



<http://dx.doi.org/10.11646/zootaxa.3856.2.6>

<http://zoobank.org/urn:lsid:zoobank.org:pub:835CC97E-14D1-40AC-A30D-4D6AA159AF6D>

The genus *Scirtothrips* (Thysanoptera: Thripidae) in Malaysia, with four new species and comments on *Biltothrips*, a related genus

Y.F. NG¹, L.A. MOUND² & A.A. AZIDAH³

¹Centre for Insect Systematics (CISUKM), Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia.

E-mail: ng_yf@ukm.edu.my

²Australian National Insect Collection CSIRO, Canberra, ACT 2601, Australia. E-mail: laurence.mound@csiro.au

³Institute of Biological Sciences, Faculty of Science, University of Malaya, Kuala Lumpur, Malaysia. E-mail: azie@um.edu.my

Abstract

Species of the genus *Scirtothrips* are studied from Malaysia for the first time. Six species of this genus are here recorded from Malaysia: *S. dobroskyi* is newly recorded, and four new species: *S. lantanae* sp.n., *S. linoxiae* sp.n., *S. hitam* sp.n. and *S. malayensis* sp.n. are described together with an illustrated identification key. Relationships were examined between *S. dorsalis* and the closely related *S. hitam* sp.n., based on the mitochondrial gene COI, and a redescription of the widespread pest species, *dorsalis*, is provided. *Biltothrips minutus* (Bhatti) is reported from Malaysia for the first time, and illustrations provided to distinguish this genus from *Scirtothrips*.

Key words: *Scirtothrips*, Thysanoptera, Thripidae, Malaysia, new species

Introduction

The genus *Scirtothrips* is commonly associated with agricultural crops, with several species well documented as pests of economic importance on tea, coffee, citrus, chillis, grapes, avocados and mangos (Mound & Palmer 1981; Garms *et al.* 2013). These thrips are native to subtropical and tropical countries, and when introduced into new habitats and new areas some species cause serious problems. For example, *S. perseae* from Mexico is now a serious pest on avocado crops in California (Hoddle *et al.* 2003), and the Oriental species *S. dorsalis* is now a pest in Florida as well as Israel (Masumoto & Okajima 2007). These thrips have the potential to become even more widespread as pests in tropical and temperate countries. However, many species of *Scirtothrips* remain poorly defined. Rugman-Jones *et al.* (2007) produced molecular evidence that *S. dorsalis* populations in South Africa probably represent a distinct species, although Mound and Stiller (2011) found only one minor structural difference between South African females and those of the pest species.

The number of species listed in the genus *Scirtothrips* has increased from about 40 in the 1980s to the present total of 108 with the addition of the four new species described below (ThripsWiki 2014). Hoddle and Mound (2003) described 11 new species from Australia, Masumoto and Okajima (2007) described four new species from Japan, Mound (2010) and Mound and Stiller (2011) described two new species from Africa, and Majid *et al.* (2012) described one new species from *Ginkgo biloba* in China. Johansen and Mojica-Guzman (1998) described 32 new species from Mexico, but five of these were subsequently recognized as synonyms of *S. perseae* (Hoddle *et al.* 2008). Moreover, since many of the others are known only from mango trees that are not native to Mexico, an exhaustive revision is needed of the Central American species of this genus to establish the native host plants and recognise potential synonyms (Mound & zur Strassen 2001).

The original purpose of the present paper was to describe a new species from Malaysia that had previously been identified on morphological characters as *S. dorsalis*. However, this new species is here distinguished on small but consistent morphological differences as well as molecular characters. In addition, four further new species of *Scirtothrips* are described from Malaysia, together with a new record of the related monobasic genus *Biltothrips*.

The species of *Scirtothrips* are small, usually pale yellow or white in colour, and are usually not noticed by students and inexperienced field workers. Adults must be slide-mounted with considerable care, because minute details of structure, such as microtrichia and sculpture, cannot be seen on badly prepared slides. Fully cleared, slide-mounted specimens (Hoddle & Mound 2003; Masumoto & Okajima 2007) are essential, and these are best observed with a differential interference microscope as indicated in the photomicrographs presented here. Nomenclatural and bibliographic details for Thysanoptera are available at ThripsWiki (2014).

Characters used for species identification

Specimens are best collected into AGA, a mixture of 10 parts of 60% ethanol with 1 part of glycerine and 1 part of acetic acid, because this helps to distend the specimens. An alternative is to collect specimens into 95% ethanol, and then treat this with weak sodium hydroxide solution to fully distend the abdomen and dissolve the body contents (see ThripsWiki 2014). Comprehensive lists of characters used in identifying *Scirtothrips* species were discussed by Hoddle and Mound (2003) also Mound and Palmer (1981), but the species considered here included some unusual character states.

Colour: *Scirtothrips* species differ in colour from uniformly pale to specimens with patterns of darker markings on the thorax and abdomen. The fore wings are commonly pale or with weak shading particularly medially, but are darker in a few species.

Head: All species in this genus have the head wider than long, but the form of sculpture in the ocellar triangle, and the position and length of ocellar setae pair III in relation to this triangle, can provide useful character states for recognizing species. However, the apparent position of these setae may be altered as a result of slide-mounting, and setal lengths are difficult to estimate if the setae are erect rather than laid flat.

Thorax: The pronotum of *Scirtothrips* species is transversely striate, but the distance between the striae is variable in *S. malayensis* **sp.n.** described below. The length of the pronotal posteromarginal setae is useful in distinguishing species, with setal pair pm2 unusually long in *S. dobroskyi*.

Fore wing: In contrast to several *Scirtothrips* species in other parts of the world, all members of this genus known from Malaysia have the posteromarginal cilia on the fore wing straight. The number of setae on the second vein of the fore wing can be a useful distinguishing character.

Abdomen: The number, position and length of setae S1 on the tergites is often useful in distinguishing species, also the distribution of microtrichia on the sternites and tergite VIII. The form and colour of the antecostal ridge on the tergites and sometimes the sternites is also useful.

Molecular approaches and phylogenetic analyses

DNA was extracted from four specimens of *S. dorsalis* and three specimens of *S. hitam* **sp.n.** using a modified 'freezing method' introduced by Yaakop *et al.* (2009), a method modified from DNeasy Blood & Tissue Kit (Qiagen, Valencia, California, USA). The sample of the whole insect was soaked in 180 μ l of buffer ATL + 20 μ l of proteinase K, and this was followed by 10 minutes incubation at 55°C before being stored in the freezer at -22°C overnight. The remaining steps in the DNA extraction were according to the general protocol of the kit. This modified method is recommended for thrips DNA extraction as the sample vouchers remain in good condition and with only minor maceration processes, and the thrips body could be straight away used for dehydration and mounted on a slide. The colour of the sample remains intact. In this study, only the genetic marker COI of the mitochondrial DNA was used. The primers used in the amplification of COI gene were of the design of Monteiro and Pierre (2000) (Table 1), and PCR was performed using the similar protocol as described by Rugman-Jones *et al.* (2006). The DNA sequencing was done using the method described by Yaakop *et al.* (2009). *Scirtothrips bounites* (GenBank: EU101006.1) and *S. citri* (GenBank: EU101005.1) were used as outgroup taxa in the phylogenetic analyses. The COI sequence of another *S. dorsalis* (GenBank: JF719590.1) was also included in the phylogenetic analyses. Neighbour-Joining (NJ), Maximum Parsimony (MP) and Maximum Likelihood (ML) trees were generated using Paup* 4.0-Test version 4.0d63 (Swofford 1998).

TABLE 1. The primer sequences used in the amplification of COI gene

Gene	Sequence (5'–3')
COI	Ron—5' GGA TCA CCT CAT ATA GCA TTC CC3' (forward) Nancy—5' CCC GGT AAA AAT TAA AAT ATA AAC TTC 3' (Reverse)

Abbreviations: CISUKM—Centre for Insect Systematics, Universiti Kebangsaan Malaysia, Bangi; MZUM—Institute of Biological Sciences, University of Malaya, Kuala Lumpur; ANIC—CSIRO Ecosystem Sciences, Canberra; Head setae: po—postocular setae. Abdominal tergite setae: S1—discal median setae; S2—discal submedian setae. Pronotum setae: pm1—median posteromarginal setae; pm2—second posteromarginal setae.

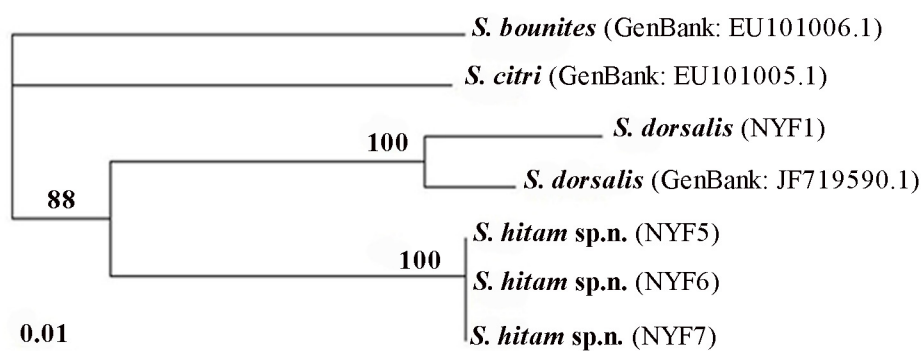


FIGURE 1. Neighbour-Joining (NJ) tree generated from the analysis of COI sequences. Number above branch indicates bootstrap value (500 replicates).

Key to *Scirtothrips* species from Malaysia

1. Abdominal sternites II–VI with numerous rows of microtrichia extending medially across at least the posterior half of these sternites (Figs 14, 18) 2
- Abdominal sternites II–VI with rows of microtrichia not extending medially but restricted to lateral areas (Figs 25, 32) 4
2. Abdominal sternites II–VI with complete posteromarginal comb of microtrichia (Fig. 18); pronotum with shaded longitudinal bands sub-laterally (Fig 15) *lantanae* sp.n.
- Abdominal sternites II–VI with no posteromarginal comb of microtrichia (Fig 14); pronotum never with shaded longitudinal bands sub-laterally (Figs 5, 9) 3
3. Abdominal tergites III–VII with dark antecostal ridge complete medially (Fig. 8), tergites with median shading not extending to discal setae S2 (Fig. 8); antennal segment I pale, II variable, III–VIII dark (Fig. 6); fore wing pale apically; sternites IV–VI with microtrichia rows absent from anterior half of each segment. *dorsalis*
- Abdominal tergites III–VII with dark antecostal ridge interrupted medially, tergites with shading extending broadly across segment (Fig. 12); all antennal segments dark (Fig. 11); fore wing uniformly dark; sternites IV–VI with microtrichia more extensive, absent only from less than anterior third of each segment (Fig. 14) *hitam* sp.n.
4. Metanotum with irregular transverse striae on anterior third, and irregular longitudinal reticulations on posterior (Fig. 22); antennal segment IV almost 3.0 times as long as wide, sensorium stout and U-shaped, extending to midpoint of segment V (Fig. 23); pronotal posteromarginal setae pm 2 scarcely twice as long as pm 1 (Fig. 21); abdominal tergites III–VI shaded medially (Fig. 24) *lixinae* sp.n.
- Metanotum with irregular reticulation, no transverse striae anteriorly (Figs 2, 27, 28); antennal segment IV usually less than 2.5 times as long as wide, sensoria slender, not extending beyond basal third of segment V (Figs 3, 29); pronotal posteromarginal setae pm2 more than 2.5 times as long as setae pm1; abdominal tergites III–VI without shaded marking medially (Figs 4, 30) 5
5. Fore wing second vein with 2 setae; abdominal tergites III–V with S1 closer together than their length; tergite VIII with no microtrichia extending mesad of S2 (Fig. 4) *dobroskyi*
- Fore wing second vein with only one seta; abdominal tergites III–V with S1 wider apart than their length (Fig. 30); tergite VIII with microtrichia extending mesad of S2 or even mesad of S1 (Fig. 31) *malayensis* sp.n.



FIGURES 2–4. *Scirtothrips dobroskyi* Moulton. (2) Head, pronotum and metascutum; (3) Antenna; (4) Abdominal tergites VII–X.

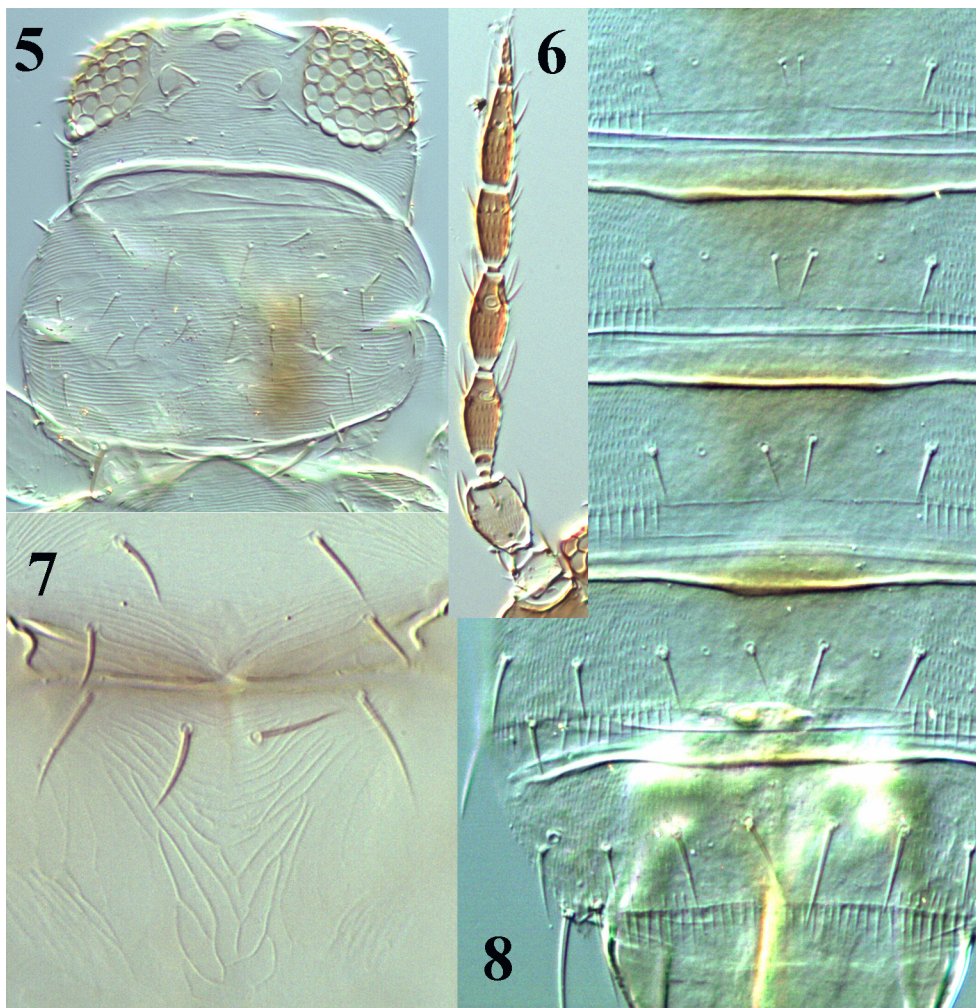
***Scirtothrips dobroskyi* Moulton, 1936: 264**

(Figs 2–4)

Female macroptera. Body yellow, femora, tibiae and tarsi pale; frons shaded; antennal segment I pale, segment II variable, segments III–VIII shaded; fore wing base and clavus shaded, wing paler towards apex; abdominal tergites and sternites IV–VII without median shaded marking, antecostal ridges on III–VII dark complete across segment. Antennae 8-segmented, forked sensoria on III–IV short, not reaching more than one-third the length of succeeding segment; ocellar area with widely spaced transverse striae; ocellar setae III well-developed, close together between hind ocelli; 2 pairs of po setae as long as ocellar setae III. Pronotum anterior half with about 12 transverse striae per 30 microns, about 7–10 discal setae; 4 pairs of posteromarginal setae, pm2 pair long 2.5–4.0 times longer than

pm1, but pm1 variable in length. Metanotum with irregular equiangular to longitudinal reticulation; median setae situated behind but close to anterior margin. Fore wing second vein with 2 setae; clavus with 4 marginal setae, one discal seta. Abdominal tergites II–VI with S1 small, closer together than their length; VIII with no discal microtrichia medially; sternites with microtrichia areas not or scarcely extending mesad of posteromarginal setae S2.

Comments. Described from Luzon, The Philippines, this species is widespread in the warmer parts of northern and eastern Australia (Hoddle & Mound 2003). The following specimens have been seen from **Malaysia**: Kuala Lumpur, Universiti Malaya, 2 females on *Capsicum frutescens*, 24.vi.2011; Penang, 1 female from *Nephrolepis falcata*, 9.vii.2009. Males from Australia have a pair of long dark drepanae posterolaterally on tergite IX.



FIGURES 5–8. *Scirtothrips dorsalis* Hood. (5) Head and pronotum; (6) Antenna; (7) Metascutum; (8) Abdominal tergites IV–VIII.

***Scirtothrips dorsalis* Hood, 1919: 90**

(Figs 5–8)

Female macroptera. Body pale yellow, femora, tibiae and tarsi pale; antennal segment I pale, segment II variable, segments III–VIII shaded to dark; ocellar area sometimes shaded, also frons between antennal sockets; fore wing base and clavus commonly shaded, wing pale at apex; abdominal tergites IV–VII with weak to strong brown area medially not extending laterally to setal pair S2, antecostal ridge dark and continuous medially; sternites without shaded area, antecostal ridge on IV–VII dark. Antennae 8-segmented, forked sensoria on III–IV short, not reaching more than one-third the length of succeeding segment; ocellar triangle with closely spaced transverse striae, ocellar setae III arising between hind ocelli, 2 pairs of po setae as long as ocellar setae III. Pronotum closely striate, with

about 12–15 discal setae; 4 pairs of posteromarginal setae, pm 2 pair not elongate, usually less than 30 microns long and about twice as long as pm 1. Metanotum anterior third with arcuate transverse striae, irregular longitudinal reticulations posteriorly; median setae arise behind anterior margin. Fore wing second vein with 2 setae; clavus with 4 marginal setae, one discal seta. Abdominal tergites II–VI with S1 small, closer together than their length; VIII with microtrichia extending across anterior median area, IX–X with microtrichia present posteromedially; sternites III–VII with rows of microtrichia extending across segment on posterior half.

Male macroptera. Similar to female but smaller; abdominal tergite IX without drepanae.

Comments. Females collected from the leaves of tea in Pahang, Cameron Highlands, are darker than females of the typical form of this species that is common in Malaysia from lowland sites. The darker form has antennal segment II shaded and the tergal shaded area more extensive, also the ocellar area and frons between the antennal sockets dark. The significance of this colour form is not known, but it may be associated with lower temperatures during pupation. *Scirtothrips dorsalis* is widespread in Asia and northern Australia, and introduced to Israel and Florida. Although certainly polyphagous, there is little precise information on the range of plant species on which it can actually breed.

***Scirtothrips hitam* sp.n.**

(Figs 9–14)

Female macroptera. Body pale with brown markings to more uniformly brown, frons dark between antennal sockets; head posterior margin darker; femora, tibiae and tarsi weakly shaded; all antennal segments shaded, segment I scarcely paler than II; fore wings and clavus uniformly shaded, wing sometimes with extreme apex paler; abdominal tergites IV–VII with brown area medially, lateral thirds of tergites varying from uniformly brown to yellow with posterolateral margins brown; antecostal ridge of tergites III–VII dark but interrupted medially; sternites extensively shaded, IV–VII with antecostal ridge dark across segment.

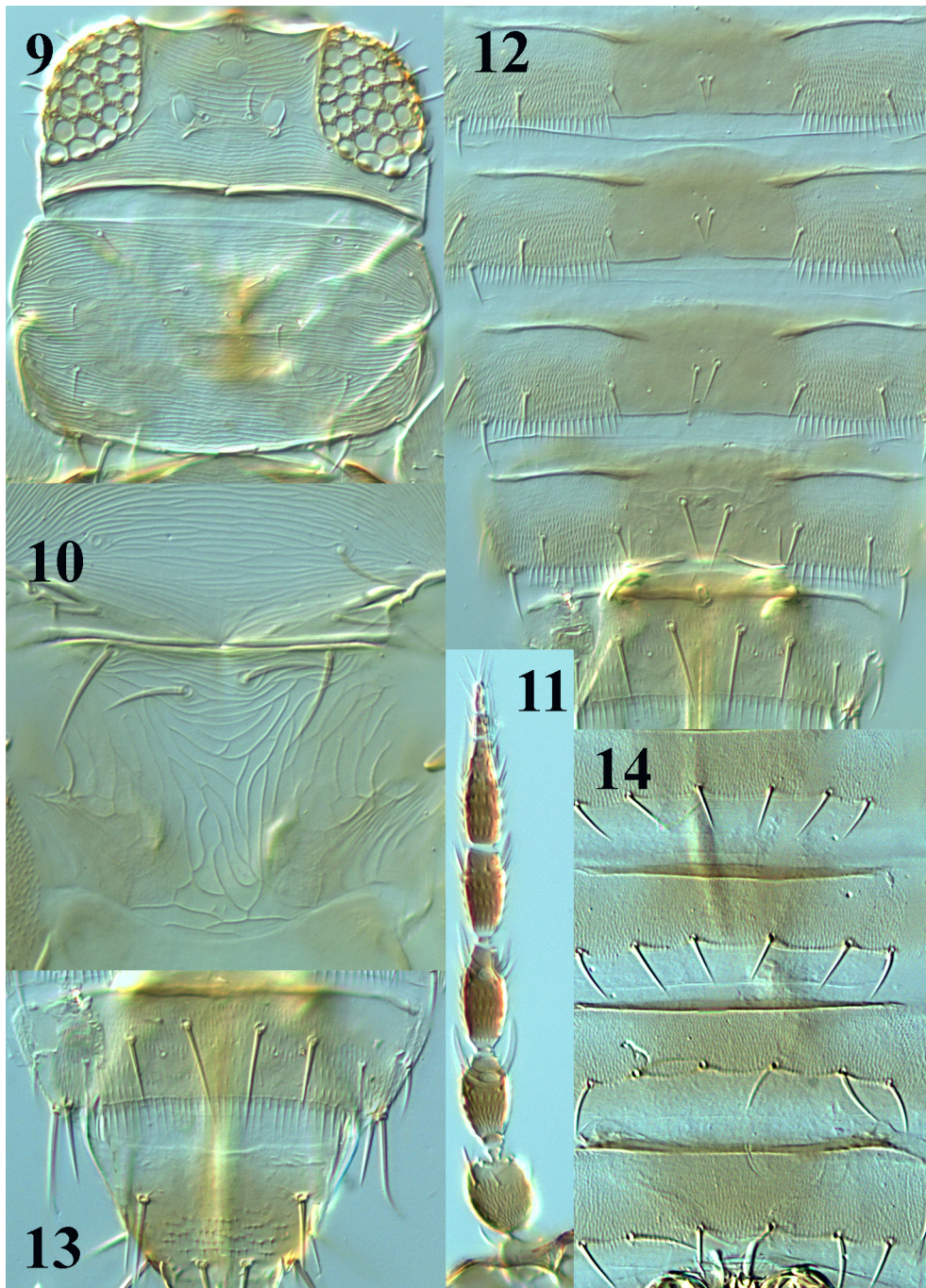
Antennae 8-segmented, forked sensoria on III–IV short, not reaching more than one-third the length of succeeding segment; ocellar triangle with closely spaced transverse striae, ocellar setae III arising between hind ocelli, 2 pairs of po as long as ocellar setae III. Pronotum closely striate, with about 10 discal setae; 4 pairs of posteromarginal setae, pair pm2 not elongate, usually less than 30 microns long and about twice as long as pm1. Metanotum anterior third with arcuate transverse striae, irregular longitudinal reticulations posteriorly; median setae arise behind anterior margin. Fore wing second vein with 2 setae; clavus with 4 marginal setae, usually without discal seta. Abdominal tergites II–VI with S1 small, closer together than their length; VIII with microtrichia extending across anterior median area; IX with microtrichia present posteromedially, X without microtrichia; sternites almost fully covered with rows of microtrichia across segment, microtrichia absent from only small and variable anterior area.

Measurements (female in microns). Distended body length 880. Head width across eyes 148. Pronotum, length 86, width 180; posteromarginal pm1 setae 9, pm2 20. Metanotum median setae 19, submedian setae 22. Fore wing, length 484; distal setae on second vein length 16–18. Antennae length 227; segments III–VI length 39, 32, 41, 40. Tergites III–VI S1 length 10–26, distance between bases 8–24.

Male macroptera. Similar in colour and sculpture to female, but smaller and darker; S1 on tergites widely separated, distance between bases almost as long or longer than the length of these setae. Abdominal tergite IX without drepanae.

Material studied. Holotype female: **MALAYSIA**, Penang, MARDI Seberang Perai, from *Artocarpus champeden* (Moraceae), 7.vii.2009 (Ng, Y.F. & Eow, L.X.) (in CISUKM). Paratypes: 4 females, all collected with holotype, 3 females from Kota Damansara, Community Forest, Selangor (All DNA extracted) 17–19.iv.2011 (Ng, Y.F. & Eow, L.X.); Pahang, Sg Bebar, 1 male from flowering tree, 20–28.ix.2009; Negari Sembilan, Kg. Bertam, 1 female from *Averrhoa carambola*, 5.v.2010; Selangor, MARDI, 4 females, 2 males from *Garcinia mangostana*, 25.vi.2008; Universiti Malaya, 8 females from *Saraca indica*, 24.vii.2011, 1 female from *Euodia redlevi*, 16.v.2011. **INDONESIA, JAVA**, Bogor, from Mango, 3 females, 4.vii.2008, 1 female, 25.iv.2008, (in CISUKM, MZUM and ANIC).

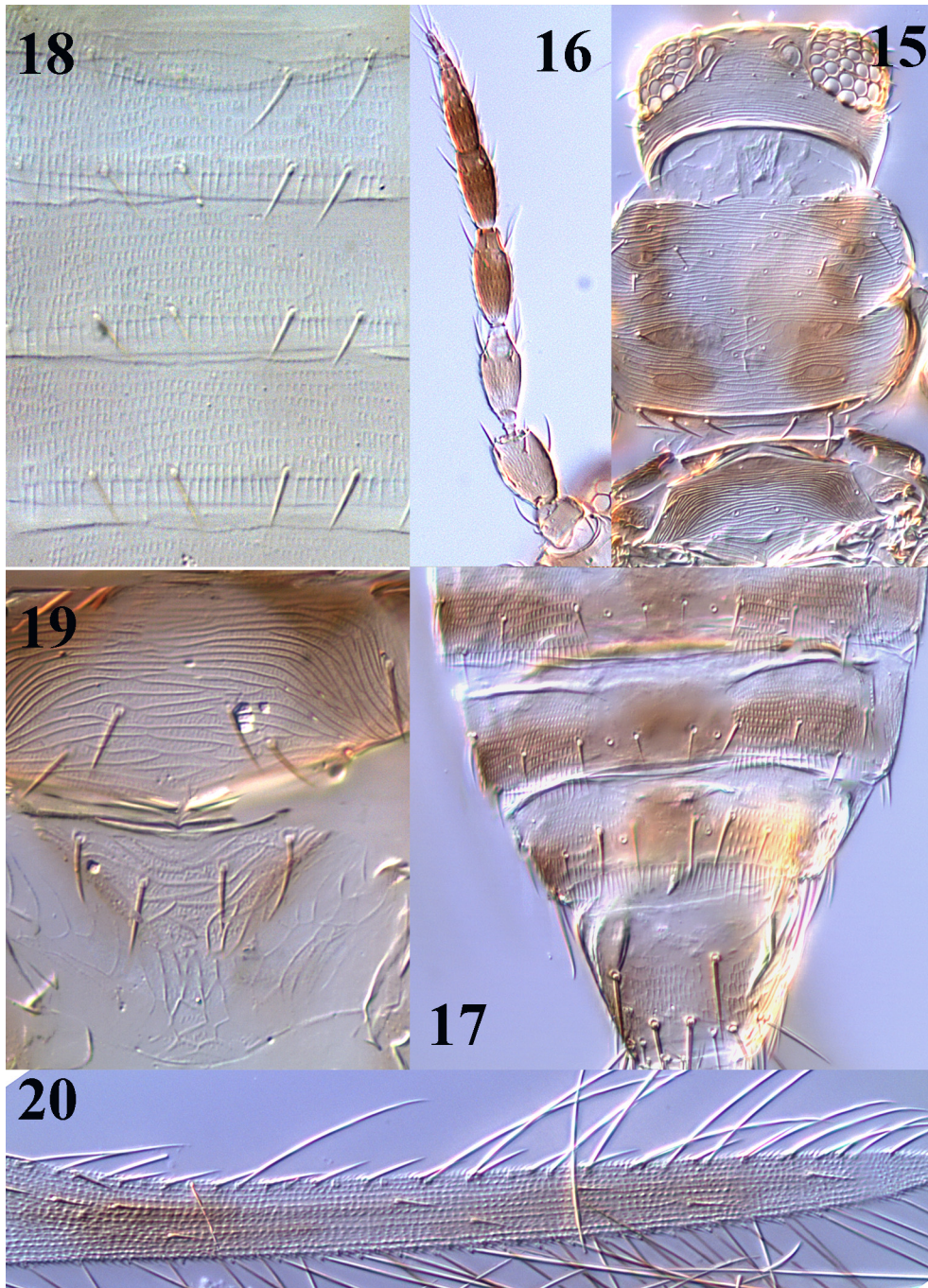
Etymology. The species name refers to the dark colour of the body in Malay languages.



FIGURES 9–14. *Scirtothrips hitam* sp.n. (9) Head and pronotum; (10) Metascutum; (11) Antenna; (12) Abdominal tergites IV–VIII; (13) Abdominal tergites VIII–XI; (14) Abdominal sternites IV–VII.

Comments. This species shares most structural details with *S. dorsalis*. It appears to be both polyphagous and widespread in tropical Asia, and is widely distributed in western Malaysia and present in Indonesia. In contrast to the common pest species, *dorsalis*, the sternites are more extensively covered with microtrichia (Fig. 14), the tergal antecostal ridge is discontinuous medially (Fig. 12), and there are colour differences indicated in the key above. Most specimens are considerably darker than the typical form of *S. dorsalis*, but the lateral thirds of the tergites are almost yellow in a few, possibly teneral, females.

The NJ, MP and ML trees generated from the COI sequences in the phylogenetic analyses had similar topology. Only the NJ tree is shown here (Fig. 1). All the *S. hitam* and *S. dorsalis* samples formed two well supported clusters in the NJ tree indicating these taxa are well separated. The genetic distance between *S. hitam* and *S. dorsalis* was sufficiently high (*S. dorsalis* (NYF1) vs. *S. hitam* (NYF 5,6,7) = 0.141) to recognize these as distinct species. However, this recognition might be improved if more extensive sampling could be carried out.



FIGURES 15–20. *Scirtothrips lantanae* sp.n. (15) Head and pronotum; (16) Antenna; (17) Abdominal tergites VI–IX; (18) Abdominal sternites IV–VI; (19) Metascutum; (20) Fore wing.

***Scirtothrips lantanae* sp.n.**
(Figs 15–20)

Female macroptera. Body generally light brown; pronotum with shaded longitudinal bands sublaterally, femora, tibiae and tarsi slightly shaded; antennal segments I–III pale, IV–VII brown, VIII pale apically; fore wings weakly shaded at base including clavus, middle and sub-apical areas; abdominal tergites II–VIII light brown with anterior margins paler; III–VII with antecostal ridge slightly darker but interrupted medially; sternites IV–VII with antecostal ridges dark.

Antennae 8-segmented, forked sensoria on III–IV short, not reaching more than one-third the length of succeeding segment; ocellar triangle with closely spaced transverse striae; ocellar setae III on tangent between anterior margins of hind ocelli, 2 pairs of po setae as long as ocellar setae III. Pronotum with closely spaced striae, with about 20 discal setae; 4 pairs of almost subequal posteromarginal setae. Metanotum with transversely arcuate striae on anterior third, posterior area longitudinally striate/reticulate; median setae far behind anterior margin. Fore wing second vein with 3 setae; fore wing clavus with 3–4 marginal setae, and one discal seta. Abdominal tergites II–VI with setae S1 small, close together, distance between bases less than setal length; VIII with two or more rows of microtrichia across anterior half of segment; IX–X with many rows of microtrichia on posterior half. Sternites fully covered by rows of microtrichia across segment; II–VI with complete comb of microtrichia on posterior margin, but absent medially on VII.

Measurements (female in microns). Distended body length 905. Head width across eyes 120. Pronotum, length 103, width 138; posteromarginal setae pm1 19, pm2 20. Metanotum median setae 17, submedian setae 22. Fore wing, length 472; distal setae on second vein 16–17. Antennae length 228; segments III–VI length 40, 41, 38, 36. Tergites III–VI S1 length 10–31, distance between bases 11–26.

Male macroptera. Similar in colour and sculpture to female but smaller; antecostal ridges on abdominal sternites III–VII pale; tergite IX without drepanae.

Material studied. Holotype female: **MALAYSIA**, Bukit Kesing, Terengganu, on *Lantana* sp., 23.viii.2011 (Ng, Y.F.) (in CISUKM). Paratypes: 6 females and 2 males collected with holotype; 1 male and 3 females from KL, University Malaya Campus, Rimba Ilmu, collected on *Lantana* sp., 16.v. 2012 (Ng, Y.F.), (in CISUKM and ANIC).

Comments. The body colouration of this new species is unique, with two shaded longitudinal bands on the pronotum and fore wing. The abdominal sternites III–V have a comb of long microtrichia on the posterior margin (Fig. 18). This condition is found also in *S. aurantii* and *Siamothrips argus* Okajima described from Thailand, but the microtrichia are much shorter and/or sparser in those species.

***Scirtothrips lixinae* sp.n.**

(Figs 21–26)

Female macroptera. Body yellow, frons and posterior margin of head weakly shaded; femora, tibiae and tarsi pale or slightly shaded; antennal segment I pale, II–VIII shaded; fore wings at base lightly shaded also clavus, wing paler towards apex; tergites with brown area medially not extending laterally to setae S2, III–VII with antecostal ridge dark brown complete across segment; sternites without shading, IV–VII with antecostal ridge dark brown.

Antennae 8-segmented, IV elongate and constricted apically, sensoria on III–IV forked and unusually long extending to mid-point of the succeeding segment; ocellar area with widely spaced transverse striae; ocellar setae III close together between hind ocelli, 2 pairs of po as long as ocellar setae III. Pronotum with closely spaced striae, with about 14 discal setae; 4 pairs of posteromarginal setae, pair pm2 about twice as long as pm1. Metanotum anterior third with irregular transverse striae, posterior area longitudinally reticulate/striate, median setae near anterior margin. Fore wing second vein with 2 or 3 setae; clavus with 4 marginal setae, with or without discal seta. Abdominal tergites II–VII with setae S1 small, closer together than their length; VIII without microtrichia medially; segment IX with microtrichia present posteromedially, X with very weak microtrichia; sternites with microtrichia scarcely extending mesad of posteromarginal setal pair S2.

Measurements (female in microns). Distended body length 968. Head length 65, width across eyes 145. Pronotum, length 109, width 143; posteromarginal setae pm1 20, pm2 42. Metanotum median setae 16, submedian setae 23. Fore wing, length 472; distal setae on second vein length 10–13. Antennae length 243; segments III–VI length 47, 51, 35, 38. Tergites III–VI S1 length 10–18, distance between bases 8–11.

Male. Not known.

Material studied. Holotype female: **MALAYSIA**, Penang, Penang Botanical Garden, on *Podocarpus macrophyllus*, 8.vii.2009 (Ng, Y.F. & Eow, L.X.), (in CISUKM).

Paratypes: 4 females collected with holotype; Penang, MARDI, Seberang Perai, 1 female from *Artocarpus champeden*, 7.vii.2009 (Ng, Y.F. & Eow, L.X.), (in CISUKM and ANIC).

Etymology. The species is named after the second collector Miss Li-Xin Eow.



FIGURES 21–26. *Scirtothrips lixinae* sp.n. (21) Head and pronotum; (22) Meso- and Metascutum; (23) Antenna; (24) Abdominal tergites IV–VIII; (25) Abdominal sternites IV–VII; (26) Abdominal tergite VIII.

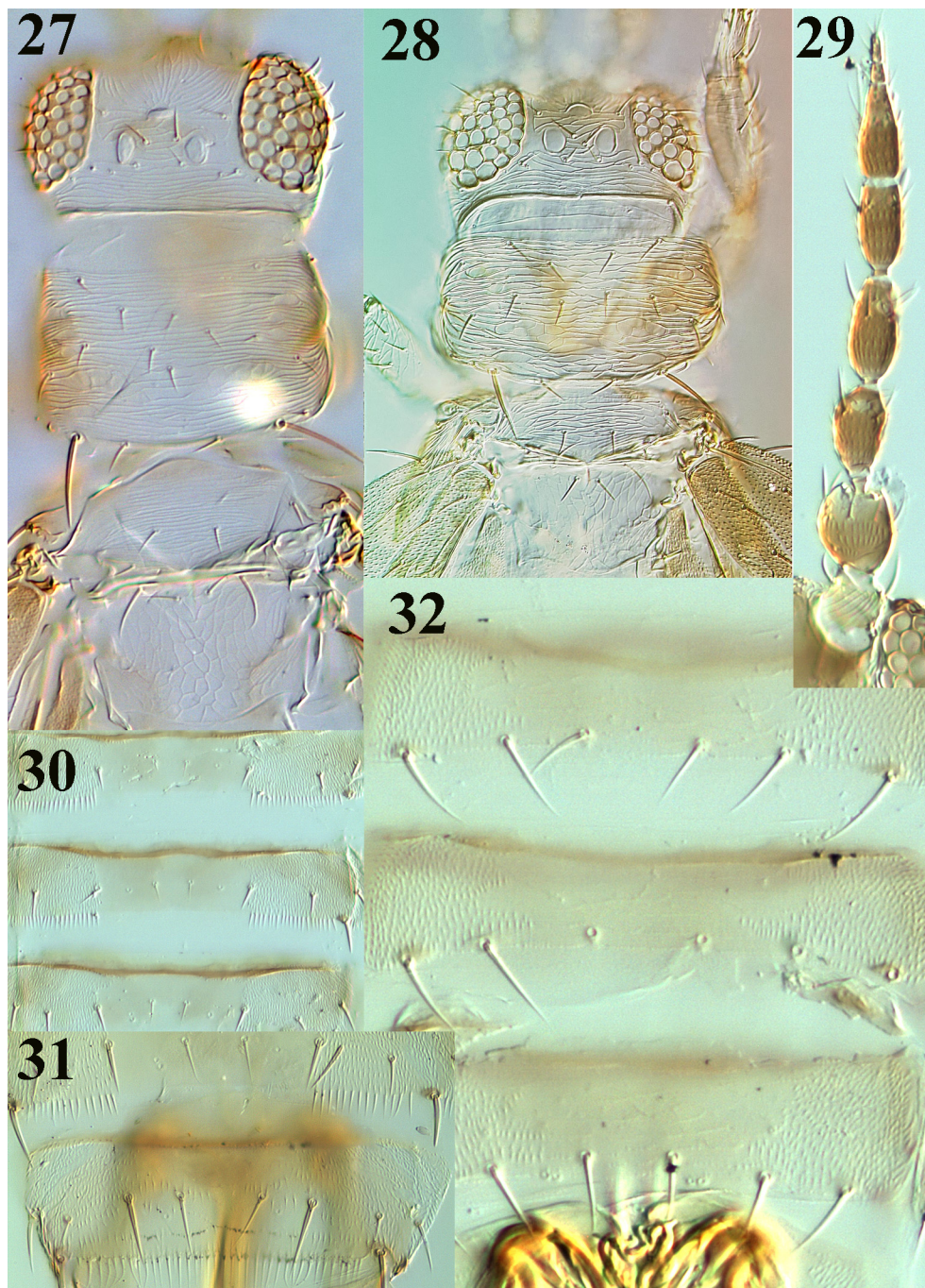
Comments. Relationships of this species are difficult to determine. The sculpture of the metanotum and the abdominal tergites III–VI shaded medially are different in comparison to *S. dobroskyi* as distinguished in the key above. This new species has antennal segment IV relatively large, with the apex prolonged and the sensoria particularly long and stout (Fig. 23).

***Scirtothrips malayensis* sp.n.**

(Figs 27–32)

Female macroptera. Body yellow, weakly shaded in ocellar triangle and on frons between antennal sockets, also at posterior margin of head, but vertex pale; antennal segment I pale, II–VIII shaded; fore wing shaded basally

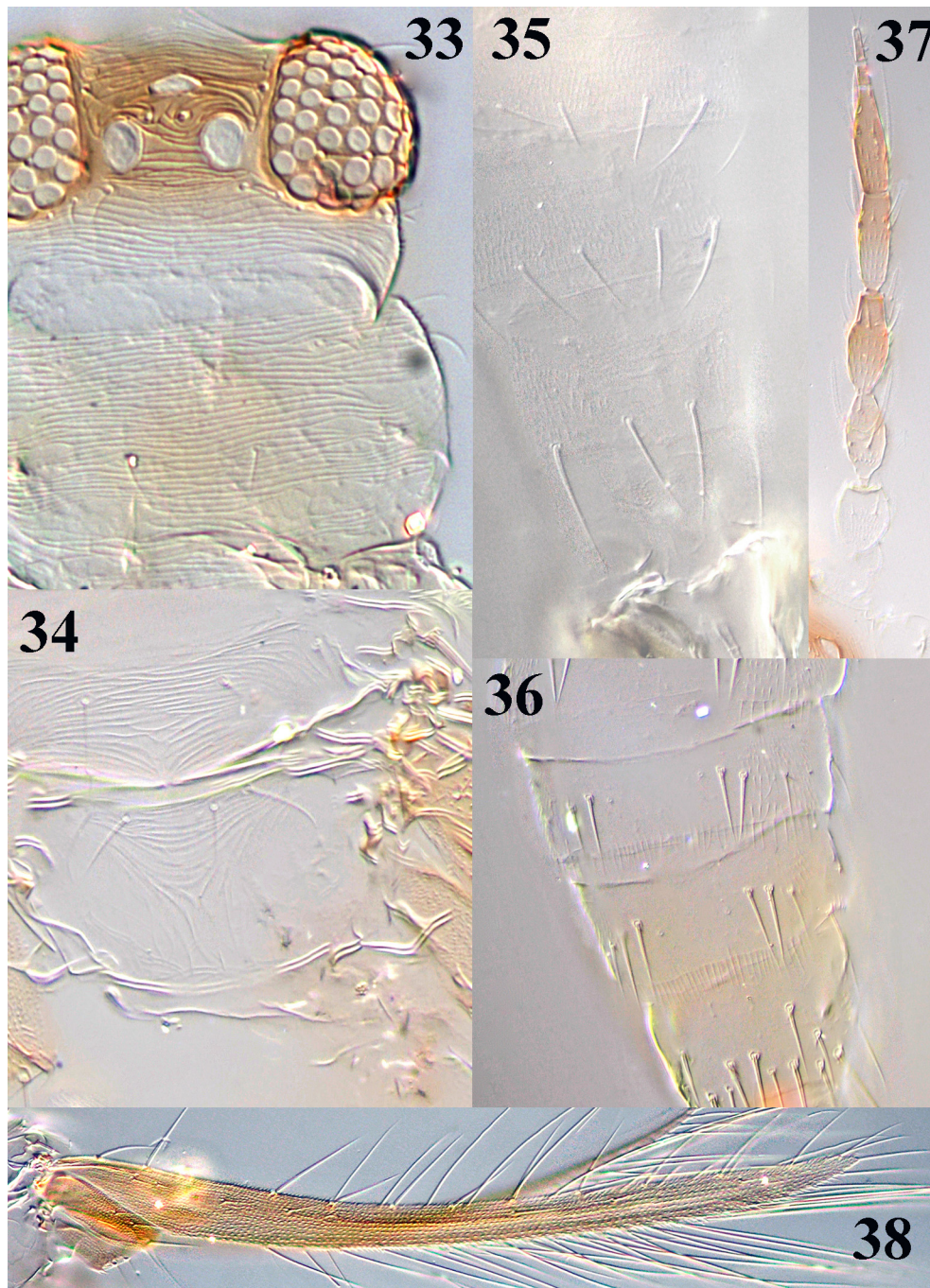
including clavus, but paler toward apex; abdominal tergites III–VII without dark markings medially, but sometimes very weakly shaded laterally, antecostal ridge dark brown; sternites without dark areas but IV–VII with dark brown antecostal ridge.



FIGURES 27–32. *Scirtothrips malayensis* sp.n. (27) Head, pronotum and metascutum (Holotype); (28) Head, pronotum and metascutum (Paratype variant); (29) Antenna; (30) Abdominal tergites IV–VI; (31) Abdominal tergites VII–VIII; (32) Abdominal sternites V–VII.

Antennae 8-segmented, forked sensoria on III–IV short, not reaching more than one-third the length of succeeding segment; ocellar triangle with widely spaced irregular transverse striae, ocellar setae III close together arising between hind ocelli, 2 pairs of long po setae. Pronotum transversely striate, but striae varying from straight to slightly undulating, and from 8 to 16 striae per 30 microns, and 6–10 discal setae; 4 pairs of posteromarginal setae, pm2 long, usually 2.5–3 times longer than pm1. Metanotum reticulate; median setae behind anterior margin. Fore wing second vein with one seta, clavus with 3 marginal setae, and 1 discal seta. Abdominal tergites II–VII

with setae S1 wider apart than their length; VIII with one or more transverse rows of microtrichia medially; IX with microtrichia present posteromedially, X with very weak microtrichia. Sternal microtrichia areas not extending mesad of posteromarginal setal pair S2.



FIGURES 33–38. *Bitothrips minutus* Bhatti. (33) Head and pronotum; (34) Metascutum; (35) Abdominal sternites V–VII; (36) Abdominal tergites IV–IX; (37) Antenna; (38) Fore wing.

Measurements (female in microns). Distended body length 968. Head length 64, width across eyes 137. Pronotum, length 79, width 156; posteromarginal pm1 setae 13, pm2 39. Metanotum median setae 11, submedian setae 21. Fore wing, length 494; distal seta on second vein length 18. Antennae length 204; segments III–VI length 33, 35, 28, 32. Tergites III–VI S1 length 8–13, distance between bases 22–38.

Male macroptera. Similar in colour and sculpture to female, but smaller and paler; Abdominal tergite IX with drepanae.

Material studied. Holotype female: **MALAYSIA**, Terengganu, Gunung Tebu, on *Allamanda* sp. (Apocynaceae), 1–6.viii.2012 (Ng, Y.F.). (in CISUKM).

Paratypes: 7 females collected with holotype; Pahang, Tasik Chiini, 2 females on *Allamanda* sp., 28.i.2013 (Ng, Y.F.), (in CISUKM and ANIC); Gombak, 1 female from *Clerodendron myricoides* lvs, 4.iii.2007; Selangor, Kota Damansara, 4 females from *Barringtonia* sp., 17.iv.2011, (in CISUKM, MZUM and ANIC).

Comments. This is probably another widespread and common species in tropical Asia. It is similar in structure to *S. dobroskyi*, but is distinguished in the key above by the presence of microtrichia on tergite VIII, and the greater distance between the setal pair S1 medially on the abdominal tergites. However, there is considerable variation between the available specimens in the form of the pronotal sculpture (Figs 27, 28).

***Biltothrips* Bhatti**

(Figs 33–38)

Biltothrips Bhatti, 1973: 438. Type species *Sericothrips minutus* Bhatti 1967, by monotypy

The only species in this genus shares many character states with *Scirtothrips*, but is distinguished as follows: absence of a pair of setae in front of the first ocellus (ocellar setae pair I); absence of mid-dorsal seta on antennal segment II; absence of setae on fore wing second vein; lateral position of tergal setal pair S1 that arise close to S2 and to the lateral microtrichial fields (Fig. 36).

The only known species in this genus was described from both sexes collected in West Bengal, India (Bhatti 1967). Subsequently, specimens were collected on the **SOCIETY ISLANDS** in the Pacific Ocean (Hoddle *et al.* 2008), one female from Bangkok, **THAILAND**, is available in ANIC, Canberra, and the species is here recorded from **MALAYSIA**, Pahang, Pulau Tioman, 4 females 3 males collected on Cassava leaves, 8.vii.2013 (Ng, Y.F.), (in CISUKM and ANIC).

Acknowledgements

Special thanks to Penang Botanical Garden and Malaysian Agricultural Research and Development Institute, Cameron Highlands Research Station for allowing us to collect thrips from their garden. Special thanks also to the Forestry Department of Peninsular Malaysia (JPSM), Forestry Department of Perak State, Forestry Department of Selangor State, Forestry Department of Terengganu State, Sarawak Forestry Department and Malaysian Nature Society for organizing the expeditions to Pulau Pangkor in Perak, Kota Damansara in Selangor, Gunung Tebu in Terengganu and Paga Maga Lawas in Sarawak. The study of Malaysian thrips (Thysanoptera) is funded by research grant LRGS/BU/2012/UKM/BS and DPP-2013-071. The first author would like to thank Dr. Salmah Yaakop for suggesting using the Freezing methods and laboratory. Also thank to Miss Ameyra Aman Zuki for DNA extraction. A special thanks to Dr. C.Y. Choong from Universiti Kebangsaan Malaysia (UKM) for the DNA analyses and interpreting the results.

References

- Bhatti, J.S. (1967) *Thysanoptera nova Indica*. Published by the author, Delhi, pp. 1–24.
- Bhatti, J.S. (1973) A preliminary revision of *Sericothrips* Haliday, sensu lat., and related genera, with a revised concept of the tribe Sericothripini. *Oriental Insects*, 7, 403–449.
<http://dx.doi.org/10.1080/00305316.1973.10434100>
- Garms, B.J., Mound, L.A. & Schellhorn, N.A. (2013) Polyphagy in the Australian population of South African citrus thrips (*Scirtothrips aurantii* Faure). *Australian Journal of Entomology*, 52, 282–289.
<http://dx.doi.org/10.1111/aen.12028>
- Hoddle, M.S. & Mound, L.A. (2003) The genus *Scirtothrips* in Australia (Insecta, Thysanoptera, Thripidae). *Zootaxa*, 268, 1–40.
- Hoddle, M.S., Hoddle, C.D. & Mound, L.A. (2008) An inventory of Thysanoptera collected from French Polynesia. *Pacific Science*, 62, 509–515.

- [http://dx.doi.org/10.2984/1534-6188\(2008\)62\[509:iotcff\]2.0.co;2](http://dx.doi.org/10.2984/1534-6188(2008)62[509:iotcff]2.0.co;2)
- Hoddle, M.S., Jetter, K.M. & Morse, J.G. (2003) The economic impact of *Scirtothrips perseae* Nakahara (Thysanoptera: Thripidae) on California avocado production. *Crop Protection*, 22, 485–493.
[http://dx.doi.org/10.1016/s0261-2194\(02\)00199-0](http://dx.doi.org/10.1016/s0261-2194(02)00199-0)
- Johansen, R.M. & Mojica-Guzmán, A. (1998) The genus *Scirtothrips* Shull, 1909 (Thysanoptera: Thripidae, Sericothripini) in Mexico. *Folia Entomologica Mexicana*, 104, 23–108.
- Majid, M.B., Tong, X.L. & Chen, X.X. (2012) A new species of *Scirtothrips* infesting *Ginkgo biloba* in eastern China. *Journal of Insect Science*, 12 (117), 1–7.
<http://dx.doi.org/10.1673/031.012.11701>
- Masumoto, M. & Okajima, S. (2007) The genus *Scirtothrips* Shull (Insecta, Thysanoptera, Thripidae) and three related genera in Japan. *Zootaxa*, 1552, 13–33.
- Mound, L.A. & Palmer, J.M. (1981) Identification, distribution and host-plants of the pest species of *Scirtothrips* (Thysanoptera: Thripidae). *Bulletin of Entomological Research*, 71, 467–479.
<http://dx.doi.org/10.1017/s0007485300008488>
- Mound, L.A. (2010) A second *Scirtothrips* species with a hind-femoral comb in males (Thysanoptera, Thripidae). *Zootaxa*, 2643, 66–68.
- Mound, L.A. & Stiller M. (2011) Species of the genus *Scirtothrips* from Africa (Thysanoptera, Thripidae). *Zootaxa*, 2786, 51–61.
- Mound, L.A. & zur Strassen, R. (2001) The genus *Scirtothrips* (Thysanoptera: Thripidae) in Mexico: a critique of the review by Johansen & Mojica-Guzman. *Folia Entomologica Mexicana*, 40, 133–142.
- Monteiro, A. & Pierre, N.E. (2000) Phylogeny of *Bicyclus* (Lepidoptera: Nymphalidae) Inferred from COI, COII, and EF-1 α Gene Sequences. *Molecular Phylogenetics and Evolution*, 18, 264–281.
<http://dx.doi.org/10.1006/mpev.2000.0872>
- Rugman-Jones, P.F., Hoddle, M.S. & Mound, L.A. (2006) Molecular Identification key for pest species of *Scirtothrips* (Thysanoptera: Thripidae). *Molecular Entomology*, 99 (5), 1814–1819.
<http://dx.doi.org/10.1603/0022-0493-99.5.1813>
- Rugman-Jones, P.F., Hoddle, M.S. & Stouthamer, R. (2007) Population Genetics of *Scirtothrips perseae*: tracing the origin of a recently introduced exotic pest of Californian avocado orchards, using mitochondrial and microsatellite DNA markers. *Entomologia Experimentalis et Applicata*, 124, 101–115.
<http://dx.doi.org/10.1111/j.1570-7458.2007.00559.x>
- Swofford, D.L. (1998) Paup* (version 4.0). Phylogenetic analysis using parsimony (* and the other method). Sunderland MA, (beta version).
- Yaakop, S., van Achterberg, C. & Ghani, I.B.A. (2009) *Heratemis* Walker (Hymenoptera: Braconidae: Alysiinae: Alysiini): revision and reconstruction of the phylogeny combining molecular data and morphology. *Tijdschrift voor Entomologie*, 152, 1–62.
<http://dx.doi.org/10.1163/22119434-900000268>
- ThripsWiki (2014) *ThripsWiki - providing information on the World's thrips*. Available from: http://thrips.info/wiki/Main_Page (accessed 26 July 2014)