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A new genus of Thripinae (Thysanoptera, Thripidae) collected from *Pandanus* in Japan, Malaysia and Australia, with three new species

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Abstract

Pandanothrips **gen. n.** is described, with three new species inhabiting *Pandanus*: *P. ryukyuensis* **sp. n.** from Japan, *P. wangi* **sp. n.** from Malaysia, and *P. hallingi* **sp. n.** from Australia. This new genus shows no relationship to *Projectothrips* Moulton, the only other Thripinae genus known to be associated with *Pandanus*. *Pandanothrips* is superficially similar to *Danothrips* Bhatti, a genus of leaf feeding thrips. The morphological relationships among these genera are discussed, and an illustrated key to the species of *Pandanothrips* is provided.

Key words: Thysanoptera, Thripidae, *Pandanus*, *Pandanothrips*, Japan, Malaysia, Australia

Introduction

The plant genus *Pandanus* is one of four genera in the Pandanaceae, and comprises 600 species of small to medium sized shrubs and trees that are native to Old World tropical and subtropical areas (Susanti & Miyamoto 2009). Many species of this genus are grown widely, with several species planted in various public areas such as community gardens, schools, and house yards. *P. amaryllifolius* or fragrant pandan is one of the most important ingredients for traditional dishes in the Asia Pacific area, because of its sweet and pleasant aroma. In Japan, three species are native, *P. odoratissimus*, which is widespread in Southeast Asia to Ryukyu Islands and Pacific Islands, *P. boninensis*, which is endemic to Ogasawara Islands, and *P. daitoensis*, which is endemic to Daito Islands. Moreover, *P. centrifugalis* (= *P. concretus concretus*) was introduced to Chichi-jima Island in Ogasawara Islands although originally from Madagascar (Susanti & Miyamoto 2009). Beside these species, several other species such as *P. utilis* that is originally from Madagascar, are also planted in parks or along the road-side in the Ryukyus, and *P. boninensis* is also artificially found in the Ryukyus.

Previously, the only thrips genus known to be associated with the flowers of *Pandanus* was *Projectothrips* Moulton, with nine species from the Oriental and Pacific Regions (Bhatti 1973; Mound & Ng 2009; Mound & Tree 2011). This genus is distinctive because of its unusually long antennal segment VIII, and a series of many microsetae on the paramere of the male genitalia (Bhatti 1973).

In 2009, Masumoto had an opportunity to observe a poorly mounted female of unknown thripine species collected from *P. utilis* in Miyako-jima Island, Ryukyus. Thereafter, good series of this species was collected from the flowers and young fruit of *P. boninensis* planted along the road-side in Okinawa-hontou Island, Ryukyus. Moreover, shortly after this further species of the same genus were collected from *Pandanus* in Malaysia and Australia. In this paper, we describe from *Pandanus* a new genus, *Pandanothrips* **gen. n.**, together with three new species: *P. hallingi* **sp. n.** from Australia, *P. ryukyuensis* **sp. n.** from Japan and *P. wangi* **sp. n.** from Malaysia.

Materials and methods

All slides studied were mounted into Canada Balsam after dehydration through a series of ethanol. We had an opportunity to study Australian slides that had been prepared using Hoyers medium, and these were remounted through the same process. The slides were studied using microscope, with 100–600 magnification, and were measured using a micrometer eyepiece. Depository abbreviations of specimens examined are: ANIC (Australian National Insect Collection, CSIRO), CISUKM (Centre for Insect Systematics, UKM), TUA (Tokyo University of Agriculture, Atsugi, Japan). The following abbreviations are also used: CPS (campaniform sensillum), MD (mid-dorsal). All measurements are given in microns.

Pandanothrips gen. n.

Type species: *P. ryukyuensis* sp. n.

Female macropterous (Figs 1, 13, 23). Head (Fig. 15) with interantennal projection slightly wide; mouth-cone short, rounded at apex, with 3-segmented maxillary palpi. Ocellar setae I present, setae II lateral or posterolateral to setae III and near compound eye, setae III lateral to fore ocellus. Six pairs of postocular setae, parallel to compound eye but setae II mesad of setal row. Antennae (Fig. 4) 8-segmented, segment I without median dorsal apical setae, III and IV with sensoria forked, III–VI with some rows of microtrichia on both dorsal and ventral surfaces. Pronotum with two pairs of long posteroangular setae. Mesonotum (Fig. 5) with median pair of setae far from posterior margin. Metascutum with median pair of setae at or close to anterior margin. Prosternal ferna divided medially; basantra weakly thickened (Fig. 18). Prospinasternum broad and transverse. Mesosternum with sternopleural sutures complete. Spinula present on mesosternal endofurca but absent from metasternum. Fore wing (Figs 1, 19, 30) first vein without or with long gap in setal row, second vein with 7–10 setae irregularly spaced; clavus with one discal setae other than veinal setae; posteromarginal cilia undulated. Fore tibia with two inner apical setae slightly stout; tarsi 2-segmented. Abdominal tergites and sternites without posteromarginal craspeda; tergites without ctenidia; tergite VIII with a few microtrichia anterolateral to spiracles, with posteromarginal comb present at least laterally; tergite X with longitudinal median split distally; sternites II–VII with three pairs of posteromarginal setae, all setae arising from posterior margin (Fig. 9); pleurotergites without discal setae. Ovipositor developed. Male macropterous or micropterous (Figs 10, 14, 29); abdominal tergite IX without stout setae (Figs 11, 21, 32), sternites III–VII each with a pore plate (Figs 12, 22, 33).

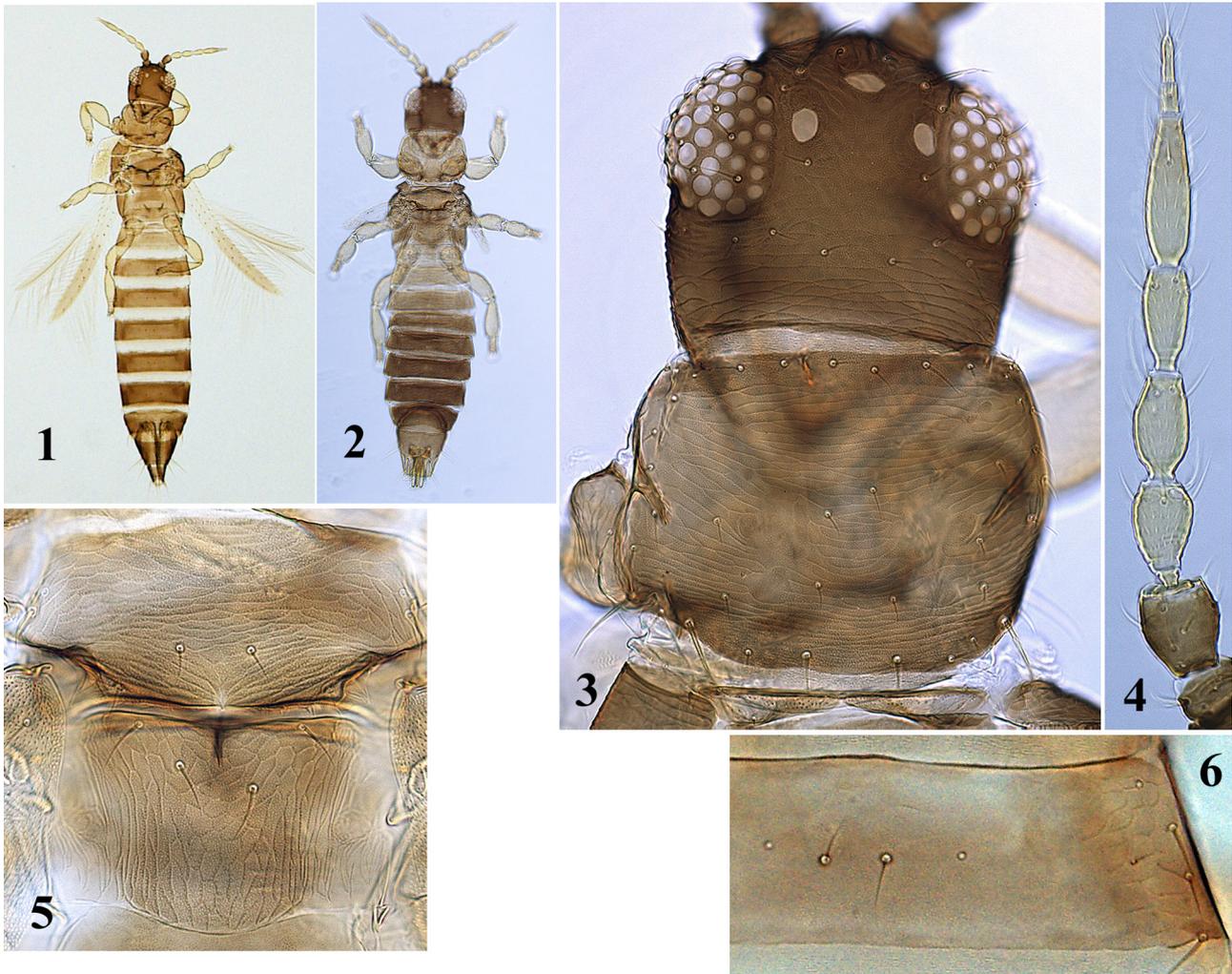
Comments. The position of ocellar setae II in this new genus is unique. In Thripidae, these setae are usually situated lateral to or anterior to fore ocellus and are not posterior to ocellar setae III (interocellar setae). However, in this new genus ocellar setae II are usually situated behind ocellar setae III. Previously, only the genus *Projectothrips* Moulton has been known to be associated with *Pandanus* flowers. Among Thripinae, *Projectothrips* is unique in having antennal segment VIII distinctly elongate with numerous microtrichia, in contrast to the antenna of *Pandanothrips*. This new genus is superficially similar to *Danothrips* Bhatti, an Oriental genus of leaf feeding species. *Danothrips* is probably closely related to *Chaetanaphothrips* because of the presence of a small stippled area around each spiracle on abdominal tergite VIII, but *Pandanothrips* has no such areas on tergite VIII. Moreover, *Pandanothrips* can be distinguished from *Danothrips* by having the pronotum without depressions anterolaterally and male tergite IX without stout setae. This new genus is thus not related to either *Danothrips* or *Projectothrips*, and its systematic relationship remain unclear.

Key to *Pandanothrips* species

1. Metascutum with median pair of setae far from anterior margin; abdominal tergites IV–VI with median pair of setae close to each other and between median CPS, distance between setae subequal to their length (Fig. 7); female abdominal tergite VIII posteromarginal comb absent medially (Fig. 8); basantra without setae; male with fore wing shorter than width of thorax (Fig. 2), abdominal tergites with small scallops along posterior margins, without posteromarginal comb on VIII (Fig. 11). *hallingi* sp. n.
- . Metascutum with median pair of setae at or close to anterior margin; abdominal tergites IV–VI with median pair of setae wide apart from each other and not between median CPS, distance between setae greater than their length; female abdominal tergite

- VIII with posteromarginal comb medially, even if microtrichia small medially (Figs 20, 31); basantra with setae (Figs 18, 26); male with fore wing at least longer than width of thorax (Figs 14, 24), abdominal tergites without scallops along posterior margins, with posteromarginal comb on VIII (Figs 21, 32) 2
2. Fore wing (Figs 13, 14) first vein without distinct gap in setal row (Fig. 19); mid and hind femora dark; male macropterous, with body bicoloured, head dark, abdominal segments IV–VII dark medially (Fig. 14), pore plates on abdominal sternites 48–50 microns wide (Fig. 22)..... *ryukyuensis* sp. n.
- . Fore wing (Figs 29, 30) first vein with distinct gap in setal row, 2 setae distally near apex (Fig. 30); all legs pale; male hemimacropterous, with body uniformly pale, head and abdominal segments pale (Fig. 24), pore plates on abdominal sternites 25–38 microns wide (Fig. 33). *wangi* sp. n.

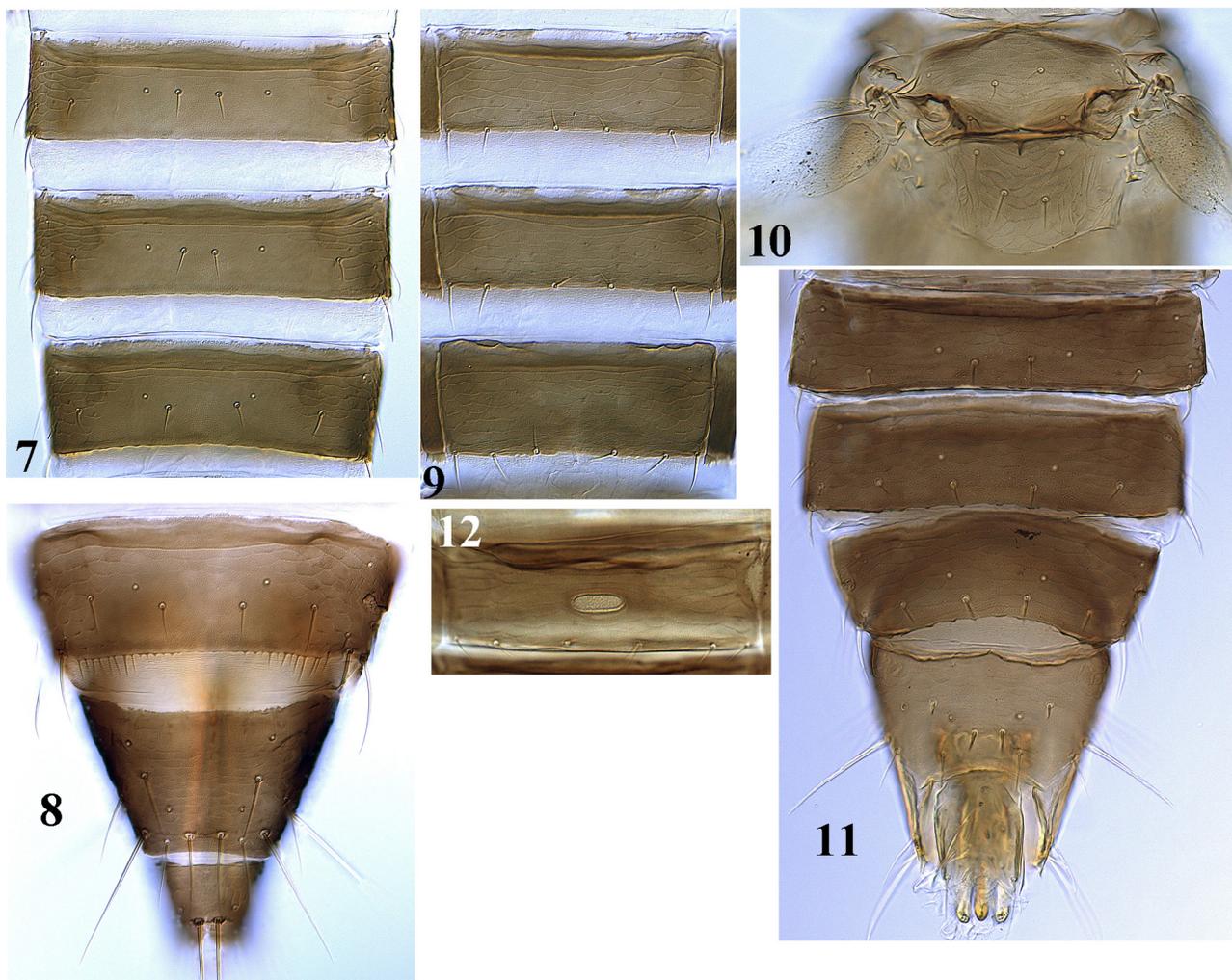
***Pandanothrips hallingi* sp. n.**
(Figs 1–12)



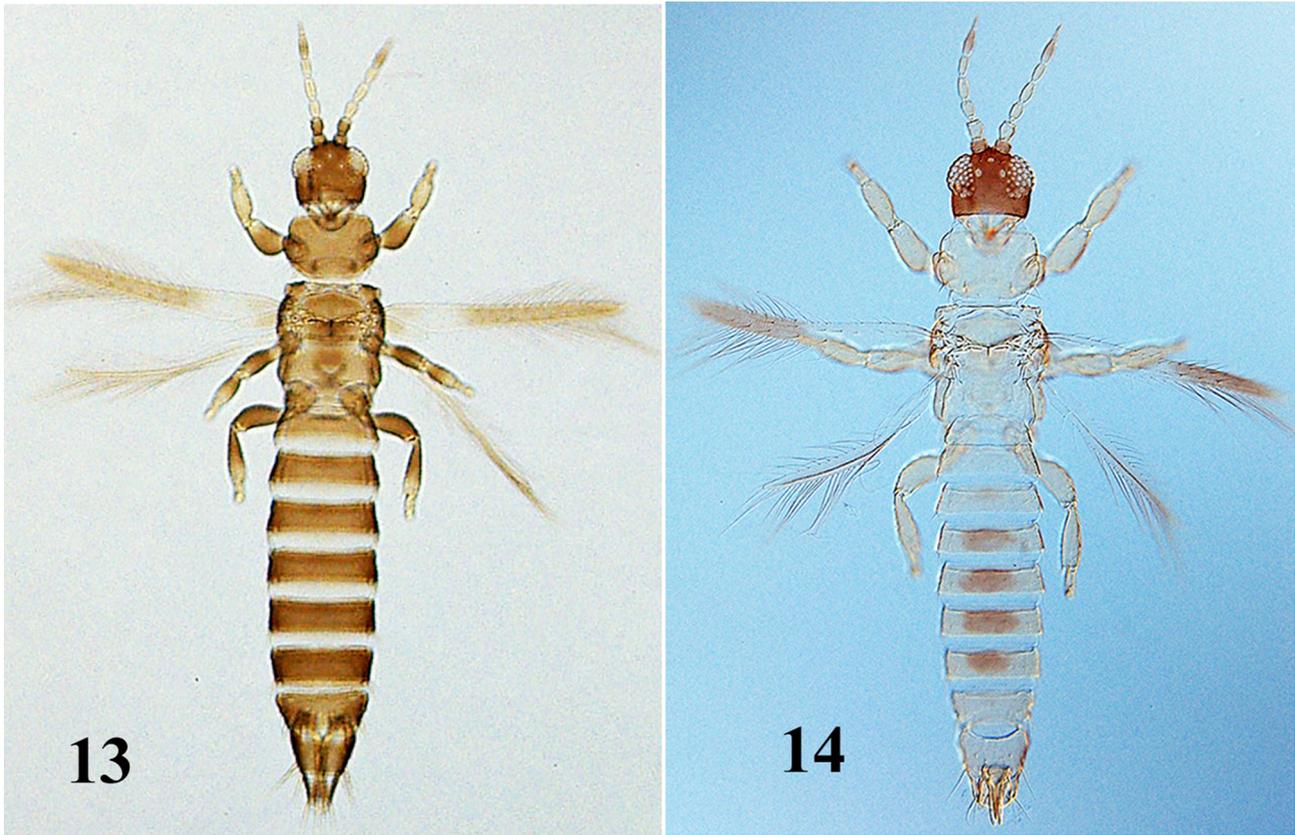
FIGURES 1–6. *Pandanothrips hallingi*. (1) Female; (2) Male. Female. 3–6: (3) Head & pronotum; (4) Antenna; (5) Mesonotum & metascutum; (6) Tergite II.

Female macroptera (Fig. 1). Distended body length 1.2–1.4 mm. Body uniformly brown; fore wing brown with basal half pale and extreme base weakly shaded, clavus pale but shaded at extreme base; all legs yellow; antennal segments (Fig. 4) I–II brown, III to basal half of VI yellow, distal half of VI–VIII weakly shaded; prominent body setae weakly shaded. Head (Fig. 3) 0.7–0.8 times as long as wide, almost straight at cheeks, weakly sculptured at middle between fore ocellus and tangent of posterior margin of compound eyes, sculptured with transverse anastomosing striae behind postocular setal row, slightly rugose on pre-ocellar area. Ocellar setae II posterolateral to setae III, setae III lateral to fore ocellus and shorter than distance between hind ocelli. Antennal segment II without microtrichia, III–VI tapering to apex but without neck, IV–VI pedicelate, sensoria on III and IV reaching

basal third of each succeeding segment, VI the longest. Antennal segments I–VIII ratio length/width as follows: 0.7, 1.1–1.2, 1.6–2.0, 1.8–2.0, 2.2, 3.2–3.3, 1.6–2.3, 4.0–4.7. Pronotum (Fig. 3) about 0.8 times as long as wide, sculptured with transverse anastomosing striae, with 13–15 discal setae; posteroangular setae I (inner pair) 0.3–0.4 times as long as pronotal median length and much longer than setae II (outer pair). Mesonotum (Fig. 5) sculptured with slightly narrowly spaced anastomosing striae; anteromedian CPS absent. Metascutum reticulate medially; median pair of setae behind anterior margin, 0.2–0.3 times as long as metascutal median length; CPS absent. Prosternal basantra without setae. Fore wing costal vein with 17–22 setae, first vein without long gap in setal row, with 11–14 setae, second vein with 8–12 setae; clavus usually four veinal setae. Abdominal tergites (Fig. 7) smooth medially, a few lines of sculpture across the tergites in front of median setae, laterally with sculpture not reaching to median CPS on III–VI; median pair of setae (S1) subequal to or slightly longer than their intervals on II–VI, situated between median CPS on II–VI or VII; tergite II (Fig. 6) with three lateral marginal setae, setae II (S2) close to lateral margin and vestigial; tergite VI–VIII with S4 setae reduced to small; tergite VIII (Fig. 8) with posteromarginal comb at each side; tergite IX with both anterior and posterior pair of CPS; sternites without discal setae.



FIGURES 7–12. *Pandanothrips hallingi*. Female 7–9: (7) Tergites V–VII; (8) Tergites VIII–X; (9) Sternites V–VII. Male 10–12: (10) Meso & metanota; (11) Tergites VI–X; (12) Sternite V.



FIGURES 13–14. *Pandanothrips ryukyuensis*. (13) Female; (14) Male.

Measurements of holotype female. Distended body length 1440. Head length 117, width across cheeks 148; compound eye dorsal length 73, width 43. Ocellar setae III length 37–40, interval 48. Pronotum median length 138, width 178; posteroangular setae I 42–50, setae II 34–38. Metascutal median length 70, median setae 15. Fore wing length 570, width at middle 45. Ovipositor length 230. Antennal segments I–VIII length (width) as follows: 20 (29), 33 (28), 40 (20), 36 (20), 35 (16), 53 (16), 11 (5), 15 (4). Sensoria length on antennal segments III and VI 23 and 31.

Male microptera (Fig. 2). Distended body length about 0.9 mm. Body colour similar to female but antennal segments VI–VIII much paler. Metascutal median setae situated medially (Fig. 10). Abdominal tergites (Fig. 11) with S1 and S2 setae near posterior margins; tergites IV–VIII with small scallops along posterior margins and no microtrichia; sternites III–VI each with oblong pore plates (Fig. 12), pore plates 20–23 microns width.

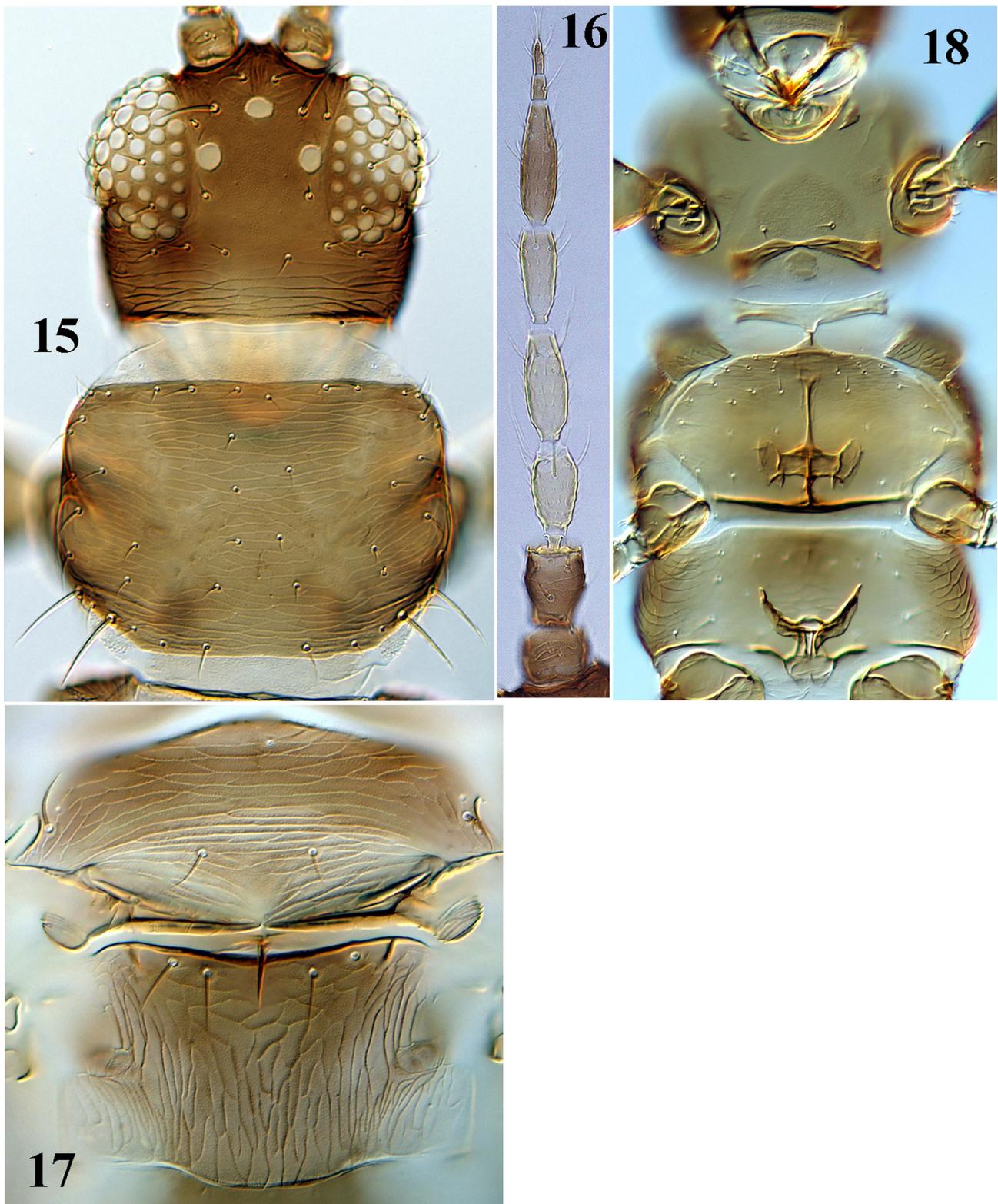
Measurements of paratype male. Distended body length 880. Head length 93, width across cheeks 128; compound eye dorsal length 60, width 38. Ocellar setae III length 34–35, interval 35. Pronotum median length 100, width 150; posteroangular setae I 40–41, setae II 40–44. Metascutal median length 53, median setae 21–24. Fore wing length 140, width at middle 40. Antennal segments I–VIII length (width) as follows: 20 (28), 25 (26), 30 (20), 28 (18), 30 (15), 44 (15), 6 (6), 15 (5). Sensoria length on antennal segments III and VI 10 and 13.

Type series. AUSTRALIA. Holotype female, Western Australia, Cape Leveque, on *Pandanus* fruits, 11.xi.2009, Luke Halling. Paratypes: 4 females 1 male collected with holotype. The type series is deposited in ANIC.

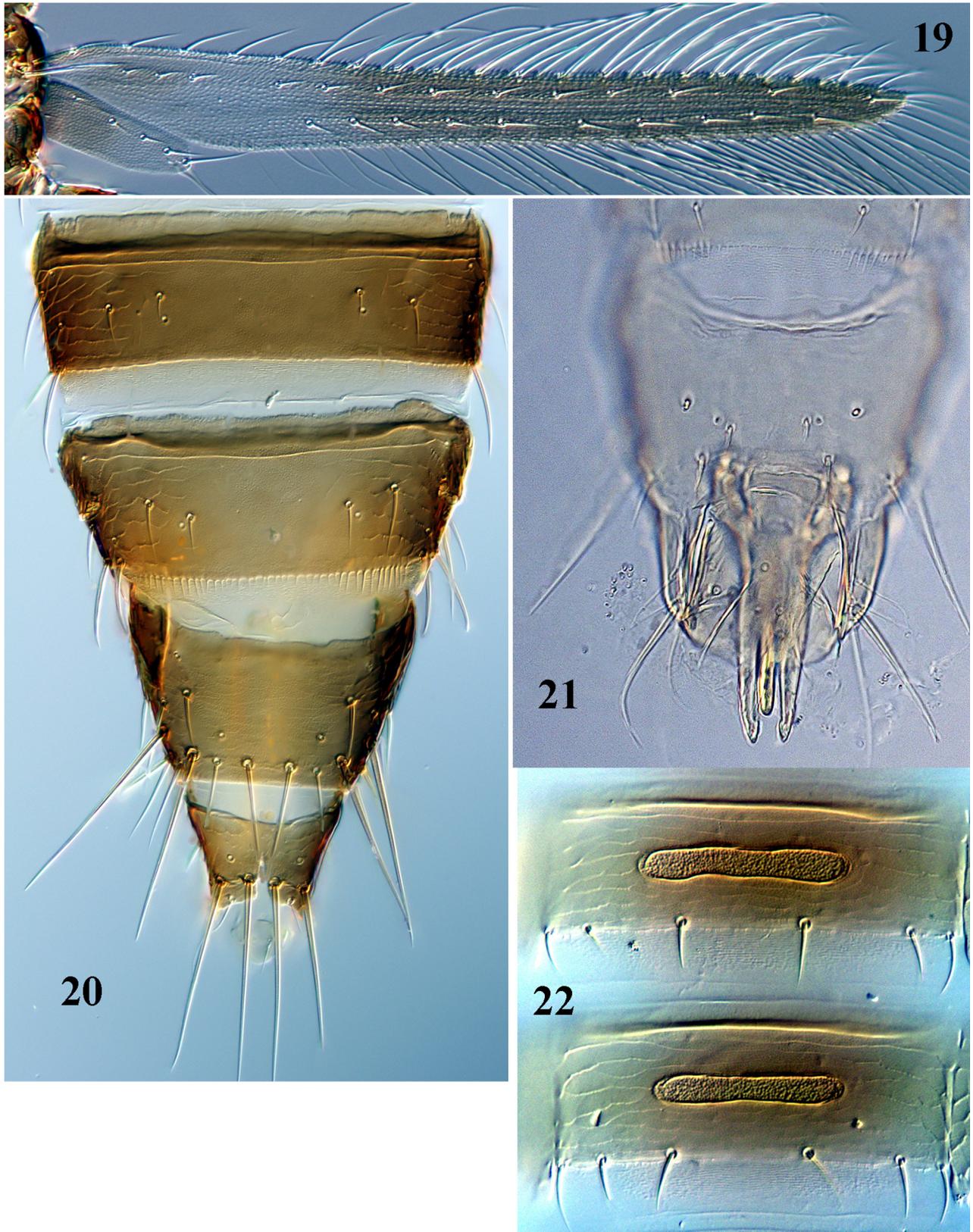
***Pandanothrips ryukyuensis* sp. n.**
(Figs 13–22)

Female macroptera (Fig. 13). Distended body length 1.3–1.5 mm. Body uniformly brown; fore wing (Fig. 19) brown with subbasal area pale, clavus brown with apex pale; all femora brown, fore tibiae yellow, mid and hind tibiae brown with apices yellowish, all tarsi yellow; antennal segments I–II brown, III–V yellow, VI–VIII pale

brown (Fig. 16); prominent body setae slightly shaded or yellowish brown. Head (Fig. 15) 0.7–0.8 times as long as wide, rounded at cheeks, smooth at middle between fore ocellus and tangent of posterior margin of compound eyes, sculptured with transverse anastomosing striae behind postocular setal row, slightly rugose on pre-ocellar area.



FIGURES 15–18. *Pandanothrips ryukyuensis*. Female. (15) Head & pronotum; (16) Antenna; (17) Mesonotum & metascutum; (18) Pro-, meso- and metasterna.



FIGURES 19–22. *Pandanothrips ryukyuensis*. Female 19–20: (19) Fore wing; (20) Tergites VII–XI. Male 21–22: (21) Tergites VIII–X; (2) Sternites VI–VII.

Ocellar setae II lateral to or posterolateral to setae III, setae III slightly shorter than distance between hind ocelli. Antennal segment II without microtrichia, III–VI tapering to apex but without neck, III–VI pedicelate, sensoria on III and IV elongate and reaching near middle of each succeeding segment, VI the longest. Antennal segments I–VIII ratio length/width as follows: 0.8–0.9, 1.1–1.2, 1.9, 2.4–2.6, 2.0–2.5, 3.2–3.3, 1.6, 3.0–4.0. Pronotum (Fig. 15) 0.7–0.8 times as long as wide, sculptured with transverse anastomosing striae, with 17–21 discal setae; posteroangular setae I 0.3–0.4 times as long as pronotal median length and usually much longer than setae II. Mesonotum (Fig. 17) sculptured with slightly narrowly spaced anastomosing striae; anteromedian CPS present (in holotype only one CPS present). Metascutum irregularly reticulate or sculptured with longitudinal anastomosing striae; median pair of setae close to or at anterior margin, 0.3–0.4 times as long as metascutal median length; CPS absent. Prosternal basantra with pair of setae (Fig. 18). Fore wing costal vein with 19–25 setae, first vein with 12–15 setae; clavus usually with five (rarely six or four) veinal setae. Abdominal tergites (Fig. 20) smooth medially, laterally with sculpture not reaching to median CPS on II–VII, with weak microtrichia along sculpture, median pair of setae very small and not situated between median CPS on III–VI; tergite II with three lateral marginal setae, setae II close to lateral margin and much longer than median setae; tergite VI–VIII with S4 setae reduced to small; tergite VIII with posteromarginal comb usually complete, but microtrichia often vestigial or small medially; tergite IX with both anterior and posterior pair of CPS; sternites without discal setae.

Measurements of holotype female. Distended body length 1530. Head length 118, width across cheeks 150; compound eye dorsal length 83, width 48. Ocellar setae III length 34–35, interval 35. Pronotum median length 130, width 188; posteroangular setae I 40–41, setae II 40–44. Metascutal median length 68, median setae 21–24. Fore wing length 550, width at middle 50. Ovipositor length 230. Antennal segments I–VIII length (width) as follows: 25 (30), 28 (28), 38 (20), 45 (18), 38 (18), 50 (15), 10 (6), 15 (13). Sensoria length on antennal segments III and VI 33–38 and 33–35.

Male macroptera (Fig. 14). Distended body length about 1.1mm. Body largely yellow but head brown, abdominal tergites IV–VII brown at median half, tergite III shaded at middle; antennal segments II–V and base of VI yellow, I and distal area of VI–VIII pale brown; fore wing brown with subbasal half and extreme apex pale; all legs yellow. Pronotal posteroangular setae I much longer than setae II. Abdominal tergite VIII with posteromarginal comb complete but often reduced to small medially; sternites III–VII each with oblong pore plates (Fig. 22), 48–50 microns wide.

Measurements of paratype male. Distended body length 1100. Head length 105, width across cheeks 130; compound eye dorsal length 73, width 48. Ocellar setae III length 34–35, interval 35. Pronotum median length 113, width 165; posteroangular setae I 37–44, setae II 29–32. Metascutal median length 60, median setae 16–18. Fore wing length 430, width at middle 35. Antennal segments I–VIII length (width) as follows: 23 (28), 28 (25), 35 (19), 35 (18), 33 (15), 43 (15), 8 (6), 15 (5). Sensoria length on antennal segments III and VI 18 and 23.

Type series. JAPAN. Holotype female, Okinawa-hontou Is., Naha City, Ashimine, on flower of *Pandanus boninensis*, 23.ix.2011, T. Ikeshiro & Y. Tsuyoshi. Paratypes: 5 females, 2 males collected together with holotype. Okinawa-hontou Is., Naha City, Kagamizu, 11 females on flower & young fruit of *P. boninensis*, 16.vi.2011, K. Sotokawachi & Y. Tsuyoshi; 10 females on flower of *P. boninensis*, 30.v.2012, T. Ikeshiro & Y. Tsuyoshi. The holotype and most paratypes are deposited in TUA.

***Pandanothrips wangi* sp. nov.**

(Figs 23–33)

Female macroptera (Fig. 23). Distended body length 1.1mm. Body bicoloured, head and abdominal segment III–X slightly darker; fore wing pale at subbasal and extreme apical areas, clavus dark at extreme base; all legs yellow; antennal segments I–II shaded, III–V yellow, VI–VIII slightly shaded (Fig. 27); prominent body setae pale brown. Head (Fig. 25) 0.6 times as long as wide, slightly convex at cheeks, ocellar triangular area smooth, pre-ocellar area slightly rugose, post-ocellar area with irregular transverse striae. Ocellar setae III shorter than distance between hind ocelli. Antennal segment II without microtrichia, III–VI normal not tapering apically, sensoria on III and IV elongate and reaching near middle of each succeeding segment, VI the longest. Antennal segments I–VIII ratio length/width as follows: 0.5–0.6, 0.9–1.1, 1.7–1.9, 1.9–2.1, 2.0–2.2, 3.0–3.1, 1.1–1.3, 3.8–4.0. Pronotum (Fig. 25) 0.7 times as long as wide, sculptured with transverse anastomosing striae, with about 12–16 discal setae;

posteroangular setae I about 0.4 times as long as pronotum length and much longer than setae II. Mesonotum (Fig. 28) sculptured with slightly narrowly spaced anastomosing striae; anteromedian CPS present (one specimen with only right CPS present); metascutum median and submedian setae subequal, about 0.3 times as long as metascutal median length; CPS absent. Prosternal basantra with a pair of setae (Fig. 26). Fore wing (Fig. 30) first vein with 8+2 setae, second vein with 7 setae. Abdominal tergites (Fig. 31) smooth medially, tergites II–VII with lateral sculpture not reaching to median CPS, with minute microtrichia along sculpture; tergite II with three lateral marginal setae (in Holotype only with 2 pair lateral setae, pair II absent), setae II close to lateral margin; tergite VIII with posteromarginal comb complete but microtrichia small on median third; tergite IX with both anterior and posterior pair of CPS; sternites without discal setae.

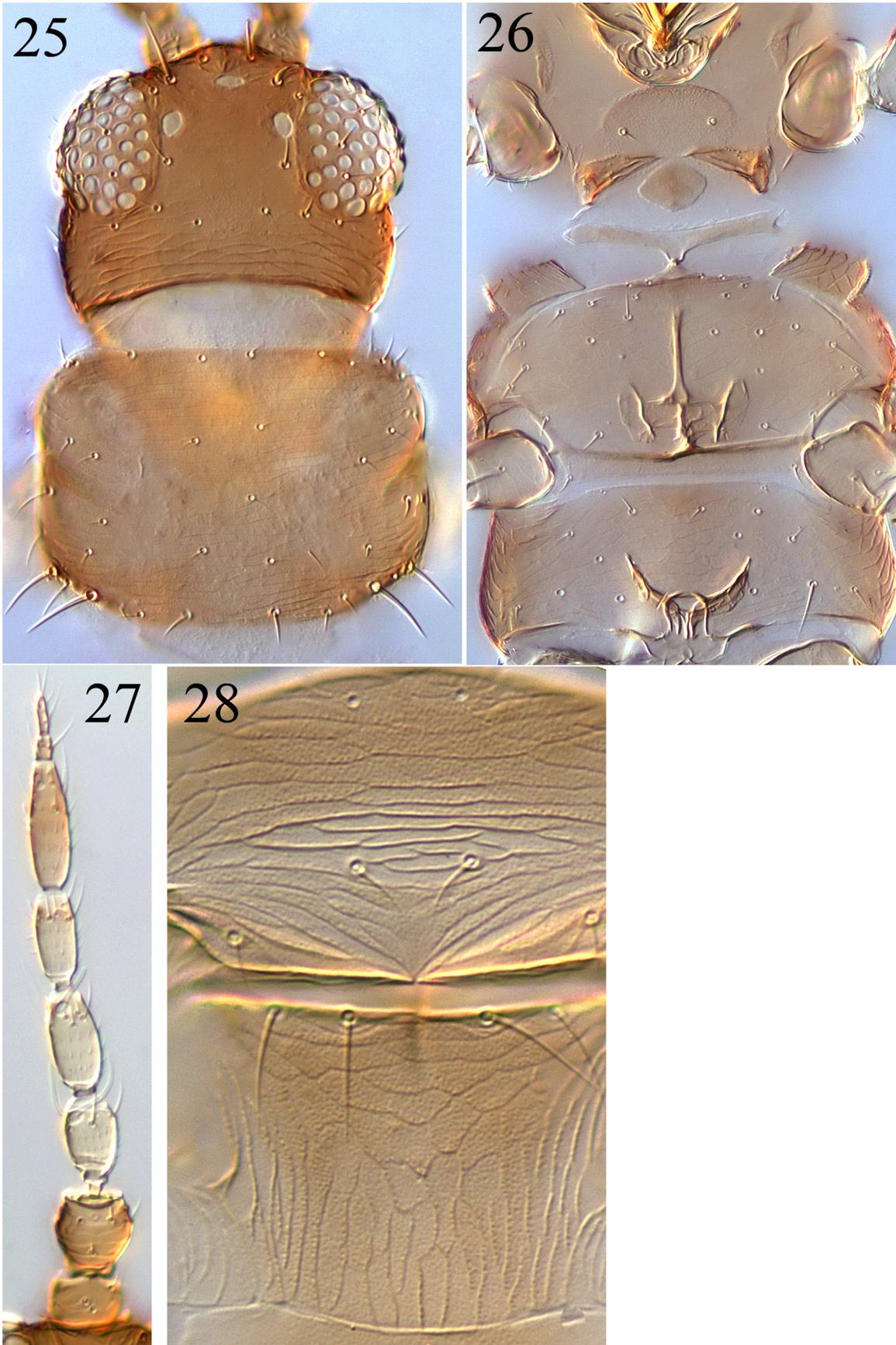
Measurements of holotype female. Distended body length 1120. Head length 110, width across cheeks 150; compound eye dorsal length 60, width 42. Ocellar setae III length 29, interval 41. Pronotum median length 115, width 166; posteroangular setae I 38, setae II 24. Metascutal median length 52, median setae 16. Fore wing length 493, width at middle 41. Ovipositor length 183. Antennal segments I–VIII length (width) as follows: 15 (26), 23 (25), 33 (18), 37 (17), 32(14), 45(15), 9 (7), 13(3.3). Sensoria length on antennal segments III and VI 22 and 28.

Male hemimacroptera (Fig. 24). Distended body length about 1.0 mm. Body yellow; all femora and tibiae yellow; antennal segments I–V yellow, segment VI apical half, VII and VIII slightly shaded. Pronotal posteroangular setae I much longer than setae II. Fore wing (Fig. 29) subapex shaded. Abdominal tergite VIII (Fig. 32) with posteromarginal comb short medially; sternites III–VII with oblong pore plates (Fig. 33), 25–38 microns wide.

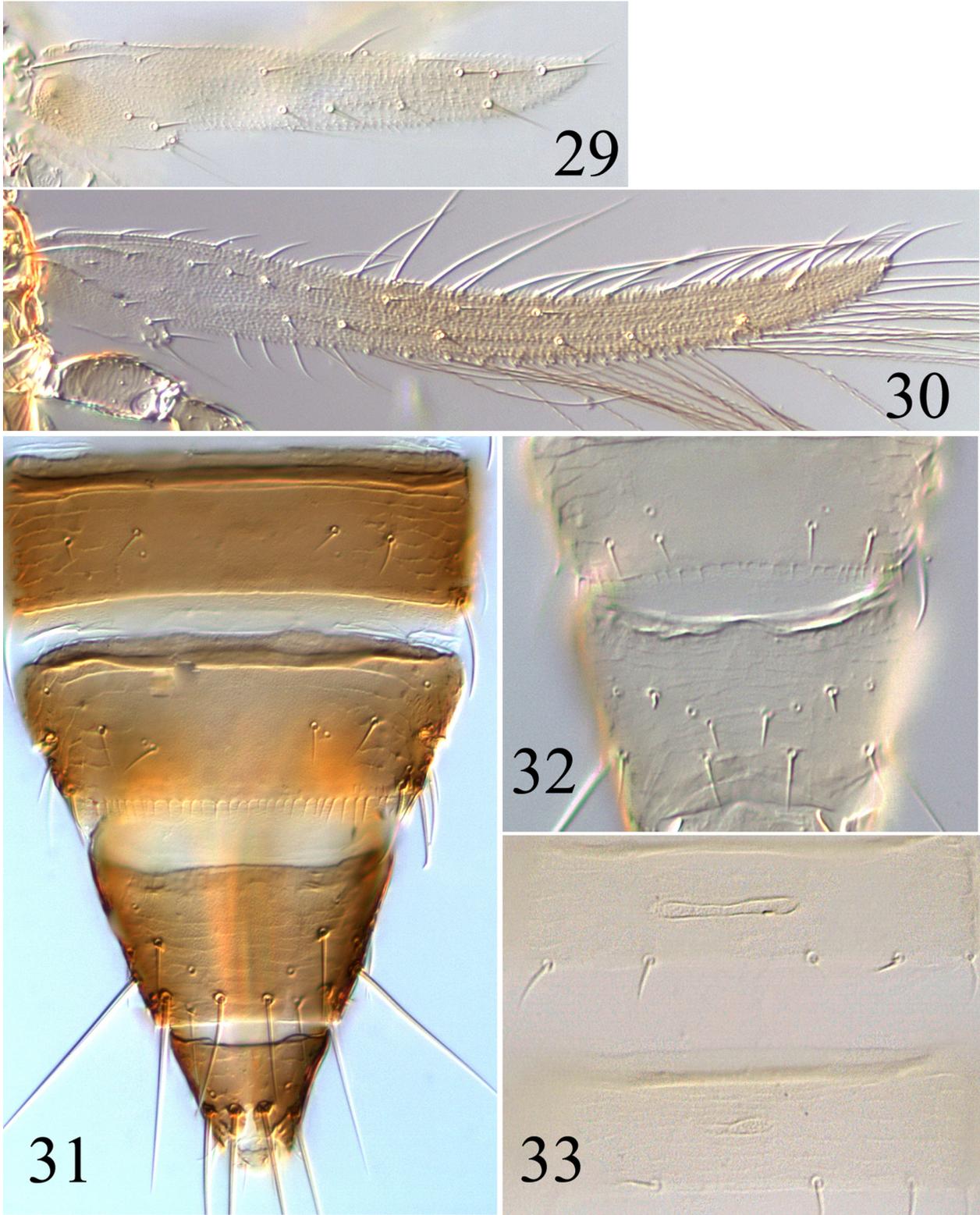
Measurements of paratype male. Distended body length 1000. Head length 108, width across cheeks 129; compound eye dorsal length 67, width 40. Ocellar setae III length 33, interval 34. Pronotum median length 101, width 146; posteroangular setae I 34–35, setae II 26. Metascutal median length 48, median setae 15. Fore wing length 226, width at middle 39. Antennal segments I–VIII length (width) as follows: 10 (24), 30 (24), 31 (16), 29 (16), 27(15), 36 (15), 8 (6), 12 (3). Sensoria length on antennal segments III and VI 12 and 16.



FIGURES 23–24. *Pandanothrips wangi*. (23) Female; (24) Male.



FIGURES 25–28. *Pandanothrips wangi*. Female. (25) Head & Pronotum; (26) Pro-, meso- and metasterna; (27) Antenna; (28) Mesonotum & metascutum.



FIGURES 29–33. *Pandanothrips wangi*. Fore wing 29–30: (29) Male; (30) Female. (31) Female, tergites VII–X. Male 32–33: (32) Tergites VIII–XI; (33) Sternites VI–VII.

Type series. MALAYSIA. Holotype female, Lata Belatan Forest Reserve. Terengganu, on leaves of *Pandanus amaryllifolius* (local common name Pandan wangi), 12.vii.2012, Ng, Y.F. Paratypes: 5 females, 1 male collected together with holotype. Malaysia, Bangi Lama, Selangor, 5 females, 2 males on leaves of *Pandanus amaryllifolius*, 1.viii.2012, Ng, Y.F. The holotype and most paratypes are deposited into CISUKM.

Acknowledgements

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