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An illustrated key to the genera of Thripinae (Thysanoptera) from South East Asia

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Abstract

An illustrated key is provided for the identification of 65 genera of Thripinae from South East Asia. Wherever possible notes are given on the host-plant associations and geographical distributions, and suggestions made concerning phylogenetic relationships. The combination *Taeniothrips euophthalmos* Moulton is re-established.

Key words: Thysanoptera, Thripinae, Asia, genus, identification

Introduction

South East Asia is one of the most biologically diverse areas on earth, but there are major impediments for young Asian biologists wishing to develop an understanding of the rich fauna of their countries. The lack of identification keys to the Asian insect fauna is critical, and the library resources, also the collections of identified reference specimens, are insufficient to help a student to develop an extensive knowledge of any particular group. Electronic copying can be expected to make scientific literature more widely available, progressively. Moreover, collaborative data-basing between institutes holding extensive collections of specimens has the potential, in time, to enrich the available research base. But the development of identification keys often requires collaboration between local workers and international specialists who have knowledge of a wider fauna. The identification key presented here was developed in this way: to fill a mutual requirement; it is needed by Malaysian biologists to facilitate identification of the thrips on their crops and in their forests, and it is needed in other countries by quarantine entomologists for routine interception work.

This is the second recent publication on Thysanoptera involving collaboration between Malaysia and Australia. The first provided an identification key to 23 species of genus *Thrips* that are known from Peninsular Malaysia, together with a checklist of 78 species of Thripidae recorded from that territory (Mound & Azidah, 2009). However, the Thysanoptera fauna of Peninsular Malaysia is just part of a more extensive, but poorly documented, fauna across South East Asia. The present contribution provides an identification key to the genera of one major group, the Thripinae. The 65 genera included in this key have been recorded in, or have been intercepted in quarantine from, countries between the Indian peninsula, the Japanese archipelago, and the northern coast of Australia. For most of this area there exists no introduction to the Thysanoptera fauna, and the utility of the available key to the thrips of India (Ananthakrishnan & Sen, 1980) is severely limited due to extensive nomenclatural and synonymy changes over the past 30 years. Further east, the faunas of Japan and China include many Palaearctic elements, whereas the taxa included here are primarily those endemic to tropical and subtropical regions. Many of the taxa in this tropical fauna have extensive ranges between India in the west and Taiwan and northern Australia in the east.

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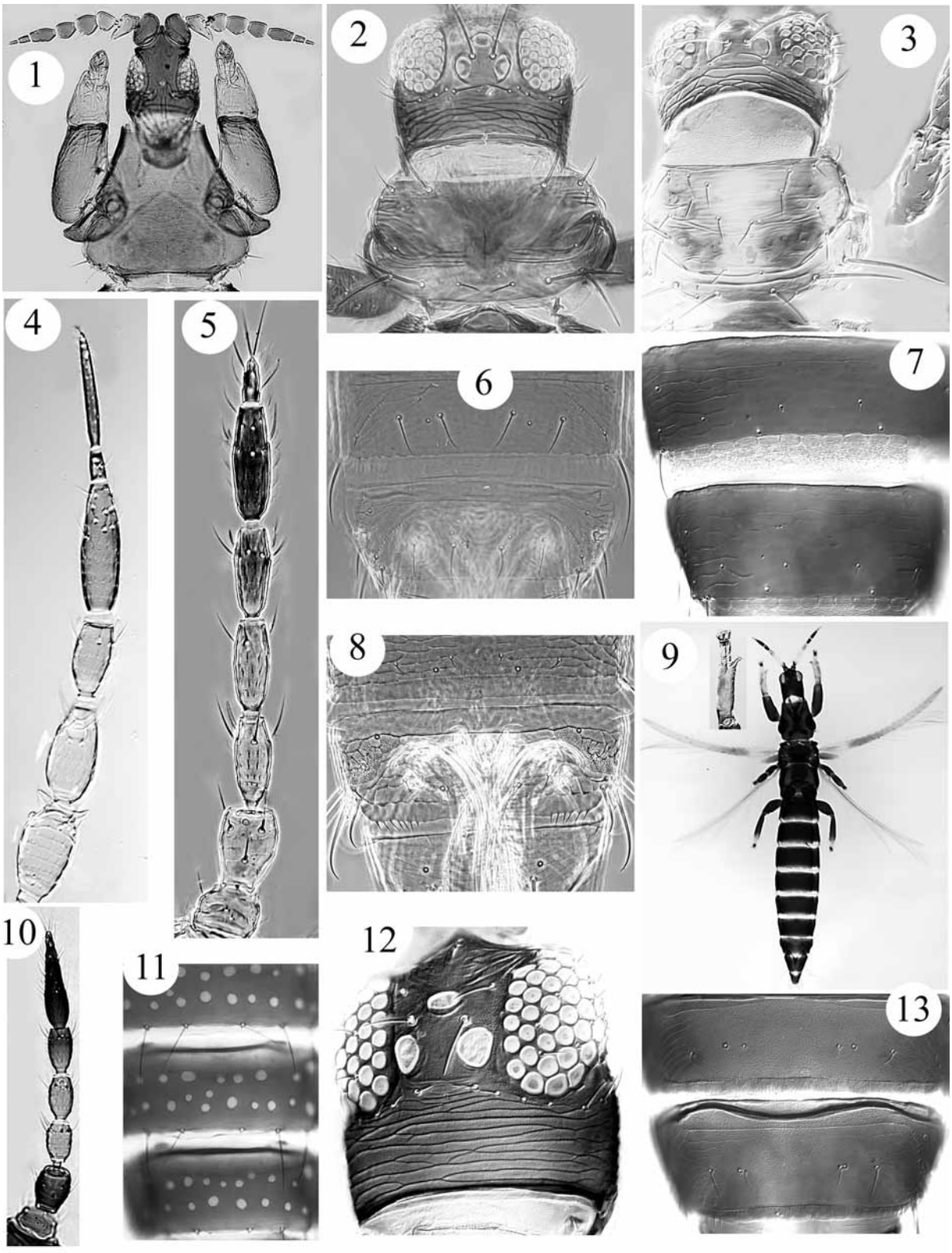
Thripidae subfamily Thripinae

The Thripinae, the target of the present work, is the largest of the four subfamilies in the family Thripidae. Recognition of these four subfamilies is facilitated by an electronic, multi-access key available on the web (Mound, 2009c). The first subfamily, Panchaetothripinae, is a worldwide group of about 40 genera and 135 species, and includes the well-known Greenhouse Thrips of the northern hemisphere, *Heliothrips haemorrhoidalis*. This subfamily also includes a number of other minor pest species (Wilson, 1975; Kudo, 1995). The second subfamily, Dendrothripinae, comprises 15 genera and about 100 species of leaf-feeding thrips, and is represented widely across the Old World (Mound, 1999), but with remarkably few species recorded from South East Asia. The third subfamily, Sericothripinae, is a group of three genera and 150 species that is found worldwide, with the species breeding on leaves as well as in flowers. Kudo (1997) has discussed many Asian species, and an account is available of the Australian Sericothripinae species (Mound & Tree, 2009).

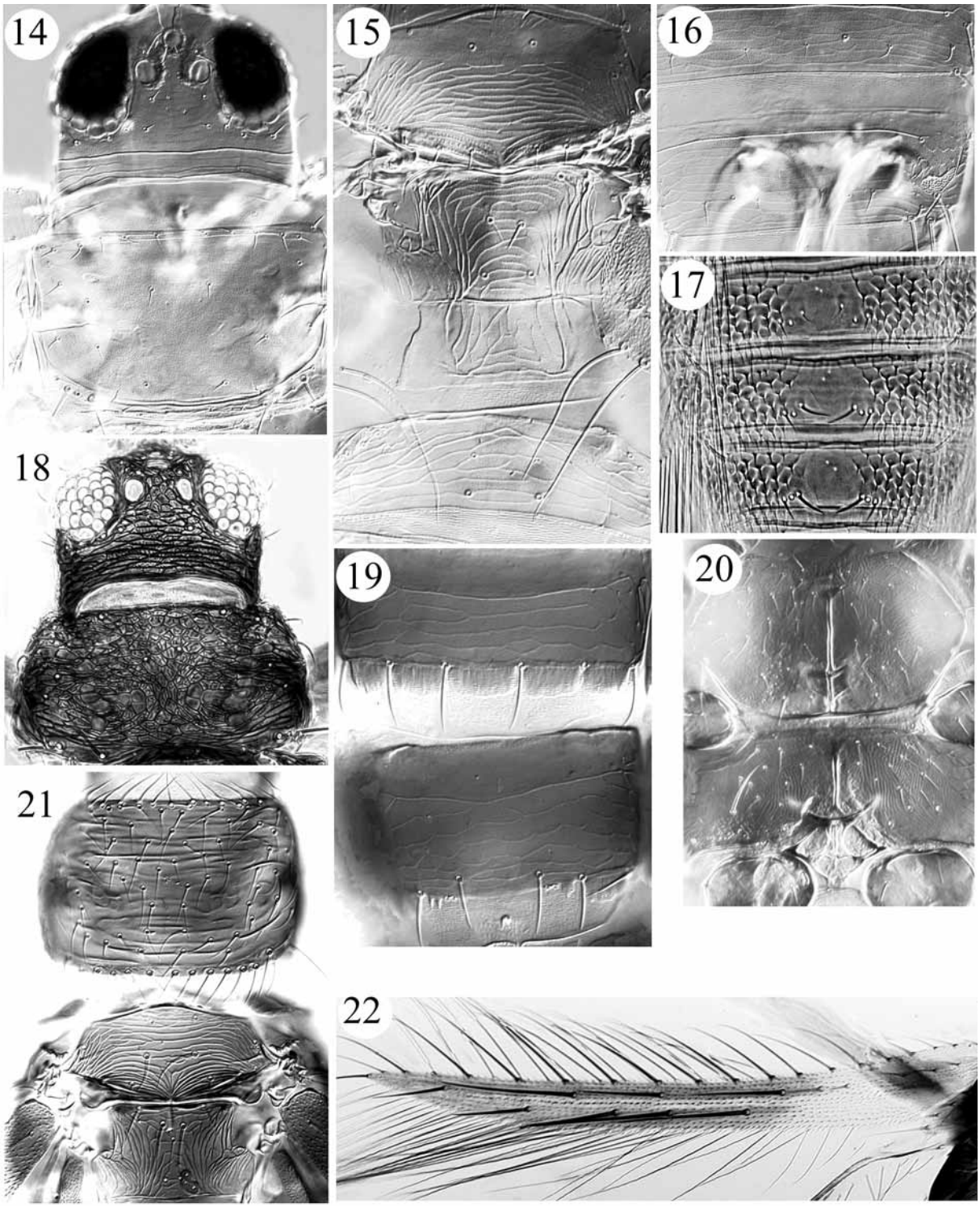
The Thripinae includes about 1650 species in 230 genera (Mound, 2009a,c), and the key presented here facilitates recognition of 65 (28%) of these genera. Thripinae are represented worldwide, and the genus *Thrips* is the largest genus in the Thysanoptera. Regional accounts of the species in *Thrips* genus are available for North America (Nakahara, 1994), Europe (zur Strassen, 2003), Pakistan to the Pacific (Palmer, 1992), and Australia (Mound & Masumoto, 2005). Keys are also available to species of a few other genera of Thripinae, including *Anaphothrips* (Nakahara, 1995; Mound & Masumoto, 2009), *Eremiothrips* (Bhatti et al., 2003), and *Frankliniella* (Mound & Marullo, 1996). However, comprehensive identification keys to genera are more difficult to produce, due to logistic problems in obtaining specimens of the relevant taxa, as well as the inherent problems created by variation both within and between taxa. Recent keys that deal with genera of Thripidae are available for the Philippines (Reyes, 1994), Central America (Mound & Marullo, 1996), Europe (zur Strassen, 2003), and California (Hoddle et al., 2009).

Key construction

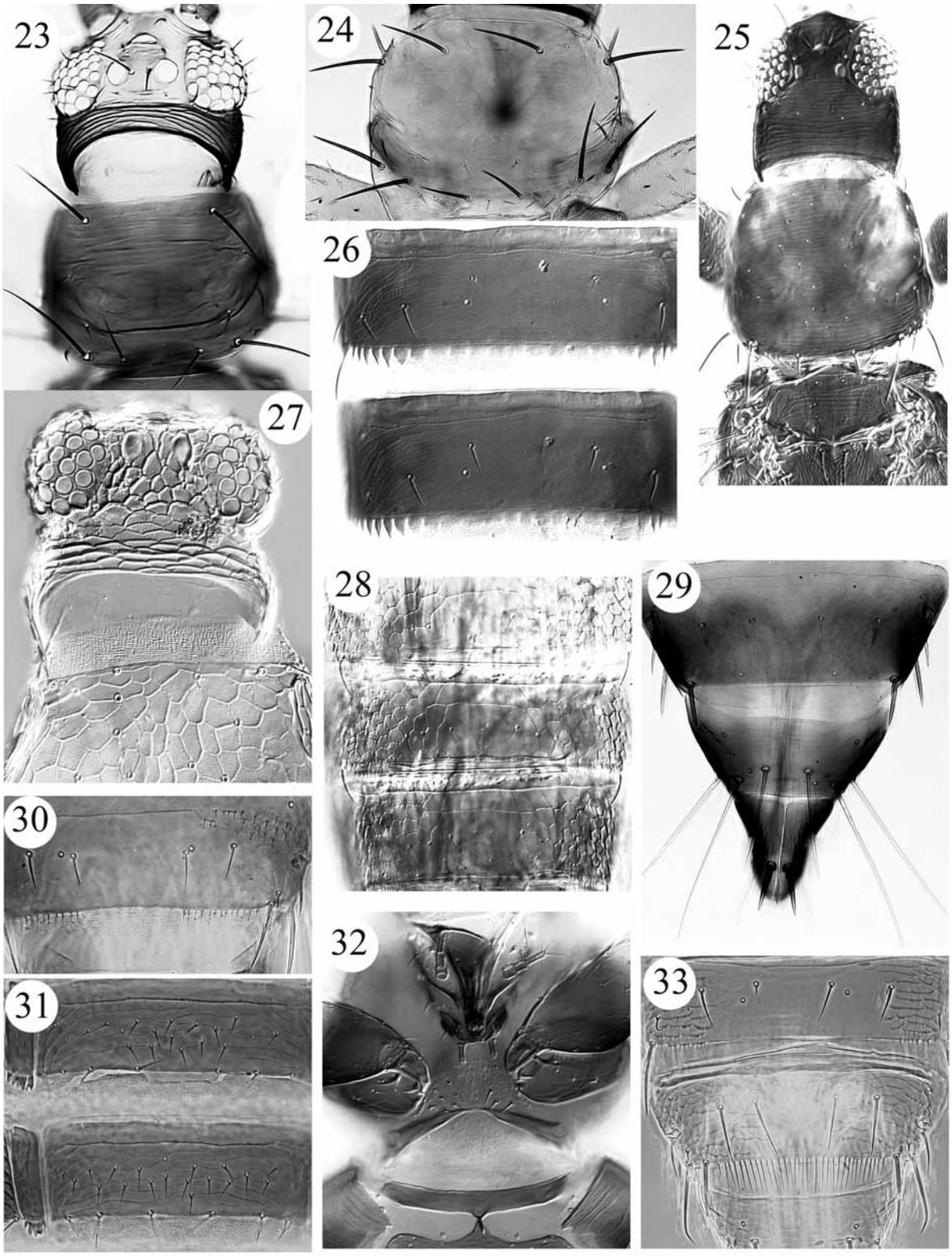
The structure of the identification key presented here is essentially arbitrary, that is, it is not based on phylogenetic principles. The reason for adopting such an approach is that an identification system that is based on phylogeny inevitably employs characteristics that are obscure and difficult for a non-specialist to observe or evaluate. Thus the presence of a pair of small or minute setae at the dorsal apical margin of the first antennal segment (Figs 37, 39) seems to be a good indicator of evolutionary relationships amongst many Thripinae, but this pair of setae can be difficult to see. Similarly, the presence of ctenidia laterally on the abdominal tergites (Figs 6, 26) is a particularly good indicator of relationships (Mound, 2002), but non-specialists often need instruction in how to distinguish ctenidia from irregular patches of microtrichia (Fig. 30). This key therefore relies as much as possible on relatively superficial character states in guiding a student toward an identification. Wherever possible we have employed more difficult characters only in later couplets. The character states used in this key are based on the species known from South East Asia, not on all of the species that are placed in any particular genus worldwide. Thus, *Mycterothrips* species in Asia have many tergal microtrichia, but some species in other parts of the world have very few such microtrichia. After the key, comments are provided for each genus on distributions, host plants and phylogenetic relationships. Further illustrations of, and comments on, many of the more common genera are available on the web site PADIL: http://www.padil.gov.au/ . Full nomenclatural information is available for all Thysanoptera taxa at: http://www.ento.csiro.au/thysanoptera/worldthrips.html.



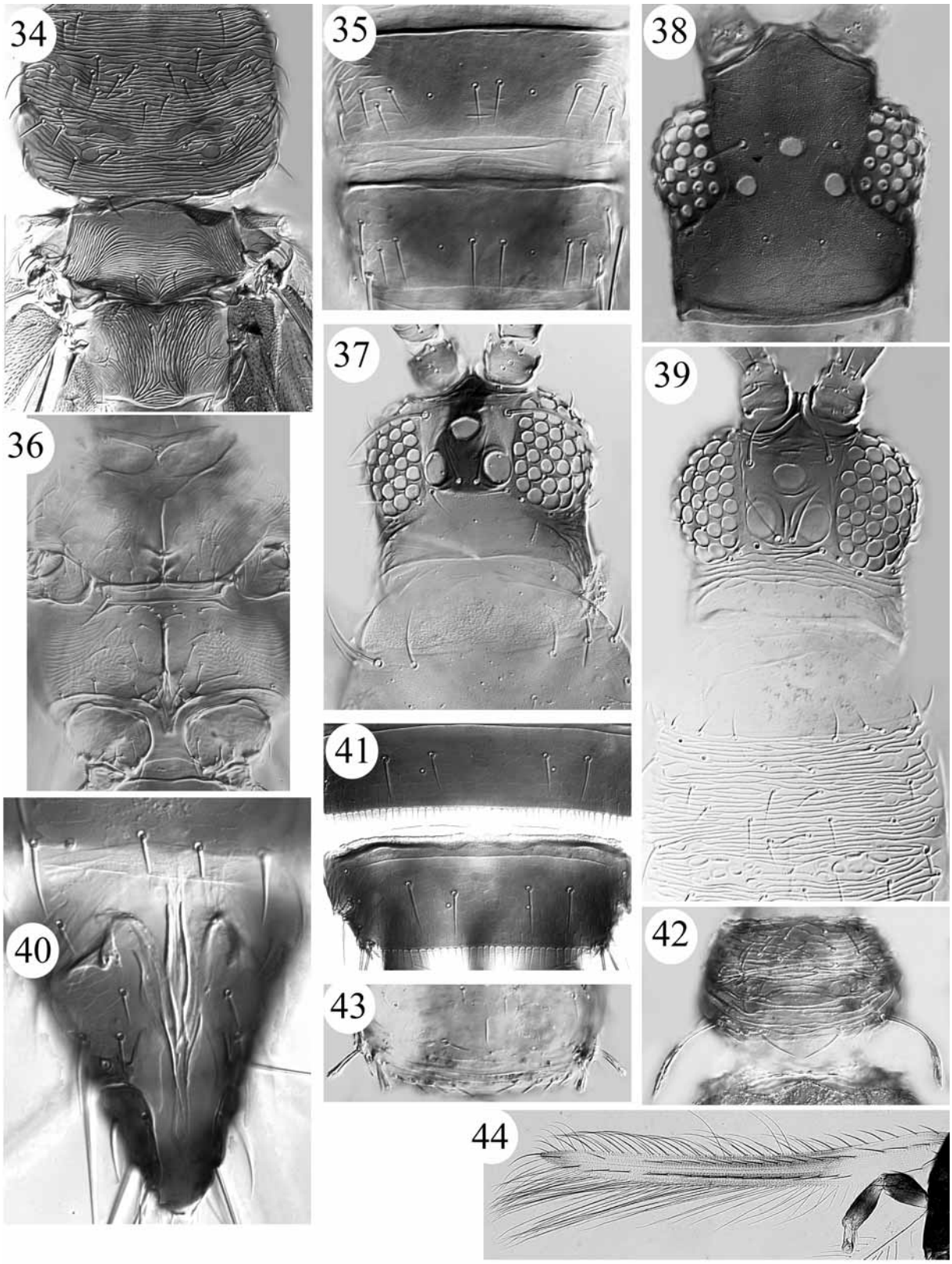
FIGURES 1–13. Thripinae genera. **(1)** *Arorathrips*; **(2)** *Ayyaria*; **(3)** *Bathrips*; **(4)** *Projectothrips*; **(5)** *Bolacothrips*; **(6)** *Bolacothrips* tergites VII–VIII; **(7)** *Bregmatothrips* tergites VII–VIII; **(8)** *Chaetanaphothrips* tergites VII–VIII; **(9)** *Clypeothrips* with detail of fore tibia; **(10)** *Priesneriola*; **(11)** *Ceratothripoides* male sternites IV–VI **(12)** *Dichromothrips*; **(13)** *Craspedothrips* tergites VII–VIII.



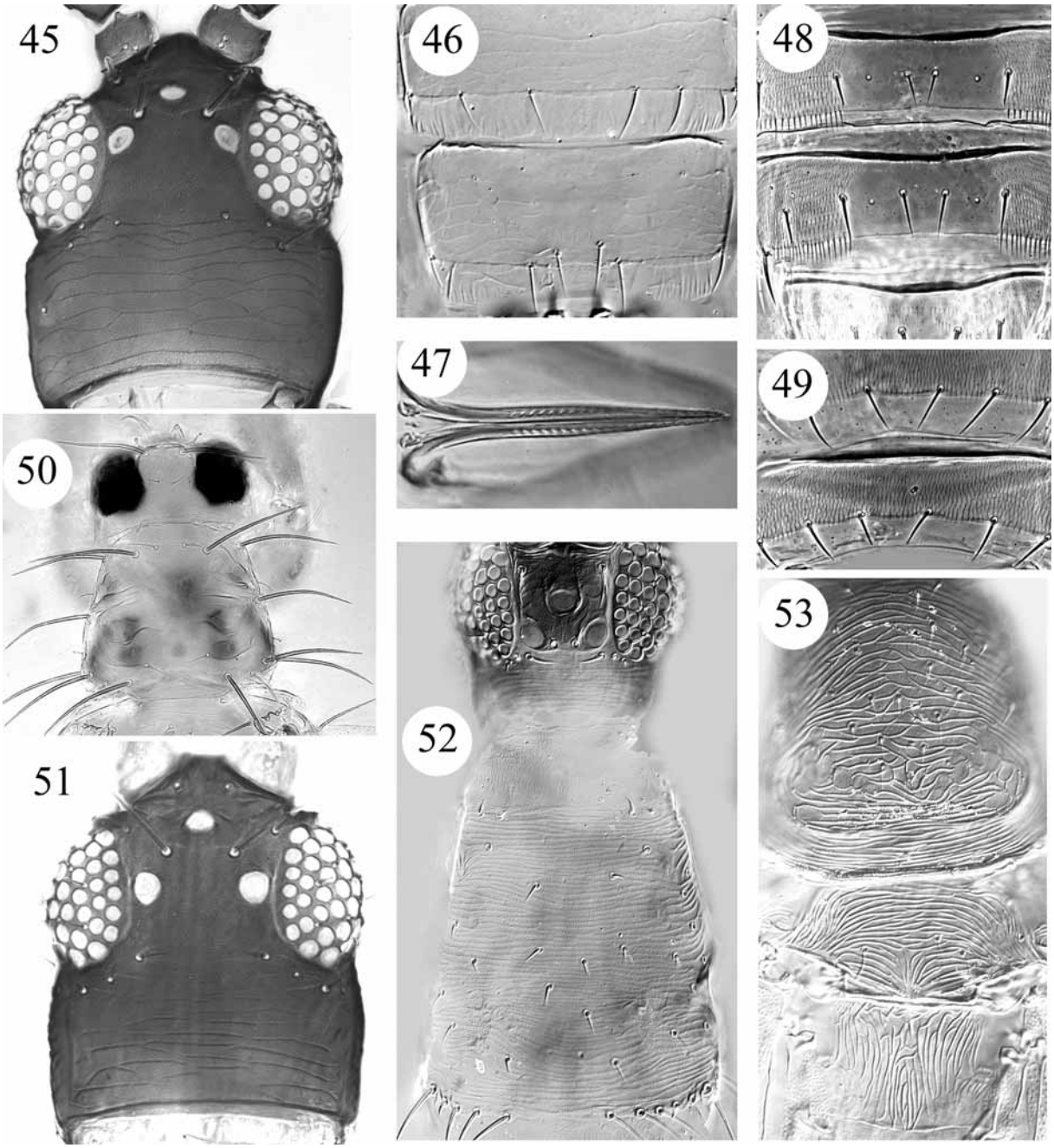
FIGURES 14–22. Thripinae genera. **(14)** *Danothrips*; **(15)** *Danothrips* metanotum; **(16)** *Danothrips* tergites VII–VIII; **(17)** *Dendrothripoides* tergites IV–VI; **(18)** *Echinothrips*; **(19)** *Ernothrips* sternites VI–VII; **(20)** *Dichromothrips* meso and metasterna; **(21)** *Euphysothrips* pronotum to metanotum; **(22)** *Euphysothrips* forewing.



FIGURES 23–33. Thripinae genera. **(23)** *Filipinothrips*; **(24)** *Frankliniella* pronotum; **(25)** *Fulmekiola*; **(26)** *Fulmekiola* tergites VI–VII; **(27)** *Indusiothrips*; **(28)** *Isunidothrips* tergites V–VII; **(29)** *Limothrips* tergites VIII–X; **(30)** *Megalurothrips* tergite VIII; **(31)** *Microcephalothrips* sternites V–VI; **(32)** *Microcephalothrips* prosternal setae; **(33)** *Mycterothrips* tergites VII–VIII.



FIGURES 34–44. Thripinae genera. **(34)** *Octothrips* pronotum to metanotum; **(35)** *Octothrips* tergites VII–VIII; **(36)** *Octothrips* meso and metasterna; **(37)** *Okajimaella*; **(38)** *Organothrips*; **(39)** *Paithrips*; **(40)** *Plesiothrips* ovipositor; **(41)** *Projectothrips* tergites VII–VIII; **(42)** *Pteridothrips* pronotum; **(43)** *Salpingothrips* pronotum; **(44)** *Megalurothrips* forewing.



FIGURES 45–53. Thripinae genera. **(45)** *Sciothrips*; **(46)** *Rhamphothrips* sternites VI–VII; **(47)** *Rhamphothrips* ovipositor; **(48)** *Scirtothrips* tergites VI–VII; **(49)** *Scirtothrips* sternites V–VI; **(50)** *Scolothrips*; **(51)** *Sorghothrips*; **(52)** *Simulothrips*; **(53)** *Siamothrips* pronotum to metanotum.

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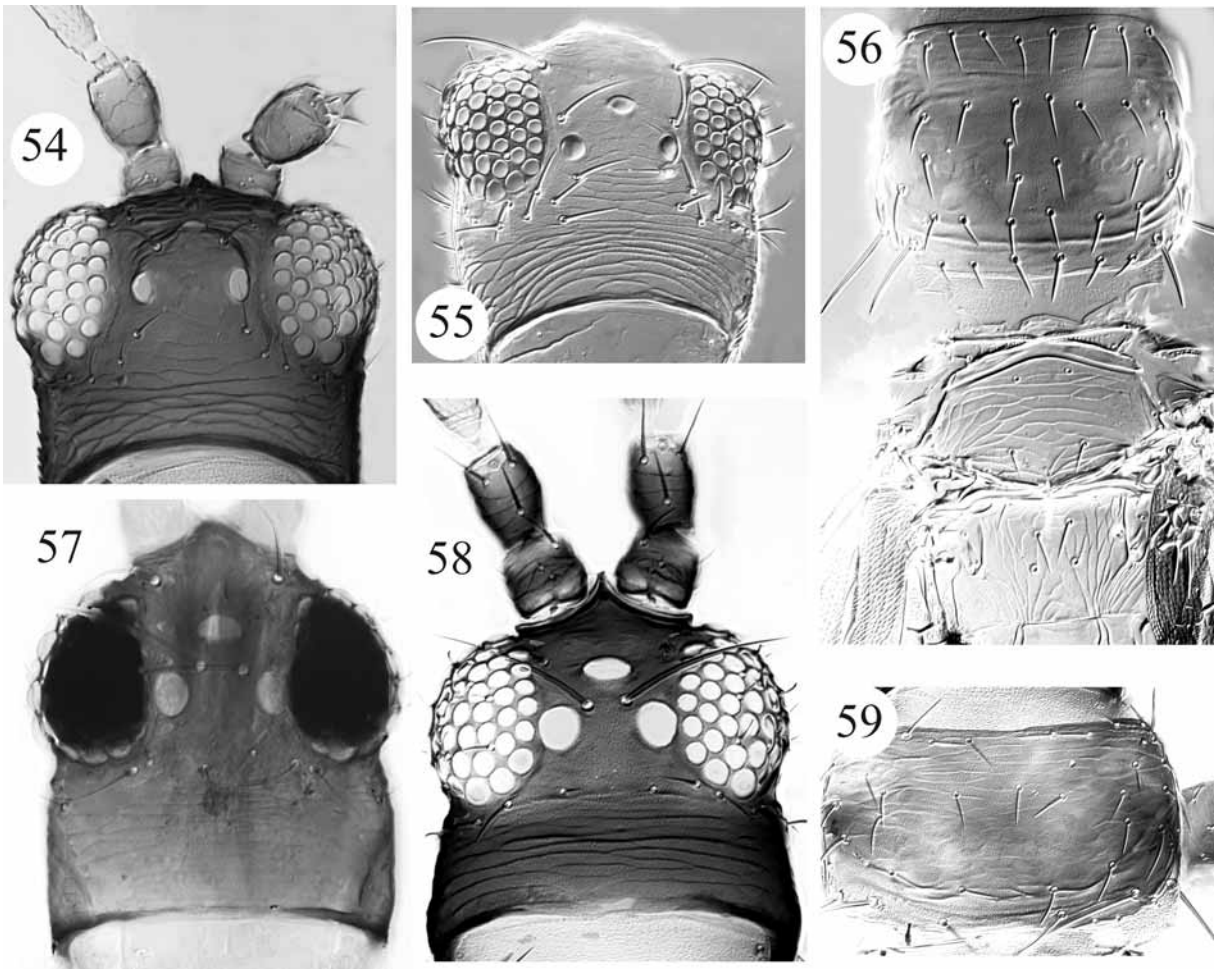
earlier drafts. The accompanying illustrations were prepared using a Leica DM2500 Differential Interference Contrast microscope, the digital images being processed with Automontage software.



FIGURES 54–59. Thripinae genera. **(54)** *Sphaeropothrips*; **(55)** *Stenchaetothrips*; **(56)** *Tusothrips* pronotum to metanotum; **(57)** *Taeniothrips euophthalmos* Holotype; **(58)** *Taeniothrips*; **(59)** *Taeniothrips* pronotum.

Key to Genera of Thripinae

[excluding *Mecothrips* and *Smeringothrips*]

[* included from published descriptions]

1. Dark brown species with head and metanotum strongly reticulate (Fig. 18); major setae on pronotum and forewing long with apices capitate ..... *Echinothrips*
-. Never dark brown and reticulate; major setae not long and capitate 2
2. Pronotum with six pairs of very long setae (Fig. 50)..... *Scolothrips*
-. Pronotum never with more than five pairs of major setae (Figs 2, 24) 3
3. Abdominal tergites with lateral thirds fully covered with numerous microtrichia (Figs 17, 28, 48) 4
-. Abdominal tergites without numerous microtrichia occupying lateral thirds, rarely with a few microtrichia near lateral margins (Fig. 30)..... 9
4. Lateral thirds of tergites with closely spaced rows of minute microtrichia 5
-. Microtrichia on lateral thirds of tergites not in closely spaced regular rows (Figs 17, 28) 8
5. Antennal segment VIII elongate, almost 10 times as long as wide and 4 times as long as VII (Fig. 4) .... *Projectothrips* [in part]
-. Antennal segment VIII not so long and slender 6
6. Pronotum with two pairs of prominent posteroangular setae; male antennal segment VI often three times as long as segment V ..... *Mycterothrips*

-. Pronotum with no long setae, or no more than one pair of prominent posteroangular setae (Fig. 53); antennae not sexually dimorphic 7
7. Forewing second vein with no setae; posterior margin of abdominal sternites with comb of microtrichia; male apterous ..... *Siamothrips*
-. Forewing second vein with irregular row of setae; posterior margin of sternites without comb of microtrichia (Fig. 49); both sexes fully winged ..... *Scirtothrips*
8. Tergites III–VII lateral thirds with numerous broadly based stout microtrichia (Fig. 17) ..... *Dendrothripoides*
-. Lateral thirds of tergites with polygonal sculpture bearing irregular minute microtrichia (Fig. 28)..... *Isunidothrips*
9. Major setae on head, pronotum and forewings fan shaped to lanceolate ..... *Watanabeothrips** [females]
-. Major setae on head, pronotum and forewings setaceous 10
10. Antennal segment II strongly asymmetric, external margin prolonged; antennal segment I much wider than long (Fig. 1)..... *Arorathrips*
-. Antennal segment II external margin not prolonged, segment I not swollen 11
11. Pronotum with no long posteroangular setae 12
-. Pronotum with at least one pair of prominent posteroangular setae (Figs 2, 3) 20
12. Meso- and meta-thoracic furcae both with prominent spinula (Fig. 36) 13
-. Meta-thoracic furca with no spinula, or with spinula weakly indicated and with diffuse margins; meso-thoracic furca with or without spinula 14
13. Abdominal tergites VII–VIII posterior margin with complete microtrichial comb arising from a narrow craspedum . ..... *Ranjana**
-. Tergites VII–VIII posterior margin without microtrichia or craspedum ..... *Octothrips*
14. Abdominal tergites V–VII laterally with pair of ctenidia (Fig. 6)..... *Thrips* [in part]
-. Abdominal tergites V–VII laterally without pair of regular ctenidia 15
15. Abdominal tergites II–VIII with entire but toothed craspedum, sternites II–VI with lobed craspedum *Aneurothrips* *
-. Tergites and sternites without craspeda 16
16. Antennal segments III–IV with sensorium simple; ocellar setae pair I absent (Fig. 45)..... 17
-. Antennal segments III–IV with sensorium forked; ocellar setae pair I usually present (Fig. 51);..... 18
17. Head strongly reticulate; major setae on tergite IX with apices expanded..... *Indusiothrips*
-. Head with almost no sculpture; major setae on tergite IX acute ..... *Takethrips*
18. Ocellar setae pair I absent; metafurca with weakly defined, diffuse spinula; metanotum with transverse lines of sculpture ..... *Dichromothrips* [in part]
-. Ocellar setae pair I present; metafurca with no spinula; metanotal sculpture longitudinal or weakly reticulate 19
19. Forewing first and second veins each with complete row of regularly spaced setae ..... *Pseudanaphothrips*
-. Forewing veins with setae irregularly and widely spaced ..... *Anaphothrips*
20. Pronotal anterior margin with 1 or 2 pairs of setae that are much longer than discal setae (Figs 2, 24)..... 21
-. Pronotum with no long setae on anterior margin (Fig. 25) 26
21. Forewing first and second veins each with complete (or almost complete) row of setae; abdominal tergites VI–VIII with paired ctenidia laterally..... 22
-. Forewing first vein with setal row widely interrupted; tergites without ctenidia 23
22. Ctenidia on tergites VI–VII terminating close to tergal seta S3 ..... *Frankliniella*
-. Ctenidia on tergites VI–VII terminating at median pair of lateral marginal setae..... *Parabaliothrips* [in part]
23. Forewing second vein with few, widely spaced, long setae; tergite VIII with complete posteromarginal comb of long regular microtrichia; tergites and sternites with prominent reticulation..... *Ayyaria*
-. Forewing second vein with many equally spaced setae (Fig. 44); tergite VIII either with no comb or with comb interrupted medially; tergites and sternites without prominent reticulation 24
24. Ocellar setae pair III arising close to anterolateral margins of ocellar triangle; tergite VIII posterior margin on lateral thirds with well-developed comb..... *Megalurothrips* [in part]
-. Ocellar setae pair III arising close to posterior margin of ocellar triangle (Fig. 23); tergite VIII posterior margin with no comb or a very few microtrichia near lateral margins 25
25. Head with width of inter-antennal process greater than width of first antennal segment (Fig. 23) .... *Filipinothrips* [in part]
-. Head with width of inter-antennal process narrow (Fig. 37)..... *Okajimaella* [in part]
26. Female with ovipositor short and weak, lacking serrations (Fig. 40) 27
-. Female with ovipositor long and clearly serrate (Fig. 47) 28
27. Antennae 7-segmented, sensoria forked [male with antennal segments IV–VI long with many long setae, III about 0.5 as long as IV] ..... *Plesiothrips*
-. Antennae 8-segmented, sensoria simple ..... *Metaxyothrips**
28. Antennal segment VIII elongate, narrowed to base (Fig. 4)..... *Projectothrips* [in part]
-. Antennal segment VIII not long and slender 29

29. Tergites V–VIII laterally with paired ctenidia (Fig. 6) 30
-. Tergites without paired ctenidia (Figs 7, 13) 38
30. Mouthcone long and pointed, extending across prosternum ..... *Oxyrrhinothrips*
-. Mouthcone not elongate, not extending across prosternum 31
31. Posterior margin of abdominal tergites without craspedum (Fig. 6) 32
-. Posterior margin of tergites with craspedum (Fig. 26) 36
32. Ocellar setae pair I present; ctenidia on tergite VIII anterolateral to spiracle ..... *Parabaliothrips* [in part]
-. Ocellar setae pair I absent; ctenidia on tergite VIII posteromesad to spiracle (Fig. 6) 33
33. Antennal segments III and IV with simple sensorium ..... *Bolacothrips*
- Antennal segments III and IV with forked sensorium 34
34. Antennal segment II without a mid-dorsal seta (Fig. 54); mesothoracic sternopleural sutures not developed ..... *Sphaeropothrips*
-. Antennal segment II with a seta on dorsal surface basad to the campaniform sensilla (Fig. 58); mesothoracic sternopleural sutures present 35
35. Ocellar setae II longer than ocellar setae III (Fig. 55) ..... *Stenchaetothrips*
-. Ocellar setae II shorter than ocellar setae III ..... *Thrips*
36. Abdominal sternites with numerous discal setae (Fig. 31), without craspedum; prosternal basantra with several setae (Fig. 32) ..... *Microcephalothrips*
-. Sternites without discal setae, posterior margins with craspedum (Fig. 19); prosternal basantra without setae 37
37. Tergites II–VII with craspedum entire, VIII with posterior margin of craspedum bearing slender microtrichial comb ..... *Ernothrips*
-. Tergites II–VIII with toothed craspedum (Fig. 26) ..... *Fulmekiola*
38. Metathoracic furca bifurcate and extending to mesothorax ..... *Trachynotothrips**
-. Metathoracic furca not greatly enlarged and bifurcate 39
39. Tergite VIII posterior margin with comb of microtrichia present medially 40
-. Tergite VIII posterior margin without a comb, or with comb present only laterally 50
40. Head strongly projecting in front of eyes (Fig. 38); fore tibia inner apex with broadly flattened seta ... *Organothrips*
-. If head projecting in front of eyes, then fore tibial apex without such a seta 41
41. Head with more than 2 pairs of pre-ocellar setae ..... *Amomothrips*
-. Head with 1 or 2 pairs of pre-ocellar setae (Fig. 45) 42
42. Ocellar setae pair I present (Fig. 51) 43
-. Ocellar setae pair I absent (Fig. 45) 45
43. Setae on the first and second vein of forewing very long, longest seta twice as long as wing width (Fig. 22) ..... *Euphysothrips*
-. Setae on the first and second vein of forewing shorter, longest seta scarcely as long as wing width 44
44. Forewing clavus without discal seta; males with numerous small pore plates on sternites (Fig. 11), tergite IX without stout thorn-like setae ..... *Ceratothripoides*
-. Forewing clavus with discal setal; male without sternal pore plates, and with three pairs of stout thorn-like setae on tergite IX ..... *Lefroyothrips*
45. Metathoracic furca with long spinula (Fig. 20) 46
-. Metathoracic furca with no spinula 47
46. Sternite VII with three pairs of major setae; head about as long as wide (Fig. 12) ..... *Dichromothrips* [in part]
-. Sternite VII with two pairs of major setae; head much longer than wide ..... *Moundinothrips**
47. Tergites and sternites with posteromarginal craspeda; male tergite IX with horn-like process bear 2 short stout setae ..... *Plutonothrips**
-. Tergites and sternites with no posteromarginal craspeda; male tergite IX without such a process 48
48. Head projecting in front of eyes (Fig. 45); ocellar setae III arising near anterior margins of ocellar triangle; metanotal median setae small and far behind anterior margin of sclerite ..... *Sciothrips*
-. Head not projecting in front of eyes; ocellar setae arise within triangle (Fig. 58); metanotal median setae long and arise at anterior margin 49
49. Pronotal posteroangular setae acute ..... *Taeniothrips*
-. Pronotal posteroangular setae “fringed or abruptly pointed” ..... *Javathrips**
50. Head with width of inter-antennal process greater than width of first antennal segment (Fig. 23) ..... *Filipinothrips* [in part]
-. Head with width of inter-antennal process narrower than first antennal segment 51
51. Tergite VIII with area of specialised sculpture extending anteriorly from each spiracle to antecostal ridge (Fig. 8) ..... *Chaetanaphothrips*
-. Tergite VIII without a large area of sculpture around the spiracles 52
52. Pronotal posterior angles each with two pairs of short, fluted and broadly expanded, trumpet-shaped setae (Fig. 43)

..... *Salpingothrips*
-. Posteroangular setae not trumpet-shaped 53
53. Pronotum with one pair of long posteroangular setae that are flattened and fringed in distal half (Fig. 42) ..... *Pteridothrips*
-. Pronotal posteroangular setae pointed not flattened near apex..... 54
54. Antennal segment III (usually also IV) with sensorium simple 55
-. Antennal segments III–IV with sensorium forked 58
55. Antennae with only 6 segments (Fig. 10)..... *Priesneriola*
-. Antennae with 8 segments 56
56. Tergite X with pair of prominent thorn-like setae (Fig. 29) ..... *Limothrips*
-. Tergite X without prominent stout setae 57
57. Tergites with no posteromarginal craspedum, campaniform sensilla not close to posterior margin..... *Yoshinothrips*
-. Tergites with posteromarginal craspedum, campaniform sensilla close to posterior margin (Fig. 7) .. *Bregmatothrips*
58. Sternite VII with posteromarginal setae S1 and S2 arising close together in front of margin (Fig. 46)..... *Rhamphothrips*/*Exothrips*
-. Sternite VII with median two pairs of setae not arising close together 59
59. Tergites IV–VII with posteromarginal craspedum (Fig. 13) 60
-. Tergites without a craspedum on posterior margin 63
60. Metanotal median setae arise behind anterior margin (Fig. 56) ..... *Tusothrips*
-. Metanotal median setae arise at anterior margin 61
61. Ocellar setae pair I absent; fore tibia with tooth at inner apex (Fig. 9); sternite II with numerous very stout microtrichia ..... *Clypeothrips*
-. Ocellar setae pair I present (Fig. 51); fore tibia without an apical tooth 62
62. Head and pronotum both wider than long ..... *Craspedothrips*
-. Head longer than wide and projecting in front of eyes (Fig. 51)..... *Sorghothrips*
63. Tergite VIII posterior margin with well developed comb laterally, but widely interrupted medially (Fig. 30) 64
-. Tergite VIII posterior margin with no comb of microtrichia 65
64. Forewing first vein with a long row of about 16 setae at base then a gap before 2 or 3 setae near the wing apex (Fig. 44) ..... *Megalurothrips* [in part]
-. Forewing first vein with a short row of about 7 setae at base, then 3 setae widely spaced before the wing apex ..... *Tenothrips*
65. Ocellar setae III arising in line with posterior margins of posterior ocelli (Fig. 39) 66
-. Ocellar setae arising in more anterior position, rarely in between posterior ocelli 69
66. Pronotum and metanotum with markings inside reticulations..... *Watanabeothrips** [males]
-. Pronotum and metanotum with no marking between any major sculpture lines..... 67
67. Pronotum almost transverse, with many prominent transverse lines of sculpture (Fig. 39)..... *Paithrips*
-. Pronotum clearly trapezoidal, either with no sculpture or with very faint transverse lines 68
68. Pronotal posteromarginal setae S5 and S6 about 1.5 times as long as S2; pronotum with no transverse striae (Fig. 37) ..... *Okajimaella* [in part]
-. Pronotal posteromarginal setae S5 and S6 sub-equal to S2; pronotum with many very fine transverse striae (Fig. 52) ..... *Simulothrips*
69. Pronotum, with many strong sculpture lines ..... *Neocorynothrips**
-. Pronotum, also metanotum and ocellar triangle, without strong sculpture 70
70. Antennal segment I with two (or one) dorso-apical setae (Figs 37, 39)..... 71
-. Antennal segment I with no dorso-apical setae (Fig. 54) 72
71. Pronotum with one pair of long posteroangular setae ..... *Laplothrips**
-. Pronotum with two pairs of long posteroangular setae ..... *Trichromothrips*
72. Ocellar setae III more than twice as long as distance between posterior ocelli (Fig. 3)..... *Bathrips*
-. Ocellar setae III about as long as distance between posterior ocelli (Fig. 14) ..... *Danothrips*

Amomothrips Bhatti

The only species in this genus was described from Sumatra, although an apparently conspecific female was studied recently from near Kuala Lumpur. The genus appears similar to *Taeniothrips*, but ocellar setae pair I are present. It was distinguished by Bhatti (1978b) because there are seven pre-ocellar setae instead of the usual two setae. That is, ocellar setae pair II is duplicated on one side of the head, but commonly triplicated on the other side. This asymmetry, suggests that the character state is not a good indicator of

phylogenetic relationships. The holotype of a second species referred to this genus by Bhatti (1978b) has now been re-examined. As a result, the original combination is re-established, *Taeniothrips euophthalmos* Moulton **comb. rev.**, because this holotype has only one pair of pre-ocellar setae, with pair I absent (Fig. 57).

Anaphothrips Uzel

Almost 80 species are now recognised in this genus, many of which are associated with Poaceae. These thrips occur mainly in the Holarctic Region, although there are many endemic Australian species, and these include species associated with many different plant families (Mound & Masumoto, 2009). Several species are described from Indonesia, and *A. sudanensis* is widespread on grasses across the tropics and subtropics.

Aneurothrips Karny

Two species are placed in this genus, one from India and the other from Java, and these are reputed to induce leaf galls (Tree & Mound, 2009).

Arorathrips Bhatti

These species all breed in the florets of Poaceae, as do the species of *Chirothrips*. Eight species are placed in the genus, mainly from the Americas, but *A. mexicanus* is common and widespread around the tropics and subtropics (Hoddle et al., 2009), including Thailand and Indonesia.

Ayyaria Karny

The only species in this genus, *A. chaetophora*, is widespread between India and Tahiti, apparently breeding on unrelated species of plants, including soybean (*Glycine max*), marigold (*Tagetes*) and castor (*Ricinus communis*) (Wilson, 1975). The species is unusual in having one pair of long setae on the anterior margin of the pronotum, and in having reticulate sculpture on the tergites.

Bathrips Bhatti

Although three species are listed in this genus, it is possible that these all represent the same species, *B. melanicornis*, a species that is widespread between India and northern Australia. Little is known of its biology, but it is sometimes taken from vegetable crops. *Bathrips* species are similar in structure to the members of the genus *Trichromothrips*, but lack a pair of dorso-apical setae in the first antennal segment.

Bolacothrips Uzel

This genus includes 13 species from the Old World tropics, mainly between India, Taiwan and Australia, but with one from Europe. *Bolacothrips* species all breed in various species of Poaceae, including *Saccharum officinarum*. These grass-living species have the antennal sensoria simple, unlike species in the closely related genus *Thrips* in which the sensoria are forked.

Bregmatothrips Hood

This genus includes nine species, all of which live on grasses. Most of the described species are from Asia, but *B. venustus* is widespread around the world and is common in the Americas (Mound & Marullo, 1996). *Sorghothrips* is similar in structure, but has the antennal sensoria forked, not simple.

Ceratothripoides Bagnall

This genus comprises five Old World species (Mound & Nickle, 2009). One of these, *C. claratris*, is recorded as a tospovirus vector on tomatoes in Thailand, and one African species, *C. brunneus*, is now common in lowland Malaysia (Mound & Azidah, 2009). As in the related genus *Megalurothrips*, the first antennal segment bears a pair of dorso-apical setae.

Chaetanaphothrips Priesner

This is an Asian genus, related to *Danothrips*, and now includes 20 species. Several of these are widespread around the world, and are considered pests on orchids, bananas and, in Florida also of grapefruit. Two species are probably involved in the induction of leaf galls (Tree & Mound, 2009).

Clypeothrips Nonaka & Jangvitaya

The only species in this genus has a long slender head and body, and was described from bamboo in Thailand. The female is remarkable for having a curved spur at the apex of the fore tibia, and a curious patch of small stout tubercles on the second abdominal sternite.The male has a curved row of 5–10 small pore plates on the sternites.

Craspedothrips zur Strassen

Seven species from the Old World tropics are listed in this genus, with further undescribed species in the Asian and northern Australian regions. Members of this genus are characterised by the presence of three large sensoria on the fifth antennal segment, whereas not all of them have the tergal and sternal craspeda indicated by the generic name (Bhatti, 1995). *C. minor* has been seen from various countries between India and northern Australia. Few reliable host-plant records are available, but in Japanese quarantine this thrips is sometimes found in the flower buds of *Cassia siamea* [teste Masami Masumoto, 2009]. As in *Trichromothrips* genus-group (Masumoto & Okajima, 2005), the first antennal segment bears a pair of dorso-apical setae.

Danothrips Bhatti

Ten Asian species are now listed in this genus, one of which, *D. trifasciatus*, is widespread around the tropics, and has been associated with damage to grapefruit in Florida (Mound & Tree, 2007). The species of *Danothrips* are very similar to those of *Chaetanaphothrips* but have a less extensive area of specialised sculpture associated with the spiracles on the eighth tergite (Fig. 16).

Dendrothripoides Bagnall

The species in this genus have distinctively stout tergal microtrichia with broad bases (Fig. 17). Of the five known species, one is from southern Africa and four from Asia. One of the latter, *D. innoxius*, is widespread around the world on *Ipomoea* leaves (Mound & Marullo, 1996).

Dichromothrips Priesner

This Old World genus includes 18 described species, all of which appear to be associated with flowers of Orchidaceae. Males in this genus have two or three pore plates on several sternites (Mound, 2009b). *D. corbetti* is unusual within the genus in lacking long setae on the pronotum, and in having the metafurcal spinula weakly developed with diffuse margins. *D. smithi* is sometimes a pest on cultivated vanilla in India.

Echinothrips Morgan

This is a New World genus of seven species. One of these, *E. americanus*, the poinsettia thrips, is a leaf-feeding pest on various greenhouse plants in Europe as well as North America, and has been recorded as a pest of capsicums in the Netherlands. Specimens have been studied both from Thailand and Java.

Ernothrips Bhatti

Three species are included in this genus: one from Thailand, one from India, and the third widespread from India to Japan and Taiwan (Masumoto & Okajima, 2002). Closely related to the members of *Thrips* genus but with tergal and sternal craspeda (Fig. 19), these species appear to be flower-living and polyphagous.

Euphysothrips Bagnall

Two species are listed in this genus. Both are known from India but one is also recorded in many other countries. The forewing chaetotaxy is unique, with very long setae on the veins (Fig. 22).

Exothrips Priesner

A total of 19 species are listed in this genus. Most are from India, but five are from Africa and one from Europe. Bhatti (1975) provided a key to 10 species, and indicated that these are associated with Poaceae. Currently the genus is not distinguished satisfactorily from *Rhamphothrips*.

Filipinothrips Reyes

Closely related to *Craspedothrips*, only two species are described in this genus, one from the Philippines and one from Kuala Lumpur, where both sexes were found in the flowers of a species of *Xanthophyllum*. The sexual dimorphism in their antennae is remarkable (Tyagi et al., 2008), and the width of the inter-antennal process is also unusual (Fig. 23).

Frankliniella Karny

This is primarily a New World genus that currently totals 223 species, many of them in the Neotropics (Mound & Marullo, 1996). Four species are widely known as crop pests. In Malaysia, *F. occidentalis* and *F. intonsa* are common in the Cameron Highlands, whereas *F. schultzei* is more common in lowland tropical areas. These three species are all vectors of tospoviruses. *F. williamsi* is widespread on *Zea mays*. The members of this genus have a small pair of setae medially on the pronotal posterior margin between the major pair of posteromarginal setae (Fig. 24).

Fulmekiola Karny

The only species placed in this genus is effectively an aberrant species of the genus *Stenchaetothrips*, with well-developed craspeda (Fig. 26). Living on the leaves of sugar cane, *F. serrata* is now established in South Africa and the West Indies, although it is Asian in origin.

Indusiothrips Priesner

Two species are placed in this genus, one each from India and Japan, and both of these apparently feed on the spores of ferns (Okajima & Urushihara, 1993).

Isunidothrips Kudo

The only species placed in this genus was described from various unrelated plants near Kuala Lumpur, Malaysia, and also from Sarawak.

Javathrips Bhatti

The five species placed in this genus, from Yunnan (China), Java and Philippines, are only weakly distinguished from *Taeniothrips*.

Laplothrips Bhatti

The two species placed in this genus, one from northern India, and the other from Java, are unusual in having only one pair of long pronotal posteroangular setae.

Lefroyothrips Priesner

Of the four species listed in this genus, one is from Nigeria but the others from India and Java. *L. lefroyi* is known as a minor pest in the flowers of tea (*Camellia sinensis*).

Limothrips Haliday

This is a European genus of about eight species that breed on grasses (zur Strassen, 2003). *L. cerealium* is widely distributed in temperate areas around the world, and has been recorded from the island of Krakatau, Indonesia (zur Strassen, 1994).

Mecothrips Karny

This genus remains known from a single species that was collected in Java. According to the available descriptions (Priesner, 1938), the antennae are 7-segmented with forked sensoria, ocellar setae III are widely spaced outside the ocellar triangle near the margins of the compound eyes, and the sternites have an irregular row of discal setae. Unfortunately, no information is available on the presence of abdominal ctenidia.

Megalurothrips Bagnall

An Old World group of 13 listed species, the members of this genus all breed in the flowers of tropical Fabaceae, and some are pests of cultivated legumes (Palmer, 1987). One species is from Africa, but the others are all from Asia, including several described from China. *Megalurothrips* species all have a pair of dorso-apical setae on the first antennal segment, and on tergite VIII there is a patch of microtrichia anterior to the spiracle (Fig. 30).

Metaxyothrips Priesner

Two species are placed in this genus, both collected in Sumatra. They are unusual in having simple sensoria on the antennae, and in having the ovipositor unusually weak (Bhatti, 1978a).

Microcephalothrips Bagnall

The only species in this genus, *M. abdominalis*, is found throughout the warmer parts of the world in the flowers of various species of Asteraceae, particularly sunflowers (Mound & Marullo, 1996). Although a member of *Thrips* genus-group, it is remarkable for having setae on the prosternal basantra (Fig. 32).

Moundinothrips Bhatti

This generic name was proposed to replace *Moundothrips* Bhatti (1995), a name that was preoccupied. The only known species is based on a single female from Java that looks very like a long-headed species of *Taeniothrips*, but has a pair of dorso-apical setae on the first antennal segment, and the metafurca bearing a spinula.

Mycterothrips Trybom

A full account of the 27 species recognised in this genus worldwide is given by Masumoto & Okajima (2006). These are leaf-feeding thrips, and many of them have sexually dimorphic antennae. All species have a pair of dorso-apical setae on the first antennal segment.

Neocorynothrips Ramakrishna & Margabandhu

Only two species are known in this genus, one from India and the other from the Philippines. The pronotum is stated to have many closely spaced transverse striae; ocellar setae pair I are present but are as wide apart as pair II; and the pronotum has only one pair of rather short posteroangular setae (Bhatti, 2000).

Octothrips Moulton

Only three species, all Asian, are recognised in this genus. As a result of synonymy established by Wang (2008), the common species that lives on *Lygodium* ferns in Malaysia and Taiwan (Figs 34–36) is *O. bhatti*, described originally from India.

Okajimaella Nonaka & Jangvitaya

The two species placed in this genus were both described from bamboo in Thailand. They are part of a suite of closely related genera and species described from that plant. In particular, this genus is not distinguished adequately from *Simulothrips*.

Organothrips Hood

Of the three species in this genus, two are very similar and live under-water in the mucous surface layer of several aquatic plants, including water hyacinth (*Eichornia*). These thrips have been found in countries between India and Hawaii, as well as in an aquarium in Germany. The third species was described from grasses in northern Australia, and has the fore tibial spur bifurcate, not fimbriate as in the other two species (Mound, 2000).

Oxyrhhinothrips Priesner

Only one species is currently recognised in this genus, from Sumatra. This is a member of the *Thrips* genus-group, but with tergal craspeda as in *Ernothrips*, and a remarkably long mouth cone. A second species is sometimes listed in the genus, from India, but cannot be recognised from its description (Bhatti, 1980).

Paithrips Nonaka & Jangvitaya

Only one species is known in this genus, taken from bamboo in Thailand and West Malaysia. The genus is closely related to the other Thripinae taken from bamboo in this area, *Okajimaella* and *Simulothrips*.

Parabaliothrips Priesner

A total of six leaf-feeding species are recognised in this genus, and these have been found in countries between Japan, Malaysia and eastern Australia (Gillespie et al., 2002). The genus is considered to be closely related to the genus *Frankliniella* (Mound, 2002).

Plutonothrips Priesner

Two species are placed in this genus, one from India and one from Sumatra. The genus is presumably close to *Tusothrips* in view of the tergal and sternal craspeda and the structure of the male ninth tergite. However, in a redefinition of *Arathrips* Bhatti, a genus now considered a synonym of *Plutonothrips*, there are two confusing statements. The females of the type species are stated to have on the eighth tergite a "weakly developed comb having a few microtrichia" and illustrated as having a complete but sparse posteromarginal comb, but the generic definition on the previous page states that tergites II–VIII have a "continuous posteromarginal flange" (Vijay Veer & Chauhan, 1983).

Priesneriola Ananthakrishnan

Only one species is described in this genus. Described from India where it appears to be widespread, this is a grass-living thrips with 6-segmented antennae (Fig. 10). It is also recorded from South Africa, Niger, and Cape Verde (Bhatti, 1990), and has been intercepted in quarantine in Australia.

Projectothrips Moulton

The eight described species in this genus are all associated with the flowers of *Pandanus* species in countries between India, Japan, Hawaii and northern Australia. These species have a curiously elongate eighth antennal segment (Fig. 4).

Pseudanaphothrips Karny

The eleven species in this genus are restricted mainly to Australia, but with two species recorded from Java. *P. achaetus* is widespread, and presumably has been distributed by the horticultural trade (Hoddle et al., 2009). This species has no long setae on the pronotum, whereas the other members of the genus have two pairs of long posteroangular setae. The genus is considered to be sister-genus to *Frankliniella* (Mound, 2002).

Pteridothrips Priesner

The only species in this genus is related to the *Trichromothrips* genus-group (Masumoto & Okajima, 2005) in having a pair of dorso-apical setae on the first antennal segment, but is unusual in having one pair of

long pronotal posteroangular setae that are flattened and fringed around the apex (Fig. 42). Described from Java, this thrips has been taken from the rolled leaves of an aquatic fern in a greenhouse in Germany.

Ranjana Bhatti

This genus comprises only a single species, described from Java but subsequently recorded from the Philippines (Reyes, 1994). A spinula is present on both the meso and metafurca, and tergites VII–VIII have a posteromarginal fringe of small microtrichia arising from a craspedum.

Rhamphothrips Karny

Although there are 14 species listed in this genus, particularly from Africa and India but with two from Java, these thrips are difficult to identify. Bhatti (1978c) provided a key to nine of the species, however the genus is not distinguished satisfactorily from *Exothrips*. In both genera the tergites and sternites bear craspeda (Fig. 46), the head is small, the pronotal major setae are scarcely twice as long as the discal setae, and ocellar setae III are usually within the ocellar triangle. In at least one Asian species, the males vary greatly in size and large males have grossly enlarged fore legs (Tyagi et al., 2008).

Salpingothrips Hood

Although the type species of this genus was described from Panama, it seems likely that all three known species are from Asia (Mound & Marullo, 1996). One species was described from India, but although *S. aimotofus* was described from Japan it is now known from northern Australia as well as Florida and Georgia. This species appears to breed on leaves of the legume kudzu (*Pueraria*), and is likely to be found in Southeast Asia.

Sciothrips Bhatti

This genus includes a single species with a distinctively elongate head (Fig. 45). It breeds on the cultivated spice plant, cardamom (*Elettaria cardamomum*), and although originally from India, it is also known from southern China and Costa Rica (Mound & Marullo, 1996).

Scirtothrips Shull

One hundred described species are listed in this genus, from many different parts of the world including Australia (Hoddle & Mound, 2003). Several species are serious crop pests in different parts of the world. However, in much of South East Asia only *S. dorsalis* is found commonly (Figs 48, 49), despite several other species being known from this area (Masumoto & Okajima, 2007).

Scolothrips Hinds

There are 18 species listed in this highly characteristic genus (Fig. 50), all apparently predatory on mites. However, there have been no studies on colour and structural variation within and between populations, and identification of most of the species is difficult. One Asian species, *A. asura*, is remarkable for having bright red internal pigment. A key to the species from Europe was provided by zur Strassen (2003).

Siamothrips Okajima

Described from a single species taken on egg-plant in Thailand, a second species of this genus was collected recently in Malaysia. The genus appears to be related to *Scirtothrips* genus-group, but the pronotum has complex sculpture (Fig. 53), and the sternites have a posteromarginal fringe of microtrichia.

Simulothrips Nonaka & Jangvitaya

In describing this new genus for a single species from Thailand taken on bamboo, the original authors did not attempt to distinguish it from *Okajimiella* that they described from the same plant and locality. The differences quoted in the key above scarcely warrant recognition of two genera. The Thripinae species swarm

on “bamboo” in South East Asia merits detailed field studies. Currently there is no biological information for any of the species that would help explain the remarkable radiation.

Smeringothrips Priesner

This genus includes a single species that was collected in Java, but which appears to have been based on a single female. Using character states given in the original description this species will run through the key provided above to *Okajimaella*.

Sorghothrips Priesner

Four species are listed in this genus, two from India, one from Taiwan, and one from Egypt. The head is prolonged in front of the eyes (Fig. 51), ocellar setae pair I are present, the metanotal median setae arise at the anterior margin of the sclerite, and the tergites bear an inconspicuous posteromarginal craspedum. The species share many character states with the species of *Bregmatothrips*.

Sphaeropothrips Priesner

This genus includes a single grass-living species that has been recorded widely, including from Europe, Iran, India, and southern Japan (Minaei et al., 2007). It shares most character states with members of *Thrips* genus, but lacks a seta on the dorsal surface of the second antennal segment (Fig. 54).

Stenchaetothrips Bagnall

This is an Old World, predominantly Asian, genus that now includes 32 species, all of which breed on species of Poaceae. The rice thrips, *S. biformis*, is particularly widespread in the Asian region, and has been introduced to other parts of the world. The metanotum of thrips in this genus is generally longitudinally striate, and ocellar setae II are unusually long (Fig. 55), but other character states are shared with species of the genus *Thrips*.

Taeniothrips Amyot & Serville

Although more than 20 species are listed in this genus (together with another 20 described from fossils), with seven from Indonesia and two from China, recognition of many of these is difficult. The species in this genus are very similar to those listed in *Javathrips*, with a long and regular comb on tergite VIII, no ocellar setae pair I (Fig. 58), and no spinula on the metafurca.

Takethrips Nonaka & Jangvitaya

This genus of two species is one of a suite of closely related genera all from bamboo in Thailand. In *Takethrips* the pronotal posteroangular setae are short, and the antennal sensoria are simple, not forked.

Tenothrips Bhatti

This genus comprises about 12, mainly European, species. However, one species has been described from the Philippines, and *T. frici* is widespread in temperate regions around the world, living in the flowers of weedy Asteraceae flowers (Hoddle et al., 2009).

Thrips Linneaeus

Including more than 280 species, this is the largest Thysanoptera genus. Most species are flower-living, although a few appear to breed mainly on leaves. There are many species of the genus in Asia (Palmer, 1992), and recent experience suggests that many species remain undescribed (Mound & Azidah, 2009).

Trachynotothrips Masumoto & Okajima

Two species are placed in this genus, from Thailand and southern Vietnam. They are remarkable for the presence of a long, bifurcate endofurca in the metathorax.

Trichromothrips Priesner

Including species that were at one time placed in *Dorcadothrips*, this genus now includes 33 species, mainly from Asia. Bhatti (2000) has provided a key to 27 of these species, and Masumoto & Okajima (2005) provided a key to the 17 genera now considered members of the *Trichromothrips* genus-group.

Tusothrips Bhatti

Six species are listed in this genus, occuring between India, southern China and the Philippines, but little is known of their biology. The tergites and sternites have a broad marginal craspedum, and males have a horn-like process on tergite IX that bears a pair of stout setae, character states that occur also in *Plutonothrips* species. A related genus, *Cyrilthrips*, has been described from eastern Australia, inducing leaf galls (Tree & Mound, 2009).

Watanabeothrips Okajima

Described from Thailand, the sexual dimorphism of the body setae in the only species in this genus is remarkable. Females have flattened fan-shaped setae, whereas males have setaceous setae. It shares with members of the *Trichromothrips* genus-group the presence of a pair of dorso-apical setae on antennal segment I, but the head has a paired row of three setae anterolateral to the first ocellus.

Yoshinothrips Kudo

Although the two species in this genus that were described from Japan were taken on grasses, the third species was from bamboo in Thailand, and the genus is likely to be related to the other bamboo thrips from that country. Antennal segment I has a pair of dorso-apical setae, and although the sensoria on antennal segment III are simple, on segment IV they are either simple or forked.

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