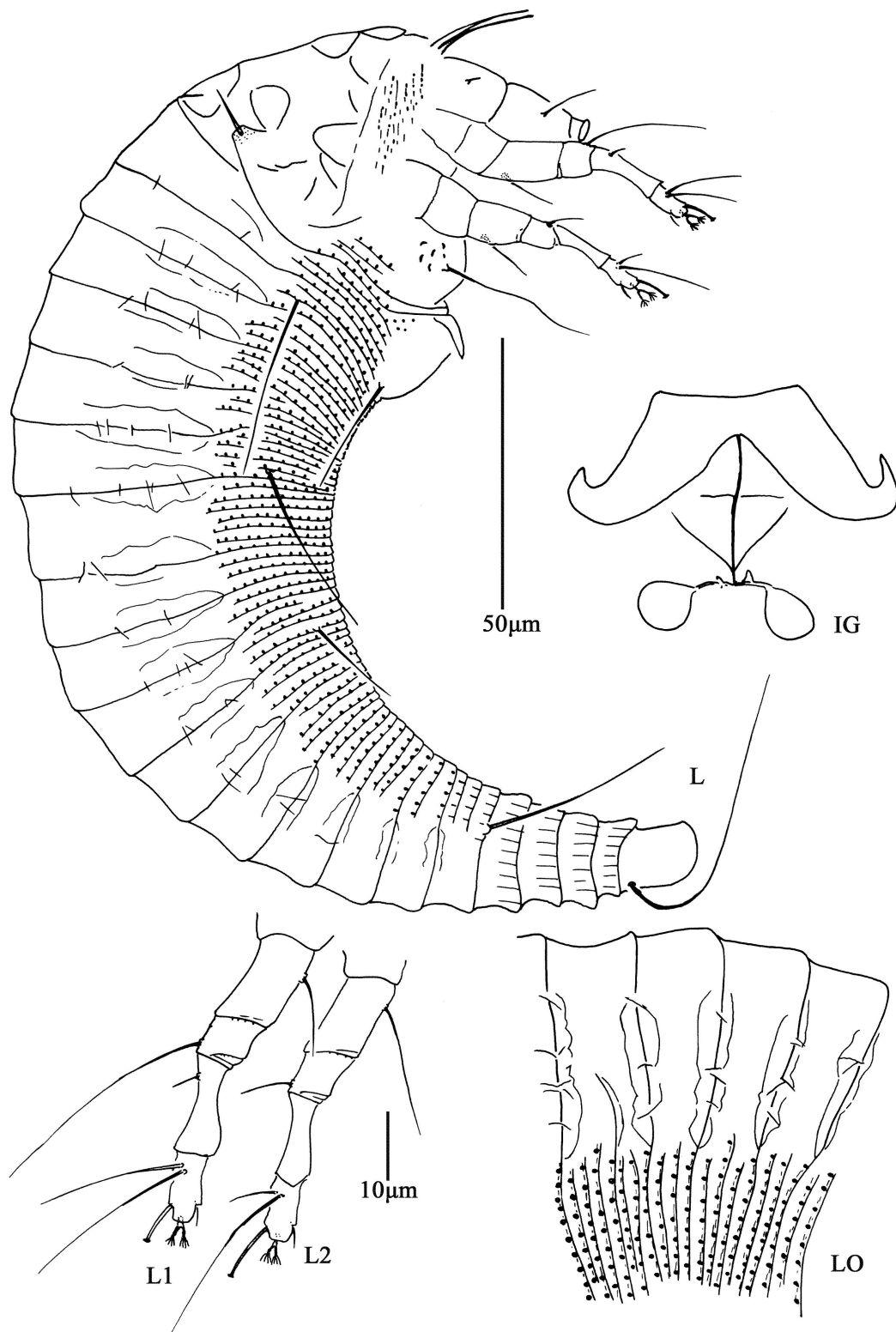


FIGURE 4: *Tegonotus canaris* n. sp.: L – lateral view of female; IG – female internal genitalia; LO – lateral view of annuli showing details of microtubercles; L1 – leg I; L2 – leg II.

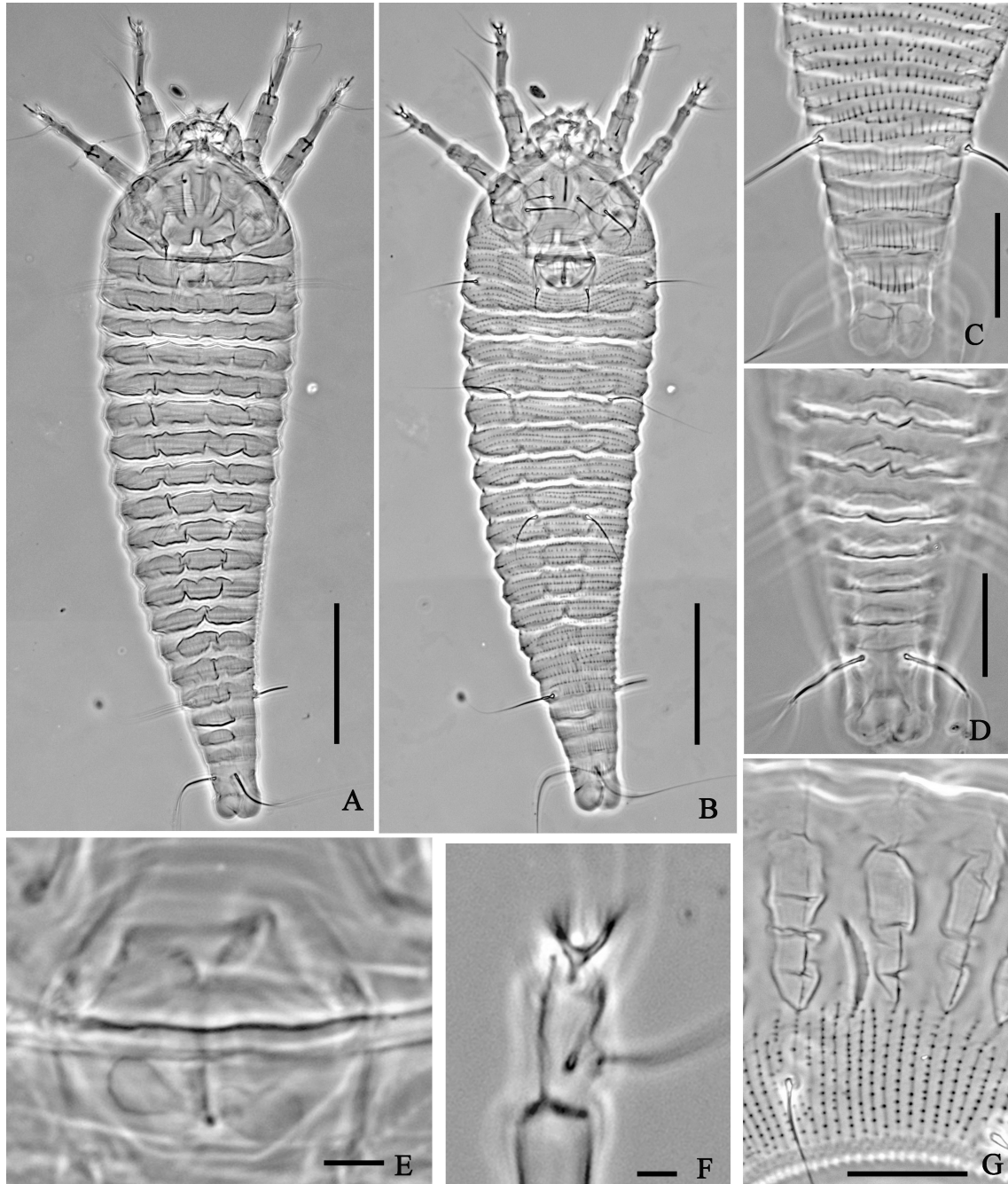


FIGURE 5: *Tegenotus canaris* n. sp.: A – dorsal view of female; B – ventral view of female; C – ventral view of female posterior part; D – dorsal view of female posterior part; E – female internal genitalia; F – tarsus with empodium of leg I; G – section of annuli in lateral view showing details of microtubercles. Scale bar: A and B = 50 µm; C and D = 20 µm; E = 5 µm; F = 2 µm; G = 20 µm.

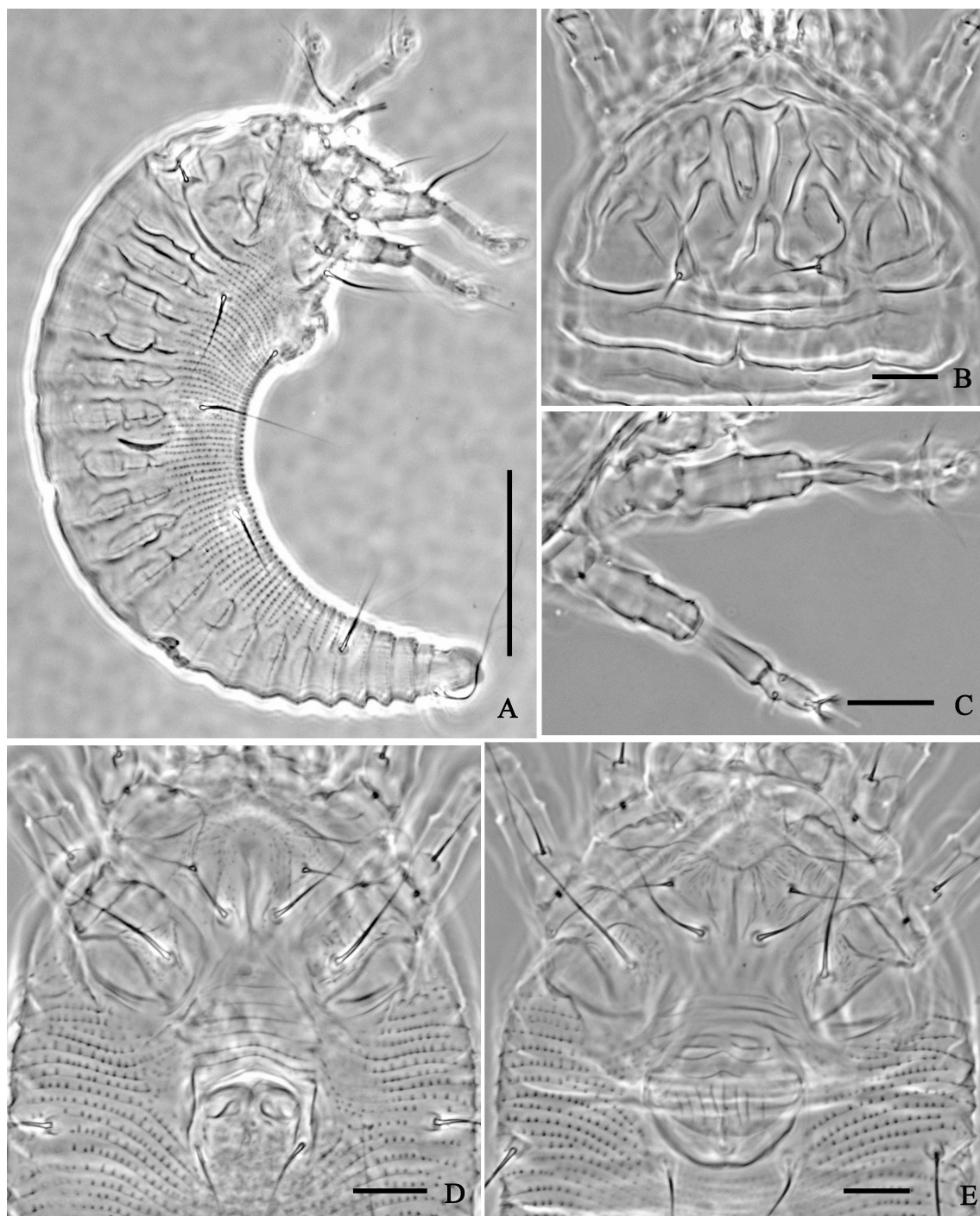


FIGURE 6: *Tegenotus canaris* n. sp.: A – lateral view of female; B – prodorsal shield; C – leg I and leg II; D – coxae and male genitalia; E – coxae and female genital coverflap. Scale bar: A = 50 µm; B – E = 10 µm.

(9 – 10), knobbed.

Opisthosoma — dorsally with 18 (18 – 20) annuli, anterior 15 (15 – 17) annuli irregular, broad and “thickening” (Fig. 2, Fig. 3D, Fig. 5A), posterior 3 (3 – 4) annuli normal, a slight and irregular dorsal ridge maybe present, all dorsal annuli with lateral projections except posterior 3 to 4 annuli (Fig. 2, Fig. 3D); ventrally with 70 (64 – 75) annuli, with round microtubercles on rear annular margins, except 4 posterior annuli; laterally with irregular “fissures” (Fig. 4LO, Fig. 5G). The posterior 4 dorsal and ventral annuli have the same size and have filament microtubercles. Setae *c2* 30 (30 – 33) on ventral annulus 8 (8 – 10), 60 (60 – 61) apart; setae *d* 32 (32 – 38) on ventral annulus 26 (24 – 28), 35 (35 – 36) apart; setae *e* 20 (20 – 25) on ventral annulus 43 (39 – 45), 22 (22 – 23) apart, setae *f* 35 (33 – 38) on 5th ventral annulus from rear, 26 (25 – 26) apart. Setae *h1* absent, *h2* 52 (52 – 63).

Female genitalia — 15 (15 – 17), 24 (24 – 25) wide, coverflap with three transverse lines at base and 10 longitudinal ridges, setae *3a* 20 (20 – 23), 20 (20 – 22) apart. Internal genitalia is similar to that of other species in the tribe Tegenotini— spermathecae ovoid, oriented laterally; spermathecal tubes relatively short; transverse genital apodeme trapezoidal, distally folded.

Male (n = 6) — Body fusiform, 229 – 235, 63 – 65 wide; light yellow in colour.

Gnathosoma — 20 – 21, projecting obliquely downwards, pedipalp coxal setae (*ep*) 2 – 3, dorsal pedipalp genual setae (*d*) simple, 13 – 14, cheliceral stylets 12 – 13.

Prodorsal shield — 43 – 45, 55 – 57 wide, with similar design of female; anterior shield lobe broad. Scapular tubercles ahead of rear shield margin, 2 – 3, 17 – 18 apart, scapular setae (*sc*) 6 – 8, projecting centrad and upwards.

Coxal plates — with elongate granules and short lines, anterolateral setae on coxisternum I (*1b*) 10 – 11, 14 – 15 apart; proximal setae on coxisternum I (*1a*) 15 – 17, 6 – 7 apart; proximal setae on coxisternum II (*2a*) 38 – 43, 21 – 23 apart. Prosternal apodeme 10 – 11.

Legs — with usual series of setae. Leg I 43 – 45, femur 12 – 13, basiventral femoral seta (*bv*) 10 – 11; genu 5 – 6, antaxial genual seta (*l''*) 26 – 28; tibia 14 – 15, paraxial tibial seta (*l'*) 4 – 5, located at 1/3 from dorsal base; tarsus 8 – 9, seta *ft'* 17 – 19, seta *ft''* 20 – 22, seta *u'* 3 – 4; tarsal empodium (*em*) 4 – 5, divided, 2-rayed at each side, tarsal solenidion (ω) 6 – 7, knobbed. Leg II 40 – 42, femur 11 – 12, basiventral femoral seta (*bv*) 12 – 13; genu 7 – 8, antaxial genual seta (*l''*) 6 – 7; tibia 12 – 13; tarsus 8 – 9, seta *ft'* 6 – 8, seta *ft''* 18 – 20, seta *u'* 3 – 4; tarsal empodium (*em*) 5 – 6, divided, 2-rayed at each side, tarsal solenidion (ω) 7 – 8, knobbed.

Opisthosoma — dorsally with 18 – 20 annuli, anterior 14 – 16 annuli irregular, broad and “thickening” posterior 3 – 4 annuli normal, a slight and irregular dorsal ridge maybe present, all dorsal annuli with lateral projections except posterior 4 annuli, ventrally with 73 – 78 annuli, with elliptical microtubercles on rear annular margins. The posterior 4 dorsal and ventral annuli have the same size and have filament microtubercles. Setae *c2* 30 – 33 on ventral annulus 10 – 11, 52 – 55 apart; setae *d* 33 – 35 on ventral annulus 26 – 27, 35 – 36 apart; setae *e* 20 – 23 on ventral annulus 42 – 43, 17 – 18 apart, setae *f* 36 – 42 on 6-7th ventral annulus from rear, 22 – 23 apart. Setae *h1* absent, *h2* 65 – 68.

Male genitalia — 17 – 20 wide, setae *3a* 17 – 20, 15 – 17 apart, with granules between setae tubercles of *3a*.

Type material — Holotype, female, found on *Canarium album* (Lour.) DC. (Burseraceae), Institute of Pomology, Fujian Academy of Agricultural Science, Fuzhou City, Fujian Province, People's Republic of China, 31 December 2011, coll. Jin Chen and Xing-Quan Xu, deposited as a slide-mounted specimen in the Arthropod/Mite Collection of the Department of Entomology, NJAU, Jiangsu Province, China. Paratypes, 14 females and 6 males on seven slides, from *C. album* (Lour.) DC. (Burseraceae), same details as holotype, deposited as a slide mounted specimen in the Arthropod/Mite Collection of the Department of Entomology, NJAU, Jiangsu Province, China. Six females on two slides, from *C. album* (Lour.) DC. (Burseraceae), same details as holotype, deposited as a slide mounted specimen in NZMC,

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Relation to plant host — Vagrant on the under leaf surface, causing leaf edges to become curved, later becoming dark, dry and defoliated; causing bud to discoloured red.

Etymology — This species designation *canaris* is derived from the generic name of the host plant, *Canarium*, by adding the postfix. The gender is neuter.

Key to eriophyoid species on *Canarium* spp.

1. Gnathosoma large in comparison to body, projecting abruptly curved.....
Diptilomiopidae.....*Sakthirhynchus canariae* Uma-
pathy & Mohanasundaram, 1999
— Gnathosoma small in comparison to body, pro-
jecting obliquely downwards...Eriophyidae.....2
2. Empodium divided.....3
— Empodium simple.....4
3. Scapular tubercles and setae (*sc*) ahead of rear
shield margin, scapular setae projecting centrad
and upwards.....*Tegonotus canaris* **n. sp.**
— Scapular tubercles and setae (*sc*) on rear shield
margin, scapular setae projecting backwards
Dichopelmus canarii Kuang, Xu & Zeng, 2002
4. Body vermiform.....*Eriophyes reijnvaanae*
Nalepa, 1923
— Body fusiform.....5
5. Median line on prodorsal shield present, em-
podium 5-rayed.....*Phyllocoptes heterozonus*
Nalepa, 1923
— Median line on prodorsal shield absent, em-
podium 4-rayed.....*Phyllocoptes canarii*
Nalepa, 1923

DISCUSSION

The subfamily Phyllocoptinae includes five tribes: Acaricalini, Anthocoptini, Calacarini, Phyllocoptini and Tegonotini (Amrine *et al.* 2003). Following the

key of Amrine *et al.* (2003), the tribe Tegonotini can be differentiated from others in the Phyllocoptinae by characters as: empodium entire, scapular setae present, dorsal annuli with lateral lobes or projections. The morphological character of empodium is widely used in the classification of eriophyoid mites at generic, tribal or subfamilial level (Amrine, 2003). Basically there are two types of empodium in eriophyoid mites, divided or simple. Following the key of Amrine *et al.* (2003), *T. canaris* **n. sp.** should certainly be put into the subfamily Phyllocoptinae, while the status at tribal level was unclear (P57, Amrine 2003). The tribe Acaricalini has an obligatory character of empodium, divided. Based on the molecular phylogenetic analysis, monophyly of Acaricalini was rejected (Li *et al.* 2014). Empodium divided as a proposed synapomorphy of Acaricalini was also rejected by Li *et al.* (2014). Herein, divided empodium was not considered as a synapomorphic character of Acaricalini. Besides character of empodium, *T. canaris* **n. sp.** should belong to the tribe Tegonotini as having scapular setae present (Figures 3-6) and opisthosoma with projections from some annuli (Figure 2). We first describe one *Tegonotus* species in the tribe Tegonotini having divided empodium. The character of divided empodium was also found in *Notostrix* spp. in the tribe Anthocoptini of Phyllocoptinae. Apically divided empodium was found in *N. jamaicae* (Keifer 1970). Bipartite empodium was found in *N. fissipes* (Navia and Flechtmann 2003). Furthermore, tripartite empodium was found in *N. exigua* (Flechtmann 1998), *N. trifida* and *N. miniseta* (Navia and Flechtmann 2003).

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