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FURTHER NOTES ON THE GENUS LITOTETOTHRIPS (THYSANOPTERA : PHLAEOTHRIPIDAE)

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Systematic and Ecological Surveys on Some Plant-Parasitic Microarthropods in Southeast Asia, Scientific Report No. 20.

Abstract

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Five new species of *Litotetothrips* are described from Semenanjung Malaysia : *L. berangan* on *Castanopsis schefferiana, L. kochummeni* on *Castanopsis* sp., *L. keladan* on *Dryobalanops oblongifolia, L. pinanganus* on *Engelhardtia spicata*, and *L. medangteja* on *Cinnamomum iners*. The second instar larvae of five species, *L. medangteja, L. pasaniae, L. pinanganus, L. roberti* and *L. rotundus*, are described for the first time. A key to the known species of *Litotetothrips* is presented.

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Contents. Introduction — *Litotetothrips keladan* — *L. kochummeni* — *L. berangan* — *L. pinanganus* — *L. medangteja* — *L. rotundus* — *L. pasaniae* — *L. roberti* — Key to the species — References.

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INTRODUCTION

The genus *Litotetothrips* is a small group of medium-sized thrips living on tree leaves in eastern Asia including Japan, Taiwan and Malaysia. It has been known by four species, each feeding on one or two plant species belonging to Fagaceae, Lauraceae or Dipterocarpaceae: *L. pasaniae* on *Castanopsis cuspidata* in Japan and Taiwan, *L. roberti* on *Quercus serrata* in Japan, *L. rotundus* on *Cinnamomum japonicum* and *C. camphora* in Japan, Taiwan and Hongkong, and *L. shoreae* on *Shorea leprosula* and *S. acuminata* in Malaysia (Kudô 1975, Mound 1983). Five new species described below also appear to be monophagous, their host plants belonging to the three families mentioned above and Juglandaceae. The occurrence of *L. shoreae* causes blackish green or brown blotches on the leaves (Mound op. cit.), but this is not the case with the other species of the genus, which are associated with mature rather than young leaves. *Litotetothrips* probably originated in the tropical rain forest and later expanded to warm temperate forests, because it has now six species occurring in Semenanjung Malaysia.

Litotetothrips is characterized by the combination of the following characters: elongate and slender seventh and eighth antennal segments; one sense cone on the third antennal segment and two or three on the fourth; head broad but constricted basally; small prothoracic anteroangular and anteromarginal setae; incomplete pronotopleural suture; absence of the prothoracic basisternum and metasternopleural suture; mesopresternum occasionally rudimentary; and three subbasal setae on the fore wing usually small, one or two of them occasionally disappearing. The males of some species are unusual in the posteromarginal or "major" setae on the ninth abdominal segment: *L. shoreae* has short and thin setae B_1, *L. berangan* has long B_2 but shows short and thin B_3, and *L. kochummeni* and *L. pasaniae* have short and thin B_3.

The known species of *Litotetothrips* are easily distinguished from one another by some structural characters, color patterns on the legs, and their host plants, without the use of metric characters. However, all the specimens examined were measured for some body parts to find useful characters in tubuliferan taxonomy. Some ratios and measurements in four species, based on reasonably large numbers of females, are given in Table 1 to 6 (in which the observed range, mean$\pm$standard deviation, and the number of specimens examined are given in the mentioned order). Almost all of them considerably overlap among species. Nevertheless, it is worth mentioning that the numbers of setae on the third to sixth antennal segments show specific and sexual differences in most species.

Also in the second instar larvae the species are easily identified by brown patches on the pteronotum and eighth abdominal tergum and setae on the sixth to ninth abdominal terga as well as by their host plants. This instar is characterized as follows: head brown, wider than long; cephalic seta B_3 minute, occasionally disappearing; brown pronotal plates present; ninth to 11th abdominal segments brown; seta B_3 on ninth tergum minute; most dorsal setae on body blunt or expanded apically, arising from a brown patch.

This is a second paper based on thrips collected under the project "Systematic and ecological surveys on some plant-parasitic microarthropods in Southeast Asia." About half of the specimens examined, including the holotypes of the new species,

will be deposited in Sektion Entomologi, Institut Penyelidikan Perhutanan Malaysia (=Entomology Section, Forest Research Institute of Malaysia [FRIM]), Kepong, Selangor, Malaysia. The host plants were identified by Mr. K.M. Kochummen, ex-Botanist at FRIM.

Before going further, I would like to express my hearty gratitude to the late Dr. Tho Yow Pong (FRIM), Dr. Khoo Soo Ghee (University of Malaysia), Mr. K.M. Kochummen (FRIM), Mr. Azmi Mahyudin (FRIM), Dr. T. Kumata (Hokkaidô University) and Dr. S. Takagi (Hokkaidô University), for their helps in various ways during my surveys in Malaysia. Particular thanks are due to Prof. S. Takagi for his critical reading through the manuscript.

DESCRIPTIONS AND RECORDS

Abbreviations. A_n : Antennal segment n. AAS : Prothoracic anteroangular setae. AMS : Prothoracic anteromarginal setae. B_n : Setae on body segments numbered in meso-lateral order (see Fig. 5.1 for larva) unless otherwise indicated. EPS : Prothoracic epimeral setae. FH : Fringe hairs on wings. HOW : Hind ocellar width. IOD : Interocellar distance, or distance between hind ocelli. L : Length. MLS : Prothoracic midlateral setae. OOD : Ocelloccipital distance, or distance between posterior margin of hind ocellus and posterior margin of head. PAS : Prothoracic posteroangular setae. POS : Postocular setae. S_n : Abdominal sternum n. T_n : Abdominal tergum n. W : Width.

Litotetothrips keladan n. sp.

Female. Brown ; coxae and femora brown, tibiae and tarsi yellow. Wings pale gray. A_1 and A_2 dark brown, A_2 paler apically ; A_3-A_7 yellow, A_5-A_7 slightly brownish apically ; A_8 pale brown.

Head (Fig. 1.1) sculptured with transversely anastomosing striae, 1.40-1.52 as long as pronotum ; W/L 1.11-1.19 ; POS pointed apically, 0.29-0.32 as long as OOD ; IOD/HOW 2.57-2.83 ; OOD/IOD 3.06-3.28 ; OOD/pronotum L 1.18-1.24 ; maxillary stylet reaching eye ; maxillary bridge well represented. Antenna (Fig. 1.2) : A_4 with 2 major sense cones and no minor cone ; A_3-A_7 with 6, 4-5 (mostly 5), 6, 5-6 (usually 6), and 6 primary setae respectively ; A_3 with primary setae only ; A_3-A_8 L/W 1.89-1.95, 1.41-1.45, 1.58-1.66, 1.78-1.89, 2.43-2.71 and 4.89-5.50 respectively ; A_6L/A_3L 0.94-1.00 ; A_8L/A_7L 1.21-1.32.

Pronotum (Fig. 1.1) sculptured with transversely anastomosing striae on anterior and posterior thirds ; with 18-22 setae in all ; MLS and EPS expanded apically ; MLS 0.28-0.39, PAS 0.65-0.70 and EPS 0.27-0.44 as long as pronotum respectively. Metanotum (Fig. 1.3) reticulate medially ; AMSD (distance between anterior margin and median setae)/MSD (distance between median setae) 2.14-2.60 ; mesosternum rudimentary. Metanepimeron with 5 setae, mesosternum with 8-10, metasternum with 16-20. Fore wing with 56-63 FH ; without duplicate FH ; subbasal B_1 usually and B_3 occasionally absent. Hind wing with 57-62 FH.

Pelta (Fig. 1.4) entirely sculptured on median lobe, with narrow lateral lobes, these occasionally reduced, without campaniform sensilla ; tergal lateral setae expanded. T_{10} L/OOD 0.67-0.71 ; B_1-B_3 on T_9 pointed apically, B_1 1.76-2.10, B_2

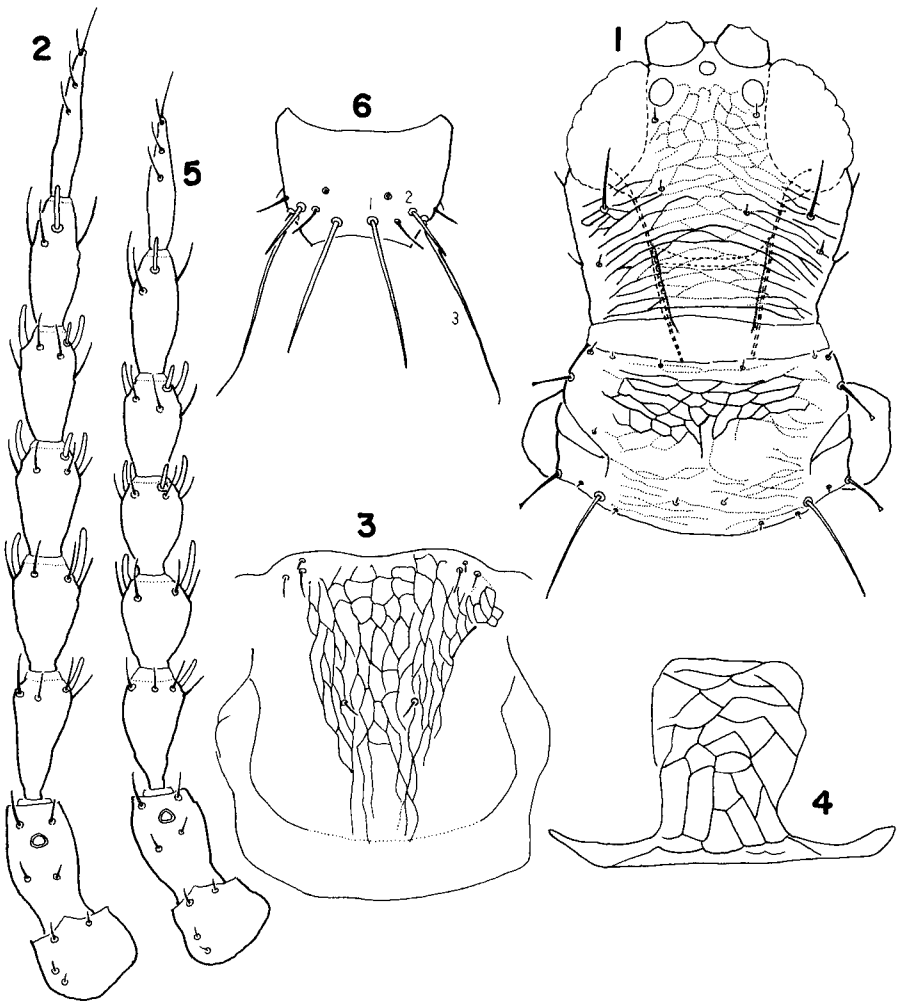

Fig. 1. *Litotetothrips keladan*. 1. ♀, head and pronotum. 2. ♀, right antenna. 3. ♀, metanotum. 4. ♀, pelta. 5. ♂, right antenna. 6. ♂, T_9.

2.10-2.50 and B_3 about 0.5 as long as T_9 respectively. S_5 with 2-4 discal setae.

Measurements (μm). Body L 1.1-1.2 mm. Head L 126-140, W 149-165; POS 30-38; OOD 105-118. Pronotum L 86-100, W 152-176; AAS 6, AMS 4, MLS 25-39, PAS 56-69, EPS 24-44. Fore wing subbasal seta B_2 9-14, B_3 4-8. T_5 lateral seta 42-56; T_9 L40-42; T_{10} L 74-82; B_1 on T_9 74-84, B_2 84-100, B_3 20. L(W) of antennal segments: A_3 36-40 (19-21); A_4 30-32 (21-22); A_5 30-34 (19-21); A_6 32-36 (18-19); A_7 34-38 (14); A_8 44-49 (8-9).

Male. Colored as in female. Head W/L 1.15-1.18, 1.40-1.50 as long as pronotum; IOD/HOW 2.50-3.00; OOD/IOD 2.94-3.13; POS/OOD 0.31-0.34. Antenna (Fig. 1.5): A_3-A_7 with 5-6 (usually 6), 5-6 (mostly 6), 6-7 (mostly 7), 7 and 5-6 (mostly 6) setae respectively; A_3-A_8 L/W 1.74-1.89, 1.17-1.43, 1.25-1.50, 1.42-1.

67, 1.93-2.43 and 4.33-5.13 respectively; A_6L/A_3L 0.79-0.88; A_8L/A_7L 1.15-1.32. Pronotum with 18-23 setae; MLS 0.28-0.37, PAS 0.63-0.69 and EPS 0.28-0.36 as long as pronotum respectively. Metanepimeron with 5 setae, mesosternum with 8, metasternum 18-23; AMSD/MSD 1.92-2.70. Fore wing with 58-65 FH, hind wing with 57-62 FH. T_{10} L/OOD 0.68-0.78; B_1 on T_9 (Fig. 1.6) 1.45-1.77 B_2 0.55-0.64 and B_3 1.91-2.05 as long as T_9 respectively. S_5 with 2-3 discal setae.

Measurements (μm). Body L 1.0-1.1 mm. Head L 120-128, W 140-147; OOD 96-106; POS 30-36. Pronotum L 80-86; MLS 24-31, PAS 54-56, EPS 24-31. Fore wing subbasal seta B_2 8-10, B_3 5-8. T_5 lateral seta 38-42; T_9 L 44, T_{10} L 68-78; B_1 on T_9 64-78, B_2 24-28, B_3 84-90. L (W) of antennal segments: A_3 33-34 (18-20); A_4 24-30 (20-21); A_5 25-27 (18-20); A_6 27-30 (17-19); A_7 28-34 (14-15); A_8 37-41 (8-9).

Specimens examined. Semenanjung Malaysia — Selangor: Kuala Lumpur: Kepong, holotype (♀) & 3♀ 4♂ (*Dryobalanops oblongifolia*, Dipterocarpaceae, Malaysian name: keladan), X. 31. 1991.

Remarks. This is the smallest species of the genus, and a second species living on Dipterocarpaceae. In the male the antennal segments are thicker than in the female as in *L. kochummeni* and *L. berangan*. It is unique in having short posteromarginal setae B_3 on T_9 in the female. *L. keladan* may come near *L. kochummeni* but it is distinguished by the rudimentary mesopresternum, by A_3 with primary setae only, by MLS, EPS and tergal lateral setae expanded, and by the maxillary bridge well represented.

Litotetothrips kochummeni n. sp.

Female. Brown; coxae and femora brown; tibiae and tarsi yellow. Wings pale. A_1 and A_2 dark brown, A_2 paler apically; A_3-A_7 yellow; A_8 yellow basally, pale brown apically.

Head (Fig. 2.1) sculptured with transversely anastomosing striae, 1.34-1.54 as long as pronotum; W/L 1.16-1.21; POS pointed apically, 0.27-0.41 as long as OOD; IOD/HOW 2.22-2.63; OOD/IOD 2.82-3.20; OOD/pronotum L 1.14-1.28; maxillary stylet reaching POS; maxillary bridge so weakly present that it can be scarcely seen. Antenna (Fig. 2.2): A_4 with 2 major sense cones and 1 minor cone; A_3-A_7 with 6, 5, 5-7 (usually 6), 5-6 (usually 6), and 5-6 (mostly 6) primary setae respectively; A_3 with 1-2 (rarely 0) dorsal and 1-2 ventral setae along with primary setae; A_3-A_8 L/W 1.58-1.95, 1.44-1.62, 1.67-1.90, 1.76-2.00, 2.35-2.63 and 4.40-4.90 respectively; A_6L/A_3L 0.88-0.97; A_8L/A_7L 1.10-1.17.

Pronotum (Fig. 2.1) sculptured with transversely anastomosing striae on anterior third and posterior fourth; with 19-20 setae; MLS pointed or blunt apically, EPS blunt or expanded; MLS 0.34-0.40, PAS 0.62-0.69 and EPS 0.45-0.56 as long as pronotum respectively. Metanotum (Fig. 2.3) weakly reticulate; AMSD/MSD 1.00-1.67; mesopresternum well represented. Metanepimeron with 6-7 setae, mesosternum with 12-15, metasternum with 20-22. Fore wing with 72-82 FH, without duplicate FH; subbasal B_1 usually absent. Hind wing with 71-81 FH.

Pelta (Fig. 2.4) irregularly reticulate, without campaniform sensilla; tergal lateral setae pointed or blunt except on T_8 expanded. $T_{10}L/OOD$ 0.95-1.14; B_1 on T_9 1.93-2.19, B_2 2.19-2.47 and B_3 1.4-1.6 as long as T_9 respectively. S_5 with 4-7 discal setae.

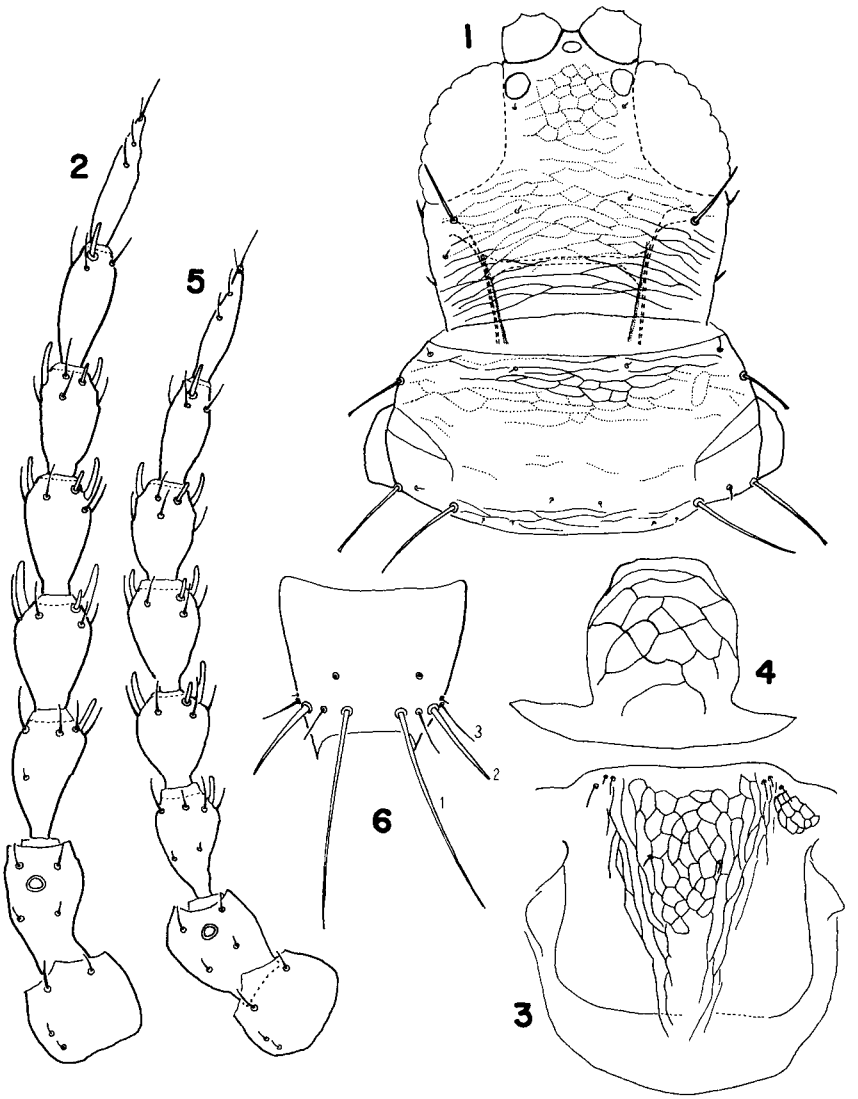

Fig. 2. *Litotetothrips kochummeni*. 1. ♀, head and pronotum. 2. ♀, right antenna. 3. ♀, metanotum. 4. ♀, pelta. 5. ♂, right antenna. 6. ♂, T_9.

Measurements (μm). Body L 1.3-1.4 mm. Head L 145-155, W 176-188; OOD 122-132; POS 34-50. Pronotum L 100-116; MLS 38-42, PAS 64-76, EPS 50-56. Fore wing subbasal B_2 18-26, B_3 13-20. T_5 lateral seta 55-70; T_9 L 58-64, T_{10} L 122-146; B_1 on T_9 114-140, B_2 134-148, B_3 85-105. L (W) of antennal segments: A_3 38-44 (22-24); A_4 36-42 (25-26); A_5 38-42 (21-24); A_6 37-42 (19-22); A_7 40-42 (16-17); A_8 44-49 (10).

Male. Colored as in female. Head W/L 1.15-1.25; IOD/HOW 2.93-3.50; OOD/IOD 2.68; POS/OOD 0.33-0.36. Antenna (Fig. 2.5): A_3-A_7 with 6, 5-6 (usually

6), 7, 6, and 5-6 (usually 6) primary setae respectively ; A_6L/A_3L 0.82-0.94 ; A_8L/A_7 L 1.15-1.25 ; A_3-A_8 L/W 1.31-1.55, 1.20-1.33, 1.45-1.55, 1.40-1.60, 2.00-2.27 and 3.80-4.00 respectively. Pronotum with 18-20 setae ; MLS 0.31-0.38, PAS 0.60-0.64 and EPS 0.47-0.51 as long as pronotum respectively. Metanepimeron with 5-6 setae, mesosternum with 16, metasternum with 24 ; AMSD/MSD 1.13-1.77. Fore wing with 68-72 FH, hind wing with 69-72 FH. $T_{10}L/OOD$ 1.02-1.11 ; B_2 on T_9 (Fig. 2.6) short and thick, B_3 very short and thin, B_1 1.62-1.82, B_2 0.64-0.68 and B_3 0.34-0.36 as long as T_9 respectively. S_5 with 5-6 discal setae.

Measurements (μm). Body L 1.3 mm. Head L 128-136, W 156-160 ; OOD 110-112 ; POS 36-40. Pronotum L 102-106 ; MLS 32-40, PAS 61-68, EPS 50-52. Fore wing subbasal B_1 4-10, B_2 12-20, B_3 12-16. T_5 lateral seta 60 ; T_9 L 66-74 ; T_{10} L 112-124 ; B_1 on T_9 120, B_2 42-50, B_3 24-25. L (W) of antennal segments : A_3 34 (22-26) ; A_4 30-32 (24-26) ; A_5 32-34 (22) ; A_6 28-32 (20) ; A_7 32-34 (15-16) ; A_8 38-40 (10).

Specimens examined. Semenanjung Malaysia — Kedah : Jitra : Bukit Wang, holotype (♀) & 5♀ 2♂ (*Castanopsis* sp., Fagaceae), XI. 12. 1991.

Remarks. This species has some small setae along with primary setae on A_3 as in *L. berangan, L. pasaniae, L. pinanganus* and *L. medangteja*. The female has an unusually long 10th abdominal segment, i.e. T_{10} is 2.1-2.4 as long as T_9 against 1.5-2.1 in the congeners. In the male the posteromarginal setae B_3 on T_9 are shortest among the three pairs as in *L. berangan* and *L. pasaniae*. *L. kochummeni* is distinguished from *L. berangan* by thick A_3 (L/W 1.6-2.0 in female, 1.3-1.6 in male) and by two major sense cones on A_4.

Litotetothrips berangan n. sp.

Female. Brown ; coxae and femora brown ; tibiae and tarsi yellow. Wings pale, slightly brownish at extreme base. A_1 and A_2 dark brown ; A_3-A_7 yellow, A_7 brownish apically ; A_8 pale brown, yellowish basally.

Head (Fig. 3.1) sculptured with transversely anastomosing striae on posterior half, nearly smooth between eyes ; 1.28-1.43 as long as pronotum ; W/L 1.09-1.23 ; IOD/HOW 2.50-3.00 ; OOD/IOD 2.86-3.25 ; OOD/pronotum L 1.09-1.16 ; POS pointed apically, 0.37-0.43 as long as OOD ; maxillary stylet reaching POS ; maxillary bridge weak, scarcely seen. Antenna (Fig. 3.2) : A_4 with 3 major sense cones and 1 minor cone ; A_3-A_7 with 5-6 (5.7 ± 0.5, n=18), 4-6 (5.0 ± 0.3), 6-7 ($6.1+0.2$), 5-6 (5.7 ± 0.5), and 6 primary setae respectively ; A_3 with 1-2 dorsal and 1-2 ventral setae along with primary setae ; A_3-A_8 L/W 2.00-2.27, 1.54-1.83, 1.64-1.76, 1.73-1.90, 2.38-2.79 and 4.50-6.00 respectively ; A_6L/A_3L 0.72-0.83 ; A_8L/A_7L 1.14-1.32.

Pronotum (Fig. 3.1) weakly sculptured with transversely anastomosing striae on anterior and posterior thirds ; with 20-25 setae ; MLS and EPS blunt apically ; MLS 0.28-0.33, PAS 0.57-0.67 and EPS 0.37-0.43 as long as pronotum respectively. Metanotum (Fig. 3.3) weakly reticulate on anteromedian two-thirds ; AMSD/MSD 1.69-2.30 ; mesopresternum well represented. Metanepimeron with 5-8 setae, mesosternum with 11-14, metasternum with 20-23. Fore wing with 71-81 FH ; without duplicate FH ; subbasal setae B_2 and B_3 usually subequal in length. Hind wing with 68-77 FH.

Pelta (Fig. 3.4) irregularly sculptured on median lobe, without campaniform sensilla ; tergal lateral setae pointed or blunt apically. $T_{10}L/OOD$ 0.89-1.00 ; B_1 on

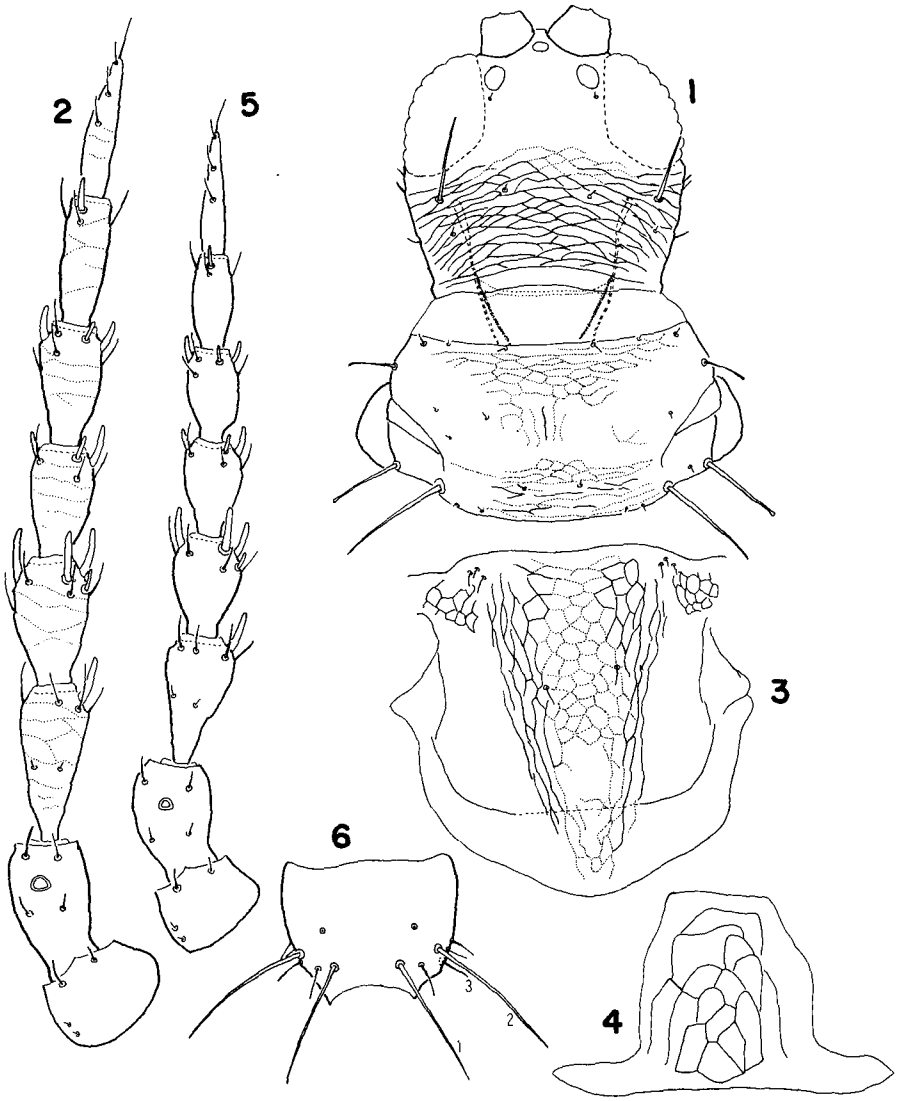

Fig. 3. *Litotetothrips berangan*. 1. ♀, head and pronotum. 2. ♀, right antenna. 3. ♀, metanotum. 4. ♀, pelta. 5. ♂, right antenna. 6. ♂, T_9.

T_9 1.47-1.81, B_2 1.85-2.10 and B_3 1.2-1.4 as long as T_9 respectively. S_5 with 4-7 discal setae.

Measurements (μm). Body L 1.4-1.6 mm. Head L 148-160, W 168-184 ; OOD 122-130 ; POS 46-56. Pronotum L 106-116 ; AAS 6-12, AMS 5-10, MLS 34-38, PAS 66-76, EPS 41-46. Fore wing subbasal B_1 6-18, B_2 14-25, B_3 14-28. T_5 lateral seta 52-66 ; T_9L 62-68 ; T_{10} L 112-130 ; B_1 on T_9 94-114, B_2 120-130, B_3 76-84. L (W) of antennal segments : $A_3$44-50 (21-23) ; A_4 40-46 (24-26) ; A_5 36-38 (21-22) ; A_6 36-38 (19-22) ; A_7 36-42 (14-16) ; A_8 45-50 (8-10).

Male. Colored as in female. Head W/L 1.14-1.26; IOD/HOW 2.86; OOD/IOD 2.65-2.80; POS/OOD 0.36-0.38. Antenna (Fig. 3.5): A_3-A_7 with 6, 6, 5-7 (usually 6), 5-6 (usually 6), and 6-7 (usually 6) primary setae respectively; A_3-A_8 L/W 1.82-2.00, 1.29-1.39, 1.40-1.50, 1.56-1.61, 1.87-2.27 and 3.89-4.44 respectively; A_6L/A_3 L 0.68-0.75; A_8L/A_7L 1.18-1.27. Pronotum with 21-25 setae; MLS 0.27-0.33, PAS 0.53-0.59 and EPS 0.41-0.43 as long as pronotum respectively. Metanepimeron with 7-9 setae, mesosternum with 11-14, metasternum with 18-23; AMSD/MSD 1.60-2.40. Fore wing with 68-71 FH, hind wing with 64-69 FH. $T_{10}L$/OOD 0.89-0.96; B_2 on T_9 (Fig. 3.6) longer than B_1, B_3 short and thin, B_1 1.05-1.13, B_2 1.19-1.30 and B_3 0.26-0.28 as long as T_9 respectively. S_5 with 3-4 discal setae.

Measurements (μm). Body L 1.2-1.3 mm. Head L 122-135, W 150-159; OOD 106-112; POS 40. Pronotum L 94-102; MLS 26-32, PAS 54-56, EPS 40-42. Fore wing subbasal B_1 10-14, B_2 8-18, B_3 2-20. T_5 lateral seta 46-56; T_9 L 80-84; T_{10} L 98-106; B_1 on T_9 88-90, B_2 100-104, B_3 22. L (W) of antennal segments: A_3 40-42 (21-22); A_4 31-33 (23-24); A_5 28-30 (20); A_6 28-30 (18-19); A_7 28-34 (15); A_8 35-40 (9).

Specimens examined. Semenanjung Malaysia — Selangor: Kuala Lumpur: Sungei Buloh, holotype (♀) & 8♀ 4♂ (*Castanopsis schefferiana*, Fagaceae, Malaysian name: berangan), VIII. 25. 1990.

Remarks. This species is unique in having long, thin posteromarginal setae B_2 on T_9 in the male. *L. berangan* is distinguished from *L. pasaniae* by the mid and hind tibiae yellow and by the slenderer A_3 (L/W 2.0-2.3) in the female.

Litotetothrips pinanganus n. sp.

Female. Dark brown. Coxae, femora, and mid and hind tibiae dark brown; fore tibia and all tarsi yellow. Fore wing slightly shaded, brown basally. A_1 and A_2 dark brown, A_2 yellowish apically; A_3-A_7 yellow; A_8 brown, yellowish at extreme base.

Head (Fig. 4.1) nearly smooth, 1.32-1.40 as long as pronotum; W/L 1.04-1.05; IOD/HOW 1.67-1.83; OOD/IOD 4.36-4.70; OOD/pronotum L 1.12-1.20; POS pointed apically, 0.31-0.36 as long as OOD; maxillary stylet not reaching POS; maxillary bridge weak, scarcely seen. Antenna (Fig. 4.2): A_4 with 3 major sense cones and 1 minor cone; A_3-A_7 with 6, 5, 6, 5-6 (usually 6), and 5-6 (usually 6) primary setae respectively; A_3 with 1-2 dorsal setae and 1 ventral seta along with primary setae; A_3-A_8 L/W 2.19-2.27, 1.71-1.76, 2.00-2.14, 2.12-2.31, 2.76-3.05 and 5.00-5.38 respectively; A_6L/A_3L 0.81-0.86; A_8L/A_7L 1.15-1.21.

Pronotum (Fig. 4.1) smooth, with 24 setae; MLS blunt apically, EPS expanded; MLS 0.40-0.44, PAS 0.66-0.69 and EPS 0.50-0.53 as long as pronotum respectively. Metanotum (Fig. 4.3) smooth medially, sculptured sublaterally with longitudinal striae; AMSD/MSD 1.59-2.17; mesopresternum well represented. Metanepimeron with 6-9 setae, mesosternum with 17-20, metasternum with 25-31. Fore wing with 126-136 FH and 7-10 duplicate FH. Hind wing with 121-136 FH.

Pelta (Fig. 4.4) weakly sculptured on median lobe, without campaniform sensilla; tergal lateral setae blunt or expanded apically. $T_{10}L$/OOD 0.94-0.98; B_1 on T_9 1.74-1.80, B_2 1.63-1.67 and B_3 1.3-1.4 as long as T_9 respectively. S_5 with 10-11 discal setae.

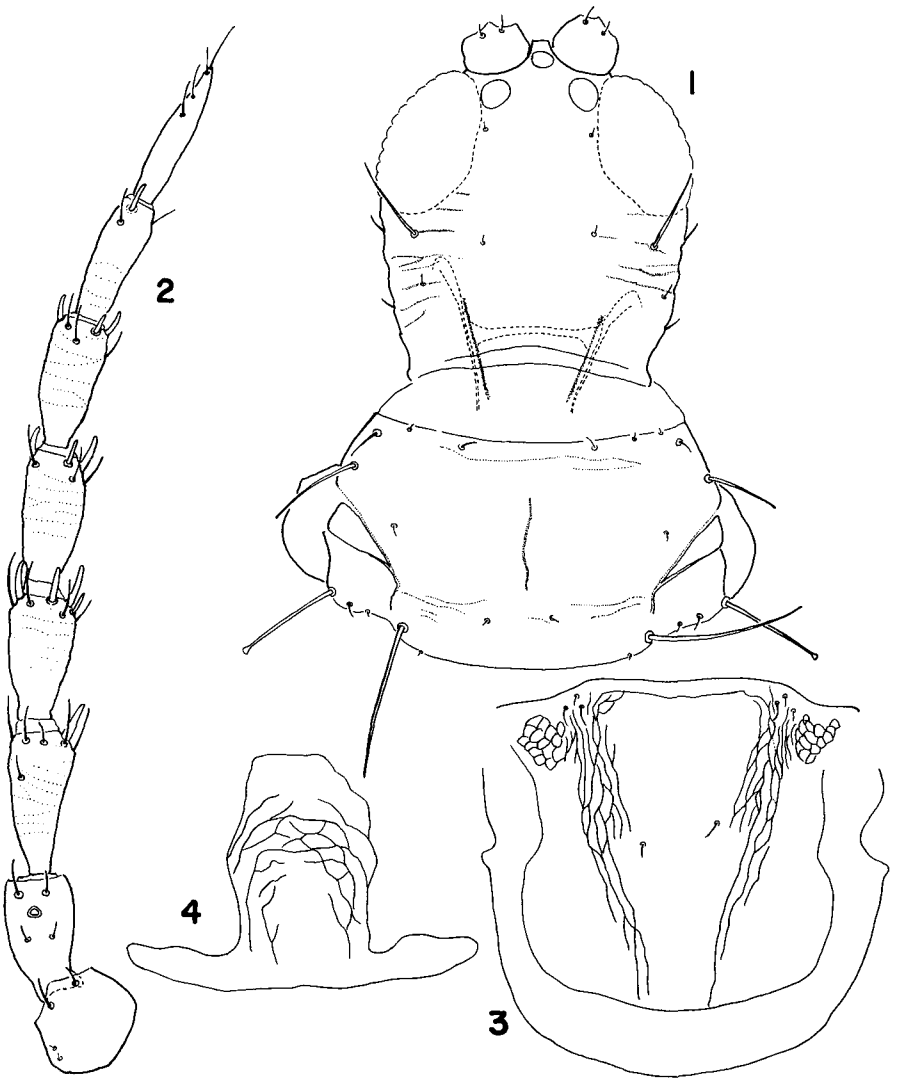

Fig. 4. *Litotetothrips pinanganus*, ♀. 1. head and pronotum. 2. right antenna. 3. metanotum. 4. pelta.

Measurements (μm). Body L 2.3-2.4 mm. Head L 222-224, W 232-234; OOD 188-192; POS 60-68. Pronotum L 160-168; AAS 10-24, AMS 10-12, MLS 64-74, PAS 106-116 EPS 80-84. Fore wing subbasal B_1 8-16, B_2 14-38, B_3 16-30. T_5 lateral seta 102-104; T_9 L 92-96; T_{10} L 180-184; B_1 on T_9 160-170, B_2 150-160, B_3 120-135. L (W) of antennal segments: A_3 68-70 (30-32); A_4 58-60 (34); A_5 56-60 (28); A_6 55-60 (26); A_7 58-61 (20-21); A_8 70 (13-14).

Male. Unknown.

Second instar larva. Generally yellow with some red hypodermal pigments; head, pronotal plates, legs and abdominal segments IX-XI brown; tibiae paler

apically. A_1 and A_2 dark brown; A_3-A_7 brown. Body setae brown, most of them arising from brown patch.

Head (Fig. 5.1) W/L 1.3, with B_3; T_9 L/W 0.60; T_{10} L/W 1.00; $T_{10}L/T_9L$ 0.92. Antenna (Fig. 5.2): inner dorsal seta on A_2 rounded apically, outer dorsal seta on A_2 and inner one on A_3 blunt; inner sense cone on A_4 largest; A_3-A_7 L/W 2.27, 2.00, 2.44, 2.40 and 3.56 respectively; A_7L/A_6L 0.89. Meso- and metanotum (Fig. 5.1) each submedially with 2 pairs of brown patches besides setal patches. B_1 and B_2 on T_8 (Fig. 5.3) arising from a large brown patch (joined patches). Peritremes of all spiracles (Figs. 5.4, 5.5) completely encircling spiracular openings; most cells in peritremes roundly oval, similar in size and shape; peritreme of mesothoracic spiracle with about 25 cells, transversely oblong, being two cells thick anteriorly and posteriorly and three to four cells thick on each lateral side; peritreme of spiracle on abdominal segment VIII with 11 cells, two cells thick anteriorly.

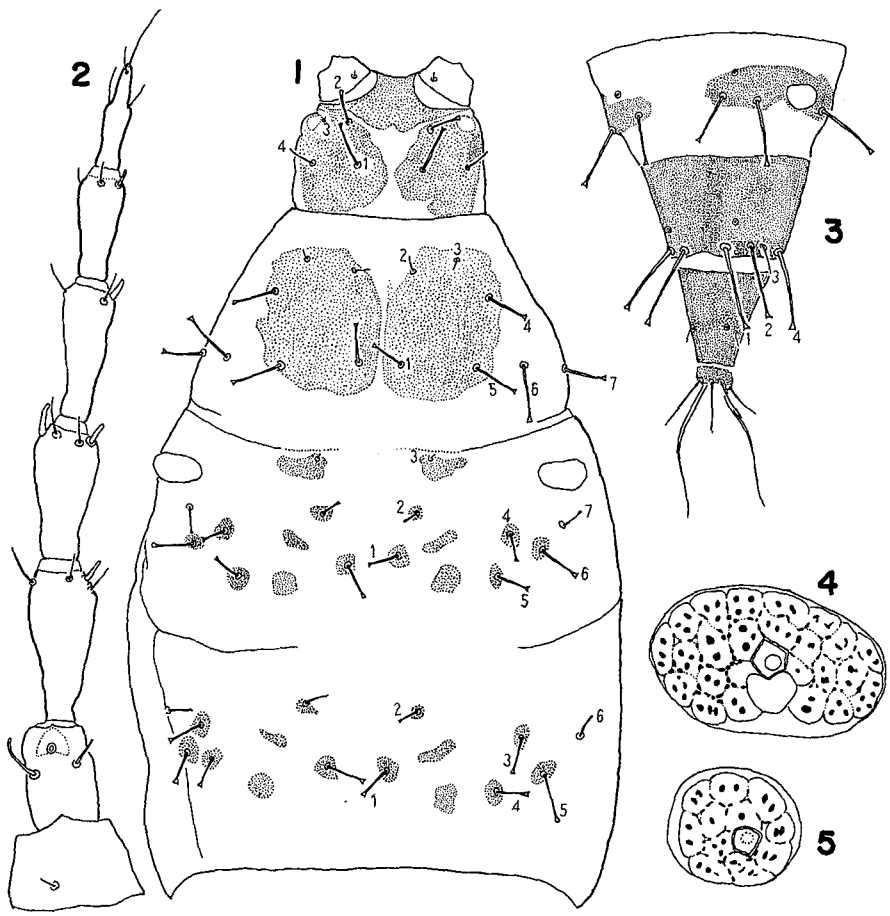

Fig. 5 *Litotetothrips pinanganus*, second instar larva. 1. head and thorax, dorsal view. 2. right antenna. 3. T_8-T_{11}. 4. mesothoracic spiracle. 5. spiracle on abdominal segment VIII.

Dorsal setae on body mostly expanded apically, cephalic B_4, mesonotal B_7 and metanotal B_2 and B_6 blunt, pronotal B_2 and B_3 pointed. Ventral setae mostly pointed apically, B_2 on S_3-S_5 blunt, on S_8 expanded. Cephalic B_1 1.31 as long as B_2, DB_2-B_2 (distance between B_2 and B_2) 2.15 as long as DB_1-B_2. Pronotal B_1 2.15 as long as B_2, B_6/B_7 1.25-1.56, DB_1-B_1/DB_1-B_2 0.40; mesonotal B_1 1.61 as long as B_2, DB_1-B_1/DB_1-B_2 0.90-1.06; metanotal B_1 0.94 as long as B_5. B_2 on T_5 1.03 as long as B_1, DB_1-B_1/DB_1-B_2 1.14; B_3 on T_7 1.54-1.70 as long as B_1. Major setae on T_9 subequal in length, B_1 0.83, B_2 0.78 and B_4 0.81 as long as T_9 respectively. Anal seta about 1.4 as long as T_{10}.

Measurements (μm). Body L 1.6 mm. Head L, mid dorsal 106, including mouth cone 198, W 138; T_9 L 72, W 120; T_{10} L 66, W 66. L (W) of antennal segments: A_3 50 (22); A_4 44 (22); A_5 44 (18); A_6 36 (15); A_7 32 (9). Cephalic B_1 34, B_2 26, B_4 20. Pronotal B_1 28, B_2 13, B_3 8, B_4 32-36, B_5 34-42, B_6 40-50, B_7 32. Mesonotal B_1 29, B_2 18, B_6 34, B_7 20; metanotal B_1 32, B_5 34. B_1 on T_5 35, B_2 36, B_3 58; B_1 on T_9 60, B_2 56, B_4 58; anal seta ca. 95.

Specimens examined. Semenanjung Malaysia — Pulau Pinang: Bukit Bendera (700 m), holotype (♀), 1♀ & 1 larva (*Engelhardtia spicata*, Juglandaceae), XI. 19. 1991.

Remarks. This is the largest species of the genus. It is unique in the unsculptured head and thorax, and distinguished from *L. rotundus* by A_4 with three major sense cones and by A_3 with some setae along with primary setae.

Litotetothrips medangteja n. sp.

Female. Brown, head darkest. Coxae brown; fore leg pale yellow, femur brown at extreme base and along outer margin; mid and hind femora brown; mid and hind tibiae and tarsi pale yellow. A_1 and A_2 brown; A_3-A_8 yellow. Wings pale, scale brownish.

Head (Fig. 6.1) sculptured with transversely anastomosing striae; maxillary stylet not reaching POS; maxillary bridge weakly present; POS pointed apically. Antenna (Fig. 6.2) slender; A_4 with 3 major sense cones and 1 minor cone; A_3-A_7 usually with 6, 5, 6, 6 or 7, and 6 primary setae respectively; A_3 with a seta at middle of inner margin along with primary setae; A_6 with 2 major sense cones and 1 minor cone. Pronotum (Fig. 6.1) weakly sculptured nearly throughout; MLS and EPS blunt apically. Metanotum (Fig. 6.3) weakly reticulate medially; mesopresternum well represented. Fore wing with duplicate FH; without subbasal B_1. Pelta (Fig. 6.4) irregularly reticulate, without campaniform sensilla; lateral lobes narrow, occasionally reduced. Tergal lateral setae blunt apically; B_3 on T_9 longer than T_9. Body L 1.8-2.1 mm. Some quantitative characterers are given in Table 1 and measurements of body parts in Table 2.

Male. Colored as in female. A_3-A_7 usually with 6, 6, 6, 6 or 7, and 6 primary setae respectively. Fore wing rarely with subbasal B_1. B_1 and B_3 on T_9 (Fig. 6.5) long, B_2 short. Body L 1.4-1.8 mm. Biometric data in Table 1 and 2.

Second instar larva. Generally colored as in *L. pinanganus*; tibiae yellow, brownish basally. A_1 and A_2 brown; A_3-A_7 yellow.

Head (Fig. 7.1) W/L 1.2-1.3, with B_3; T_9 L/W 0.72-0.84; T_{10} L/W 1.19-1.63; $T_{10}L/T_9L$ 0.92-1.03. Antenna (Fig. 7.2) slender, particularly A_5-A_7; inner dorsal

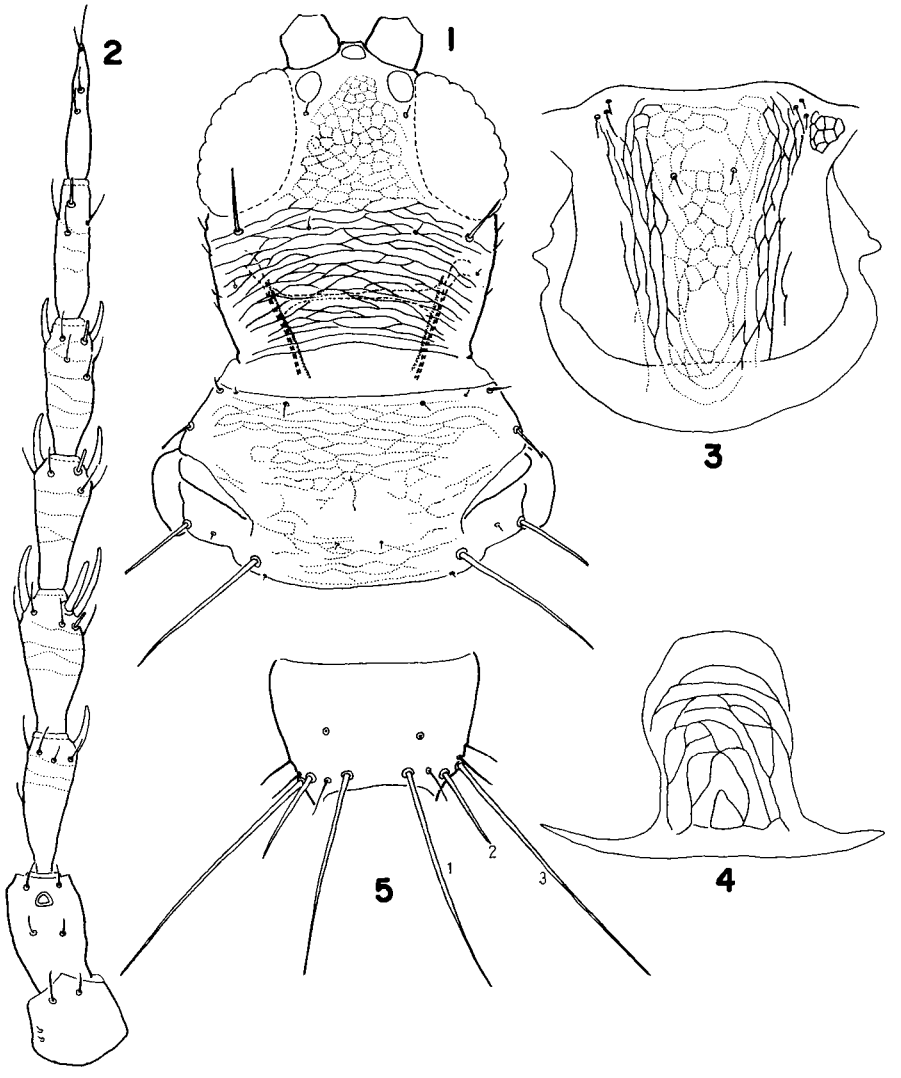

Fig. 6. *Litotetothrips medangteja*. 1. ♀, head and pronotum. 2. ♀, right antenna. 3. ♀, metanotum. 4. ♀, pelta. 5. ♂, T_9.

seta on A_2 alone blunt apically ; A_3-A_7 L/W 2.17-2.50, 2.14-2.40, 2.39-2.71, 3.00-3.54 and 4.75-5.71 respectively ; A_7L/A_6L 0.79-0.95. Meso- and metanoutm with only setal brown patches ; B_1 and B_2 on T_8 (Fig. 7.3) arising each from a brown patch. Spiracles similar to those of *L. pinanganus* ; peritreme of mesothoracic spiracle with about 30-35 cells, that on segment II with about 15, on segment VIII with about 20.

Dorsal setae on body shorter than the congeners, particularly on head and thorax, mostly blunt or slightly expanded apically ; cephalic B_4, pronotal B_2, B_3 and B_7, mesonotal B_7, and metanotal B_6 pointed. Ventral setae mostly pointed ; B_2 on

Table 1. Quantitative characters in *Litotetothrips medangteja*.

Characters	Female			Male		
Head W/L	1.00-1.26	(1.07±0.05)	23	1.04-1.16	(1.10±0.03)	31
IOD/HOW	1.73-2.30	(2.01±0.12)	22	1.70-2.38	(2.01±0.15)	30
OOD/IOD	3.91-4.79	(4.46±0.21)	22	4.05-4.76	(4.39±0.20)	29
OOD/pronotum L	1.25-1.37	(1.29±0.03)	20	1.21-1.34	(1.27±0.04)	27
POS/OOD	0.26-0.34	(0.29±0.02)	20	0.22-0.36	(0.28±0.04)	29
A_3 L/W	2.23-2.64	(2.41±0.10)	23	2.25-2.73	(2.44±0.11)	32
A_4 L/W	1.73-2.10	(1.94±0.08)	23	1.66-1.93	(1.80±0.06)	32
A_5 L/W	2.00-2.31	(2.15±0.08)	23	1.85-2.29	(2.07±0.10)	32
A_6 L/W	2.25-2.77	(2.49±0.13)	23	2.00-2.70	(2.33±0.14)	32
A_7 L/W	2.78-3.61	(3.20±0.21)	23	2.56-3.29	(2.97±0.17)	32
A_8 L/W	4.83-5.73	(5.29±0.26)	23	4.60-5.70	(5.16±0.27)	31
A_6L/A_3L	0.91-1.05	(0.97±0.04)	23	0.86-1.00	(0.92±0.04)	32
A_8L/A_7L	0.96-1.14	(1.03±0.04)	23	0.96-1.17	(1.06±0.06)	31
MLS/pronotum L	0.13-0.26	(0.18±0.04)	21	0.11-0.27	(0.19±0.04)	26
PAS/pronotum L	0.69-0.87	(0.76±0.05)	24	0.63-0.84	(0.75±0.05)	32
EPS/pronotum L	0.33-0.47	(0.38±0.03)	22	0.30-0.42	(0.37±0.03)	31
AMSD/MSD	0.82-1.63	(1.06±0.16)	34	0.81-1.90	(1.31±0.24)	52
T_{10} L/OOD	0.88-1.08	(0.91±0.04)	23	0.85-0.94	(0.89±0.03)	27
T_9B_1/T_9L	1.74-2.37	(1.89±0.10)	21	1.63-1.97	(1.78±0.10)	34
T_9B_2/T_9L	2.03-2.38	(2.22±0.10)	23	0.53-0.76	(0.67±0.05)	32
T_9B_3/T_9L	1.22-1.55	(1.41±0.09)	18	1.92-2.34	(2.12±0.11)	34
No. setae on A_3	5-6	(5.8±0.4)	31	5-6	(5.9±0.3)	34
Do. on A_4	4-6	(5.0±0.3)	31	5-6	(5.9±0.3)	34
Do. on A_5	5-7	(5.9±0.4)	31	4-7	(6.0±0.4)	34
Do. on A_6	6-7	(6.5±0.5)	31	6-7	(6.6±0.6)	34
Do. on A_7	5-6	(5.9±0.3)	31	6	(6.0±0.0)	34
No. pronotal setae	17-20	(18.1±0.7)	23	17-21	(18.3±0.9)	32
No. metanepimeral setae	6-10	(7.8±0.9)	42	5-8	(7.2±0.7)	51
No. mesosternal setae	9-14	(11.7±1.1)	18	9-13	(11.4±1.1)	29
No. metasternal setae	21-30	(25.2±2.5)	21	24-30	(26.6±1.8)	31
No. discal setae on S_5	5-10	(6.9±1.7)	20	4-11	(6.1±1.2)	33
No. FH on fore wing	90-111	(102.0±3.9)	31	87-106	(95.7±4.2)	33
No. duplicate FH	5-10	(7.3±1.0)	34	5-9	(6.9±1.0)	44
No. FH on hind wing	92-107	(100.0±4.1)	24	84-101	(93.0±4.3)	30

Range, mean±SD (in parentheses), and number of specimens examined are given in the mentioned order.

S_3-S_5 always and on S_6 occasionally blunt. Cephalic B_1 1.83-2.17 as long as B_2, B_4 small ; DB_2-B_2/DB_1-B_2 1.93-2.64. Pronotal B_1 3.00-4.00 as long as B_2 ; B_6/B_7 1.82-3.20 ; DB_1-B_1/DB_1-B_2 0.33-0.46. Mesonotal B_1 1.60-2.00 as long as B_2 ; DB_1-B_1/DB_1-B_2 1.25-1.55. Metanotal B_1 0.61-0.73 as long as B_5. B_2 on T_5 1.20-1.33 as long as B_1 ; DB_1-B_1/DB_1-B_2 0.75-1.04. B_3 on T_7 long, 2.52-2.92 as long as B_1. B_2 on T_9 clearly shorter than B_1 and B_4 ; B_1 1.24-1.80, B_2 0.79-1.00 and B_4 1.18-1.38 as long as

Table 2. Measurements of body parts in *Litotetothrips medangteja*, in micra.

Characters	Female	Male
Head L	188-222 (207±6.7) 23	166-200 (181±7.0) 31
Head W	212-236 (222±6.4) 23	186-210 (199±4.6) 31
OOD	170-192 (179±5.2) 20	140-166 (156±5.9) 29
POS	44-62 (52±4.2) 20	34-56 (44±6.5) 30
A_3 L	58-66 (61±2.1) 23	50-60 (56±2.3) 32
A_3 W	24-27 (25±0.8) 23	21-24 (23±1.1) 32
A_4 L	52-65 (59±2.4) 23	45-54 (51±2.3) 32
A_4 W	29-32 (31±0.8) 23	26-30 (28±1.0) 32
A_5 L	54-64 (59±2.3) 23	48-55 (51±1.9) 32
A_5 W	26-30 (27±1.2) 23	22-26 (25±1.1) 32
A_6 L	54-62 (60±2.1) 23	44-55 (51±2.7) 32
A_6 W	22-26 (24±1.1) 23	20-24 (22±1.0) 32
A_7 L	50-65 (59±3.2) 23	44-56 (49±2.7) 32
A_7 W	18-20 (18±0.7) 23	16-18 (17±0.7) 32
A_8 L	54-68 (60±3.5) 23	46-57 (52±2.6) 32
A_8 W	11-12 (11±0.5) 23	9-11 (10±0.4) 32
Pronotum L	126-148 (139±5.0) 23	106-138 (123±6.4) 31
MLS	18-38 (25±6.0) 21	12-32 (23±5.2) 26
PAS	92-122 (105±8.8) 24	80-103 (91±6.2) 32
EPS	46-68 (53±5.4) 22	32-56 (45±4.7) 31
Fore wing subbasal B_1	absent	absent
Do. B_2	35-58 (47±5.8) 25	22-48 (37±6.3) 39
Do. B_3	22-48 (33±6.0) 25	12-33 (25±5.1) 39
T_5 lateral seta	80-116 (95±9.1) 21	68-90 (80±5.5) 30
T_9 L	80-86 (82±2.3) 23	70-82 (78±2.9) 32
T_{10} L	156-170 (162±4.2) 23	120-154 (139±6.8) 32
T_9 B_1	144-172 (156±9.5) 21	124-154 (138±7.7) 34
T_9 B_2	162-204 (182±9.5) 23	32-60 (52±5.1) 32
T_9 B_3	100-128 (117±7.1) 18	150-186 (164±10.4) 34

T_9 respectively. Anal seta about 1.0-1.2 as long as T_{10}.

Measurements (μm). Body L 1.1-1.3 mm. Head L, mid dorsal 94-108, including mouth cone 172-180, W 120-132; T_9 L 70-80, W 87-106; T_{10} L 70-76, W 43-61. L (W) of antennal segments: A_3 46-51 (20-23); A_4 45-48 (20-21); A_5 43-46 (17-18); A_6 42-48 (13-14); A_7 38-42 (7-8). Cephalic B_1 22-28, B_2 12-14, B_4 6-9. Pronotal B_1 18-24, B_2 5-8, B_3 3-4, B_4 17-20, B_5 18-22, B_6 20-32, B_7 10-13. Mesonotal B_1 16-25, B_2 10-14, B_6 22-34, B_7 4-10; metanotal B_1 18-22, B_5 24-34. B_1 on T_5 16-20, B_2 20-26, B_3 38-44; B_1 on T_7 20-24, B_3 53-70; B_1 on T_9 94-144, B_2 60-80, B_4 86-102.

Specimens examined. Semenanjung Malaysia — Selangor: Kuala Lumpur: Bukit Nanas, holotype (♀) 15♀ 33♂ & 7 larvae (*Cinnamomum iners*, Lauraceae, Malaysian name: medang teja), IX. 26. 1991; Templer Park, 1♀ (*C. iners*), VIII. 27. 1990; Kedah: Sik: Bukit Perangin, 6♀ 6♂ (*C. iners*), XI. 9. 1991.

Remarks. This species and *L. keladan* have no subbasal seta B_1 on the fore

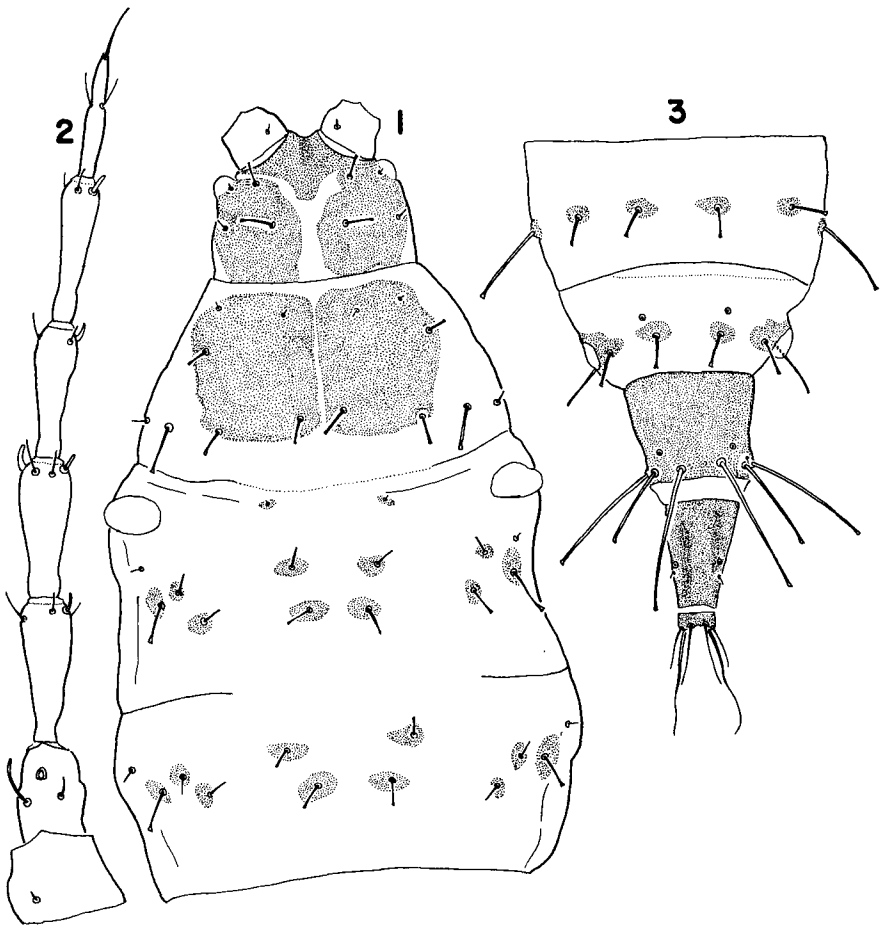

Fig. 7. *Litotetothrips medangteja,* second instar larva. 1. head and thorax, dorsal view. 2. right antenna. 3. T_7-T_{11}.

wing. *L. medangteja* is distinguished from *L. shoreae* by slender antennal segments, by A_3 with an additional seta at middle of inner margin, by the pelta with narrow lateral lobes, and by T_9 with long posteromarginal setae B_1 in the male. The second instar larva also has slender antenna, and differs from the congeners in having shorter setae on the head and thorax.

Litotetothrips rotundus

Gynaikothrips rotundus Moulton 1928 : 304-305.
Litotetothrips rotundus, Takahashi 1936, Philip. J. Sci. 60 : 444.

Adult. Legs dark brown ; fore tibia and tarsus yellow ; mid and hind tarsi pale brown. Head and posteromedian part of metanotum sculptured. Maxillary stylet just reaching below POS ; maxillary bridge absent. A_4 with 2 major sense cones

and a minor cone ; A_6 without a major sense cone at outer apex ; A_3-A_7 usually with 5, 5, 6, 7 and 6 primary setae respectively ; A_3 with only primary setae. Mesopresternum well represented. Fore wing with duplicate FH ; subbasal B_1 occasionally absent. Tergal lateral setae usually pointed, occasionally blunt. In male T_9 with short B_2, and long B_1 and B_3. Body L 1.7-2.3 mm in female, 1.5-1.9 mm in male. Some quantitative characters are given in Table 3 and measurements of body parts in Table 4.

Second instar larva. Generally colored as in *L. pinanganus* ; tibiae pale brown.

Table 3. Quantitative characters in *Litotetothrips rotundus*.

Characters	Female	Male
Head W/L	0.95-1.04 (1.01±0.03) 33	0.96-1.07 (1.01±0.03) 11
IOD/HOW	1.80-2.44 (2.11±0.16) 33	1.80-2.25 (2.08±0.14) 11
OOD/IOD	4.05-4.95 (4.61±0.20) 33	3.95-4.71 (4.41±0.21) 11
OOD/pronotum L	1.27-1.40 (1.33±0.03) 32	1.23-1.31 (1.28±0.03) 11
POS/OOD	0.23-0.33 (0.28±0.02) 27	0.20-0.27 (0.24±0.02) 10
A_3 L/W	2.21-2.67 (2.41±0.10) 32	2.32-2.64 (2.46±0.09) 12
A_4 L/W	1.74-2.07 (1.91±0.09) 32	1.77-2.00 (1.88±0.07) 12
A_5 L/W	1.93-2.25 (2.09±0.11) 32	1.96-2.16 (2.04±0.06) 12
A_6 L/W	2.00-2.48 (2.18±0.13) 32	2.00-2.30 (2.12±0.10) 12
A_7 L/W	2.25-2.90 (2.61±0.16) 32	2.29-2.79 (2.63±0.13) 12
A_8 L/W	3.64-4.83 (4.34±0.28) 32	4.00-4.45 (4.26±0.15) 12
A_6L/A_3L	0.86-0.98 (0.91±0.03) 32	0.82-0.95 (0.90±0.04) 12
A_8L/A_7L	0.87-1.04 (0.97±0.04) 32	0.92-1.02 (0.97±0.04) 12
MLS/pronotum L	0.21-0.38 (0.32±0.04) 28	0.21-0.36 (0.30±0.05) 8
PAS/pronotum L	0.57-0.87 (0.78±0.06) 31	0.46-0.74 (0.63±0.08) 13
EPS/pronotum L	0.36-0.51 (0.43±0.04) 32	0.32-0.43 (0.38±0.04) 10
AMSD/MSD	1.58-3.00 (2.11±0.31) 44	1.54-3.18 (2.14±0.51) 15
T_{10} L/OOD	0.76-0.90 (0.84±0.03) 32	0.78-0.89 (0.83±0.03) 10
T_9B_1/T_9L	1.63-2.05 (1.78±0.11) 31	1.53-1.86 (1.69±0.12) 12
T_9B_2/T_9L	1.91-2.44 (2.11±0.13) 31	0.53-0.70 (0.62±0.05) 12
T_9B_3/T_9L	1.22-1.71 (1.50±0.12) 29	1.73-2.25 (1.95±0.15) 12
No. setae on A_3	5-6 (5.1±0.4) 50	4-6 (5.0±0.4) 27
Do. on A_4	5-6 (5.1±0.3) 50	3-6 (5.0±0.5) 27
Do. on A_5	5-7 (6.0±0.3) 50	5-7 (6.0±0.3) 27
Do. on A_6	6-7 (6.8±0.4) 50	6-8 (7.0±0.3) 27
Do. on A_7	6 (6.0±0.0) 50	5-6 (6.0±0.2) 27
No. pronotal setae	17-22 (19.6±1.4) 33	17-22 (18.8±1.5) 11
No. metanepimeral setae	5-8 (6.7±0.9) 42	5-8 (6.7±0.8) 15
No. mesosternal setae	12-18 (14.5±1.8) 28	12-17 (14.5±2.0) 10
No. metasternal setae	20-33 (26.8±3.2) 28	21-32 (27.9±3.2) 10
No. discal setae on S_5	5-9 (7.5±1.0) 32	6-8 (7.4±0.7) 10
No. FH on fore wing	90-111 (99.5±4.6) 33	90-106 (96.1±5.1) 18
No. duplicate FH	3-10 (6.0±1.6) 35	3-8 (6.1±1.5) 14
No. FH on hind wing	92-112 (98.9±5.2) 27	89-103 (93.8±4.7) 12

Table 4. Measurements of body parts in *Litotetothrips rotundus*, in micra.

Characters	Female	Male
Head L	186-236 (212±10.3) 33	174-202 (193±9.2) 11
Head W	190-230 (214±8.6) 33	183-206 (195±6.8) 11
OOD	162-206 (185±9.7) 33	150-176 (165±7.9) 11
POS	40-60 (52±5.7) 27	32-48 (40±5.0) 10
A_3 L	54-72 (63±4.3) 32	54-60 (58±1.7) 12
A_3 W	21-30 (26±1.9) 32	22-25 (23±0.9) 12
A_4 L	48-66 (58±4.5) 32	46-56 (53±2.7) 12
A_4 W	26-36 (31±2.1) 32	26-30 (28±1.4) 12
A_5 L	50-66 (59±4.0) 32	48-58 (54±3.0) 12
A_5 W	24-34 (28±1.8) 32	24-28 (26±1.3) 12
A_6 L	50-64 (57±3.6) 32	46-54 (52±2.7) 12
A_6 W	23-30 (26±1.5) 32	23-26 (24±1.2) 12
A_7 L	51-62 (56±2.7) 32	48-54 (52±2.2) 12
A_7 W	19-24 (22±1.1) 32	18-21 (20±0.9) 12
A_8 L	48-62 (55±3.1) 32	46-53 (50±1.9) 12
A_8 W	11-14 (13±0.8) 32	11-13 (12±0.6) 12
Pronotum L	116-157 (139±8.4) 33	122-140 (129±7.2) 11
MLS	26-60 (45±7.1) 28	26-48 (40±7.7) 8
PAS	80-130 (109±12.1) 31	74-90 (83±5.6) 13
EPS	42-72 (60±7.0) 32	42-60 (50±5.3) 10
Forewing subbasal B_1	4-16 (7±2.3) 31	4-6 (6±0.8) 10
Do. B_2	30-50 (42±3.9) 36	28-37 (33±2.7) 11
Do. B_3	8-42 (19±8.0) 36	12-34 (21±9.0) 11
T_5 lateral seta	76-106 (92±8.7) 30	64-82 (75±4.9) 10
T_9 L	70-92 (82±4.9) 33	80-86 (83±2.4) 11
T_{10} L	130-174 (155±8.7) 33	128-146 (137±5.7) 11
T_9 B_1	116-160 (144±11.3) 31	126-158 (141±12.7) 12
T_9 B_2	152-200 (173±10.6) 31	42-60 (51±4.8) 12
T_9 B_3	100-146 (123±11.3) 29	142-180 (162±12.4) 12

A_1, A_2 and A_7 brown, A_1 darkest; A_3-A_6 pale yellow, A_6 brownish apically.

Head (Fig. 8.1) W/L 1.1-1.2, with B_3; T_9 L/W 0.74-0.99; T_{10} L/W 0.97-1.23; $T_{10}L/T_9L$ 0.86-1.09. Antenna (Fig. 8.2): dorsal setae on A_2 and inner seta on A_3 blunt apically; A_3-A_7 L/W 2.00-2.27, 1.92-2.21, 2.09-2.38, 2.40-2.79 and 3.11-3.88 respectively: A_6L/A_3L 0.74-0.81; A_7L/A_6L 0.72-0.79. Meso- and metanotum with only setal brown patches. B_1 and B_2 on T_8 (Fig. 8.3) arising each from a brown patch. Spiracles similar to those of *L. pinanganus*; peritreme of mesothoracic spiracle with about 25 cells, that on segment II about 18, on segment VIII with about 12.

Dorsal setae on body mostly expanded apically; cephalic B_4, pronotal B_2 and B_3, mesonotal B_7 and metanotal B_6 pointed or occasionally blunt; setae on T_9 also pointed. Ventral setae pointed except B_2 on S_3 blunt. Cephalic B_1 1.22-1.61 as long as B_2; DB_2-B_2/DB_1-B_2 1.66-1.82. Pronotal B_1 1.00-1.67 as long as B_2; B_6/B_7 1.50-

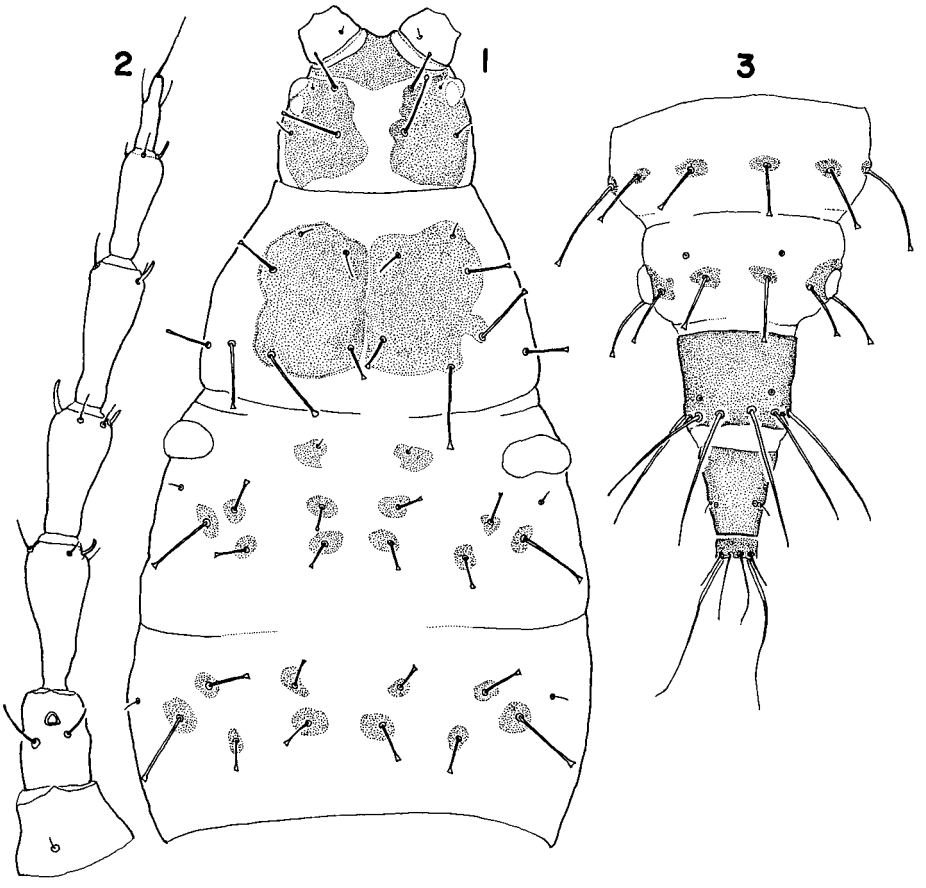

Fig. 8. *Litotetothrips rotundus*, second instar larva. 1. head and thorax, dorsal view. 2. right antenna. 3. T_7-T_{11}.

1.69; DB_1-B_1/DB_1-B_2 0.37-0.53. Mesonotal B_1 1.10-1.42 as long as B_2; DB_1-B_1/DB_1-B_2 1.38-2.63. Metanotal B_1 0.56-0.77 as long as B_5. B_2 on T_5 1.29-1.41 as long as B_1; DB_1-B_1/DB_1-B_2 0.91-1.19; B_3 on T_7 1.79-2.11 as long as B_1. B_2 on T_9 shorter than B_1 and B_4, B_1 1.43-1.71, B_2 1.19-1.42 and B_4 1.41-1.56 as long as T_9 respectively. Anal seta about 1.6-2.1 as long as T_{10}.

Measurements (μm). Body L 1.3-1.6 mm. Head L, dorsal 104-120, including mouth cone 190-200, W 114-130; T_9 L 62-70, W 79-94; T_{10} L 60-74, W 56-62. L (W) of antennal segments: A_3 46-54 (22-24); A_4 46-53 (22-25); A_5 43-50 (19-22); A_6 36-42 (14-16); A_7 28-33 (8-9). Cephalic B_1 41-50, B_2 30-34, B_4 32-38. Pronotal B_1 22-30, B_2 18-22, B_3 8-12, B_4 32-38, B_5 52-60, B_6 50-54, B_7 31-36. Mesonotal B_1 22-32, B_2 20-26, B_6 46-54, B_7 10-12; metanotal B_1 28-34, B_5 44-52. B_1 on T_5 26-32, B_2 35-45, B_3 61-66; B_1 on T_7 34-39, B_3 64-78; B_1 on T_9 94-114, B_2 76-94, B_4 90-106.

Specimens examined. Japan — Sizuoka: Udoyama, 32♀ 14♂ 7 larvae (*Cinnamomum japonicum*), 1♀ 3 larvae (*C. camphora*), VI. 10. 1992; Nagasaki: Inasayama, 1♀ 1♂ 1 larva (*C. japonicum*), X. 21. 1977; Kagosima: Ôdomari: Sata,

5♀ 1♂ (*C. japonicum*), X. 8. 1978; Okinawa: Itoman, 3♀ (*C. japonicum*), XII. 24. 1976.

Remarks. This species is unique in lacking maxillary bridge and an outer major sense cone on A_6. It is also remarkable for the occurrence of the same numbers of antennal setae in the male and the female and also of only five setae on A_3. In the second instar larva it is distinguished from the congeners by T_9 with apically pointed setae.

Litotetothrips pasaniae

Kurosawa 1937: 219-221.

Adult. Legs dark brown; fore tibia and all tarsi yellow. Head and metanotum weakly sculptured; maxillary stylet reaching POS; maxillary bridge weakly present. A_4 with 3 major sense cones; A_6 with 2 major sense cones and 1 minor cone; A_3-A_7 with 6, 5, 5 or 6, 5, and 6 primary setae respectively in female, probably 6, 5, 7, 6 and 6 setae in male; A_3 medially with 1-2 dorsal setae and 1 ventral seta along with primary setae. MLS pointed; mesopresternum well represented. Fore wing without duplicate FH; subbasal B_1 or B_3 occasionally absent. Tergal lateral setae pointed apically except on T_8 blunt or expanded. In male T_9 (L 86 μm) with B_1 (ca. 120 μm), short and thick B_2 (L 65 μm, W 6 μm), and short and thin B_3 (28 μm) as in *L. kochummeni* (cf. Fig. 2.6). Body L 1.6-1.9 mm in female, 1.4 mm in male. Some quantitative characters in female are given in Table 5 and measurements of body parts in Table 6.

Second instar larva. Generally colored as in *L. pinanganus*; legs brown, tibiae paler. A_1 and A_2 brown; A_3-A_7 pale brown, A_6 and A_7 darker.

Head (Fig. 9.1) W/L 1.0-1.2, with B_3; T_9 L/W 0.52-0.75; T_{10} L/W 1.03-1.22; $T_{10}L/T_9L$ 1.03-1.15. Antenna (Fig. 9.2): inner dorsal seta on A_2 usually blunt apically; A_3-A_7 L/W 1.91-2.15, 1.86-2.10, 2.22-2.71, 2.64-3.08 and 3.50-3.88 respectively; A_6L/A_3L 0.80-0.93; A_7L/A_6L 0.70-0.84. Meso- and metanotum (Fig. 9.1) each submedially with 2 pairs of brown patches besides setal patches. B_1 and B_2 on T_8 (Fig. 9.3) arising from a large brown patch (joined patches). Spiracles similar to those of *L. pinanganus* but much smaller: peritreme of mesothoracic spiracle with 15-18 cells, those on segments II and VIII each with 6-8 cells.

Dorsal setae on body mostly expanded apically; cephalic B_4, pronotal B_2 and B_3, mesonotal B_7, and metanotal B_6 pointed, particularly B_3 on T_6 and T_7 (Fig. 9.3) gradually tapering. Ventral setae mostly pointed; B_2 on S_3, S_4 and S_8 expanded. Cephalic B_1 1.47-1.76 as long as B_2, DB_2-B_2/DB_1-B_2 1.79-2.25. Pronotal B_1 1.38-2.50 as long as B_2; B_6/B_7 0.98-1.21; DB_1-B_1/DB_1-B_2 0.27-0.35. Mesonotal B_1 1.22-1.62 as long as B_2; DB_1-B_1/DB_1-B_2 1.05-1.64; metanotal B_1 0.85-0.97 as long as B_5. B_2 on T_5 1.00-1.17 as long as B_1, DB_1-B_1/DB_1-B_2 1.04-1.67; B_3 on T_7 long, curved, about 2.4-3.1 as long as B_1. Major setae on T_9 subequal in length, B_1 0.93-1.11, B_2 0.86-1.07 and B_4 0.91-1.07 as long as T_9 respectively. Anal seta about 2.1-2.4 as long as T_{10}.

Measurements (μm). Body L 1.2-1.5 mm. Head L, mid dorsal 104-108, including mouth cone 170-192, W 112-124; T_9 L 54-58, W 75-103; T_{10} L 58-62, W 50-60. L (W) of antennal segments: A_3 43-46 (20-23); A_4 40-44 (20-22); A_5 40-46 (17-18);

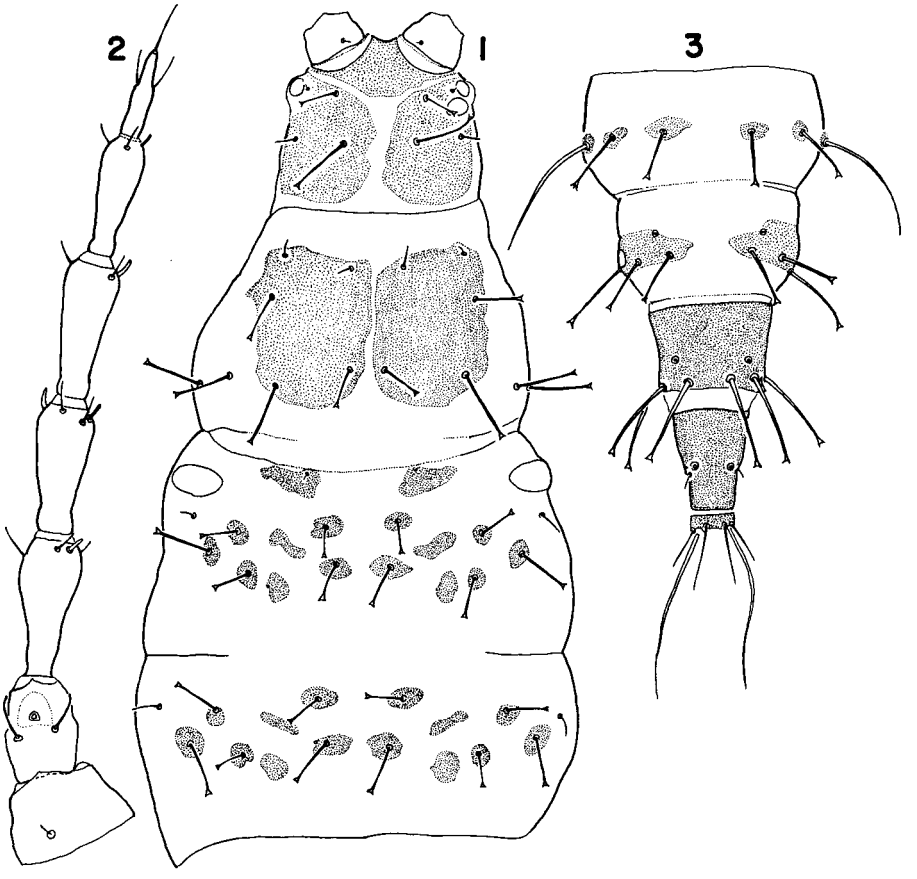

Fig. 9. *Litotetothrips pasaniae*, second instar larva. 1. head and thorax, dorsal view. 2. right antenna. 3. T_7-T_{11}.

A_6 37-40 (12-14); A_7 28-31 (8). Cephalic B_1 38-47, B_2 24-32, B_4 14-18. Pronotal B_1 22-30, B_2 12-18, B_3 8-14, B_4 30-36, B_5 36-55, B_6 39-45, B_7 36-46. Mesonotal B_1 28-34, B_2 21-24, B_6 36-46, B_7 12-18; metanotal B_1 34-41, B_5 38-45. B_1 on T_5 26-31, B_2 28-34, B_3 50-60; B_1 on T_7 30-34, B_3 80-92; B_1 on T_9 53-60, B_2 50-58, B_4 51-58.

Specimens examined. Japan—Sizuoka: Udoyama, 30♀ 8 larvae (*Castanopsis cuspidata*), VII. 13. 1992, 4♀ 1♂ (*C. cuspidata*), III. 2. 1972; Kôti: Suzaki: Urauti, 1 ♀ (*C. cuspidata*), VI. 5. 1982; Ôita: Ôta: Ono, 7♀ (*C. cuspidata*), IV. 30. 1976; Miyazaki: Nitinan: Udo, 1♀ (*C. cuspidata*), X. 26. 1977.

Remarks. This species has no remarkable characters. It is most closely related to *L. berangan* by A_3 with some additional setae, by A_4 with three major sense cones, and by the fore wing without duplicate FH, but is distinguished by thick A_3 (L/W 1.6-1.9) and by mid and hind tibiae brown. In the second instar larva it is distinguished from the congeners by T_6 and T_7 with B_3 gradually tapering.

Litotetothrips roberti

Kudô 1975 : 143-145.

Female. Legs dark brown ; fore tibia brown basally, yellow apically ; mid and hind tarsi pale brown, fore tarsus yellow. Head weakly sculptured in posterior half ; maxillary stylets inserted into POS but not spaced as much as POS ; maxillary bridge well represented. A_4 with 2 major sense cones and 1 minor cone ; A_3-

Table 5. Quantitative characters in females of *Litotetothirips pasaniae* and *L. roberti*.

Characters	*L. pasaniae*	*L. roberti*
Head W/L	1.02-1.20 (1.11±0.05) 27	1.02-1.14 (1.08±0.03) 32
IOD/HOW	2.33-3.71 (2.94±0.37) 29	1.90-2.63 (2.15±0.19) 34
OOD/IOD	2.43-3.48 (2.92±0.30) 27	3.24-3.89 (3.57±0.16) 31
OOD/pronotum L	1.08-1.22 (1.16±0.04) 27	1.04-1.20 (1.11±0.04) 31
POS/OOD	0.31-0.41 (0.36±0.03) 21	0.33-0.52 (0.43±0.05) 30
A_3 L/W	1.66-1.92 (1.80±0.08) 27	1.93-2.42 (2.12±0.13) 31
A_4 L/W	1.45-1.84 (1.62±0.10) 27	1.50-2.00 (1.68±0.11) 31
A_5 L/W	1.56-2.00 (1.77±0.12) 27	1.62-1.96 (1.79±0.09) 31
A_6 L/W	1.58-2.10 (1.90±0.15) 27	1.71-2.04 (1.89±0.08) 31
A_7 L/W	2.28-3.00 (2.63±0.19) 27	2.10-2.78 (2.41±0.14) 31
A_8 L/W	4.36-6.00 (4.93±0.38) 27	3.93-5.80 (4.67±0.35) 31
A_6L/A_3L	0.83-0.96 (0.89±0.04) 27	0.77-0.90 (0.84±0.03) 31
A_8L/A_7L	1.06-1.24 (1.16±0.04) 27	1.03-1.27 (1.17±0.05) 31
MLS/pronotum L	0.27-0.41 (0.35±0.04) 15	0.28-0.45 (0.37±0.05) 31
PAS/pronotum L	0.61-0.85 (0.74±0.06) 26	0.60-0.68 (0.63±0.03) 31
EPS/pronotum L	0.42-0.62 (0.54±0.05) 22	0.47-0.60 (0.53±0.03) 31
AMSD/MSD	0.95-1.44 (1.15±0.12) 30	0.77-1.34 (1.04±0.12) 40
$T_{10}L$/OOD	0.90-1.11 (0.99±0.06) 26	0.96-1.11 (1.04±0.04) 31
T_9B_1/T_9L	1.71-2.18 (1.83±0.11) 26	1.37-1.74 (1.56±0.09) 32
T_9B_2/T_9L	1.94-2.44 (2.08±0.11) 26	1.50-2.11 (1.88±0.13) 32
T_9B_3/T_9L	1.0-1.4 (1.24±0.11) 14	1.0-1.3 (1.20±0.09) 19
No. setae on A_3	5-6 (6.0±0.1) 50	5-7 (6.0±0.2) 50
Do. on A_4	5 (5.0±0.0) 50	4-6 (5.1±0.3) 50
Do. on A_5	5-7 (5.7±0.5) 50	4-6 (4.9±0.4) 50
Do. on A_6	4-6 (5.3±0.6) 50	4-6 (5.0±0.6) 50
Do. on A_7	5-6 (5.9±0.2) 50	5-6 (5.9±0.3) 50
No. pronotal setae	15-22 (19.2±1.9) 26	15-19 (16.8±1.2) 32
No. metanepimeral setae	6-8 (6.5±0.6) 30	6-9 (6.9±0.8) 34
No. mesosternal setae	12-16 (13.9±1.3) 17	12-17 (13.5±1.5) 28
No. metasternal setae	20-25 (22.9±1.5) 17	16-24 (20.6±1.8) 27
No. discal setae on S_5	5-10 (7.1±1.5) 27	4-8 (5.6±1.0) 30
No. FH on fore wing	81-105 (92.7±4.6) 30	86-100 (93.5±3.9) 40
No. duplicate FH	absent	4-9 (6.5±1.1) 36
No. FH on hind wing	82-101 (90.1±4.9) 30	80-100 (89.2±4.7) 37

A_7 with 6, 5, 5 or 6, 5 and 6 primary setae respectively; A_3 often with 1 ventral seta along with primary setae. MLS and EPS blunt apically; mesopresternum rudimentary. Fore wing with duplicate FH; any of subbasal setae occasionally absent. Pelta with a pair of campaniform sensilla; tergal lateral setae blunt or pointed apically. Body L 1.7-1.9 mm. Some quantitative characters are given in Table 5 and measurements of body parts in Table 6. Male unknown.

Second instar larva. Generally colored as in *L. pinanganus*; legs brown, tibiae yellow apically. A_1 and A_2 brown, A_3-A_7 pale yellow, A_7 grayish.

Head (Fig. 10.1) W/L 1.1-1.3, without B_3; T_9 L/W 0.65-0.85; T_{10} L/W 1.17-1.31; T_{10} L/T_9L 0.95-1.00. Antenna (Fig. 10.2): inner dorsal seta on A_2 expanded or blunt apically, outer seta on A_2 and inner one on A_3 usually blunt; A_3-A_7 L/W 1.84-2.08, 2.00-2.18, 2.11-2.32, 2.53, and 3.50-4.00 respectively; A_6L/A_3L 0.76-0.83; A_7L/A_6L 0.74-0.84. Meso- and metanotum each submedially with 2 pairs of brown

Table 6. Measurements of body parts in females of *Litotetothrips pasaniae* and *L. roberti*, in micra.

Characters	*L. pasaniae*	*L. roberti*
Head L	156-200 (172±10.2) 27	160-188 (173±6.5) 32
Head W	170-204 (190±6.5) 27	178-197 (187±4.9) 32
OOD	126-156 (141±6.6) 27	134-151 (144±4.7) 31
POS	42-59 (50±4.3) 21	44-74 (62±8.1) 30
A_3 L	42-52 (48±2.7) 27	52-62 (56±2.7) 31
A_3 W	23-29 (27±1.4) 27	24-28 (26±1.1) 31
A_4 L	40-52 (47±3.0) 27	42-54 (48±2.8) 31
A_4 W	25-31 (29±1.2) 27	27-31 (29±1.2) 31
A_5 L	38-53 (43±8.5) 27	42-50 (46±2.7) 31
A_5 W	24-27 (25±0.9) 27	24-28 (26±1.2) 31
A_6 L	33-50 (43±3.6) 27	41-50 (46±2.4) 31
A_6 W	21-24 (22±1.0) 27	23-26 (25±0.8) 31
A_7 L	39-50 (46±2.8) 27	42-52 (47±2.5) 31
A_7 W	16-20 (17±0.9) 27	18-22 (19±1.1) 31
A_8 L	46-61 (53±3.5) 27	48-60 (55±3.0) 31
A_8 W	9-12 (11±0.8) 27	10-14 (12±0.7) 31
Pronotum L	106-130 (122±5.5) 27	115-136 (130±5.3) 31
MLS	30-48 (41±5.5) 16	32-60 (48±7.1) 31
PAS	72-100 (91±6.8) 27	70-88 (82±4.0) 31
EPS	50-72 (65±5.2) 22	54-76 (69±5.4) 31
Fore wing subbasal B_1	6-36 (17±6.4) 27	8-18 (13±2.1) 30
Do. B_2	16-46 (31±6.5) 29	28-48 (36±4.3) 31
Do. B_3	16-46 (31±6.8) 27	20-47 (31±5.1) 32
T_5 lateral seta	60-78 (72±4.8) 22	64-90 (79±6.7) 29
T_9 L	66-82 (75±4.5) 26	72-87 (80±3.4) 32
T_{10} L	118-165 (140±12.9) 26	136-162 (151±6.8) 32
T_9 B_1	116-148 (137±14.4) 26	112-136 (125±6.1) 32
T_9 B_2	132-200 (155±15.4) 26	126-172 (152±9.3) 32
T_9 B_3 (roughly measured)	80-110 (93±8.0) 14	80-110 (96±8.0) 19

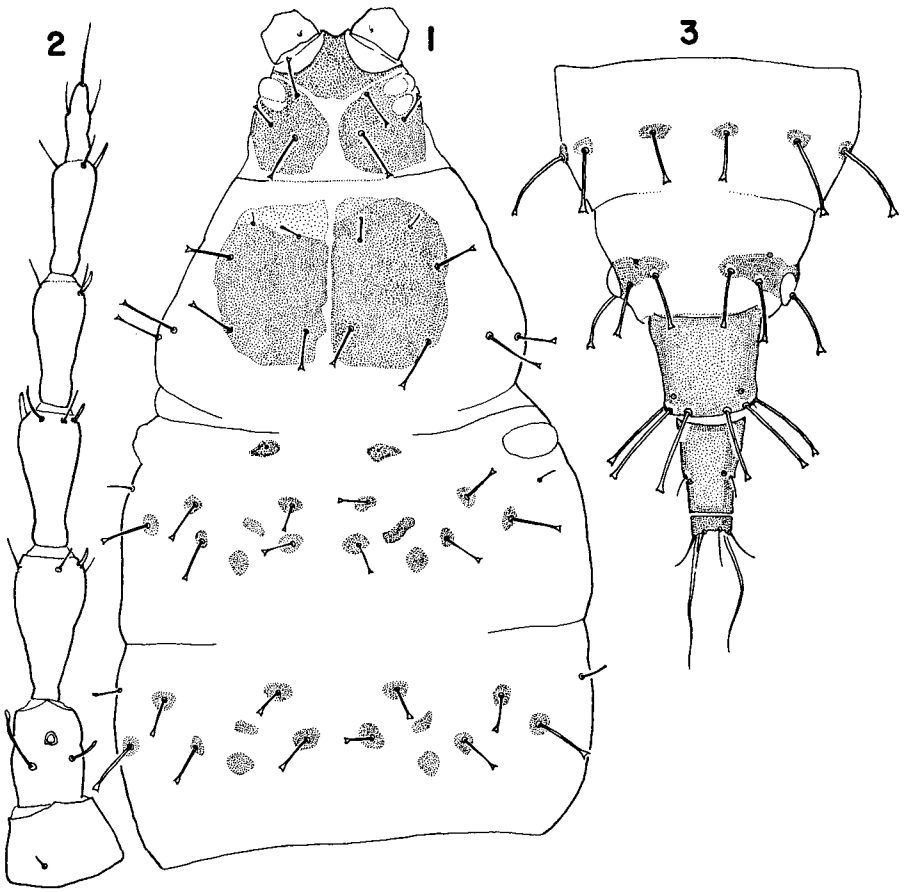

Fig. 10. *Litotetothrips roberti*, second instar larva. 1. head and thorax, dorsal view. 2. right antenna. 3. T_7-T_{11}.

patches besides setal patches. B_1 and B_2 on T_8 (Fig. 10.3) arising from a large brown patch (joined patches). Spiracles similar to those of *L. pinanganus* but smaller; peritreme of mesothoracic spiracle with 20-23 cells, that on segment II with 10-11.

Dorsal setae on body expanded apically; cephalic B_4 and pronotal B_2 occasionally pointed or blunt, pronotal B_3 and mesonotal B_7 pointed, metanotal B_6 blunt. Ventral setae mostly pointed; B_2 on S_3 and S_4 often blunt, on S_8 blunt or expanded. Cephalic B_1 1.20-1.35 as long as B_2, DB_2-B_2/DB_1-B_2 1.61-2.08. Pronotal B_1 1.41-1.75 as long as B_2, B_6/B_7 1.11-1.31, DB_1-B_1/DB_1-B_2 0.45-0.53. Mesonotal B_1 1.09-1.60 as long as B_2, DB_1-B_1/DB_1-B_2 1.52-2.04; metanotal B_1 0.68-0.84 as long as B_5. B_2 on T_5 about 1.25 as long as B_1, DB_1-B_1/DB_1-B_2 1.17-1.56; B_3 on T_7 1.50-1.67 as long as B_1. Major setae on T_9 subequal in length, B_1 0.91-1.02, B_2 0.91-0.95 and B_4 0.91-0.98 as long as T_9 respectively. Anal seta 1.7-2.0 as long as T_{10}.

Measurements (μm). Body L 1.4-1.5 mm. Head L, mid dorsal 98-102, including mouth cone 164-186, W 112-120; T_9 L 63-66, W 78-102; T_{10} L 63-68, W 48-58.

L (W) of antennal segments: A_3 46-50 (24-25); A_4 44-48 (22); A_5 40-44 (19-20); A_6 38 (18); A_7 28-32 (8). Cephalic B_1 36-42, B_2 30-31, B_4 22-26. Pronotal B_1 30-35, B_2 18-22, B_3 12-14, B_4 30-34, B_5 40-48, B_6 42-48, B_7 35-38. Mesonotal B_1 24-32, B_2 20-22, B_6 36-38, B_7 18-22; metanotal B_1 28-32, B_5 38-42. B_1 on T_5 32-34, B_2 40-42, B_3 54-60; B_1 on T_7 35-40, B_3 55-60; B_1 on T_9 60-64, B_2 60-61, B_4 60-62.

Specimens examined. Japan — Niigata: Kanose: Tunogami, 1♀ (*Akebia quinata*), VIII. 26 1977; Nagano: Sinano: Noziri, 1♀ (*Quercus serrata*), VIII. 26. 1978; Sizuoka: Umegasima (700 m), 10♀ 4 larvae (*Q. serrata*), IX. 15. 1971, 18♀ (*Q. serrata*), X. 24. 1985; Mie: Nagasima: Higasinagasima, 4♀ (*Q. serrata*), X. 26. 1976; Yamaguti: Nagato: Senzaki, 1♀ (*Castanopsis cuspidata*), X. 17. 1976.

Remarks. This species is unique in having a pair of campaniform sensilla on the pelta and in the fore tibia brown basally. It is related to *L. keladan* by the rudimentary mesopresternum, the well-represented maxillary bridge and A_4 with two major sense cones, but is distinguished by the fore wing with duplicate FH. In the second larva it is distinguished from the congeners in having no cephalic B_3.

KEY TO THE SPECIES

Female

1. Fore wing with duplicate FH 2
– Fore wing without duplicate FH 6
2. T_1 with a pair of campaniform sensilla on pelta; mesopresternum clearly reduced; fore tibia brown at least in basal half; on *Quercus serrata* ..... *roberti*
– T_1 without campaniform sensilla on pelta; mesopresternum well represented; fore tibia yellow 3
3. Mid and hind tibiae dark brown 4
– Mid and hind tibiae yellow 5
4. A_4 with 2 major sense cones; A_3 with primary setae only; A_6 without major sense cone at outer apex; head sculptured posteriorly; maxillary bridge absent; OOD 1.3-1.4 as long as pronotum; A_8 0.9-1.0 as long as A_7; on *Cinnamomum japonicum* and *C. camphora* ..... *rotundus*
– A_4 (Fig. 4.2) with 3 major sense cones; A_3 with some setae along with primary setae; A_6 with major sense cone at outer apex; head (Fig. 4.1) unsculptured; maxillary bridge weakly present; OOD 1.1-1.2 as long as pronotum; A_8 1.1-1.2 as long as A_7; on *Engelhardtia spicata* ..... *pinanganus*
5. Fore wing without subbasal B_1; A_3 2.2-2.6 as long as wide; MLS and EPS not expanded, only blunt apically; on *Cinnamomum iners* ..... *medangteja*
– Fore wing with 3 subbasal setae; A_3 scarcely 2.0 as long as wide; MLS and EPS expanded apically; on *Shorea leprosula* and *S. acuminata* ..... *shoreae*
6. Mesopresternum clearly reduced; A_3 with primary setae only; B_3 on T_9 about 0.5 as long as T_9; fore wing without subbasal B_1; on *Dryobalanops oblongifolia* ..... *keladan*
– Mesopresternum well represented; A_3 with some setae along with primary setae; B_3 on T_9 1.0-1.6 as long as T_9; fore wing normally with 3 subbasal setae; on *Castanopsis* 7
7. Mid and hind tibiae dark brown; A_6 usually with 5 setae; on *C. cuspidata* ..... *pasaniae*
– Mid and hind tibiae yellow; A_6 usually with 6 setae 8
8. A_4 with 2 major sense cones; B_1 and B_2 on T_9 1.9-2.2 and 2.2-2.5 as long as T_9 respectively; on *Castanopsis* sp. ..... *kochummeni*
– A_4 with 3 major sense cones; B_1 and B_2 on T_9 1.5-1.8 and 1.9-2.1 as long as T_9 respectively; on *C. schefferiana* ..... *berangan*

Male

1. Fore wing with duplicate FH 2

- Fore wing without duplicate FH 4
2. Mid and hind tibiae dark brown ; A_4 with 2 major sense cones ; A_6 without major sense cone at outer apex ; maxillary bridge absent ; on *Cinnamomum* ..... *rotundus*
- Mid and hind tibiae yellow ; A_4 with 3 major sense cones ; A_6 with major sense cone at outer apex ; maxillary bridge present 3
3. B_1 on T_9 short, about 0.5 as long as B_2 ; A_3 scarcely 2.0 as long as wide ; fore wing with 3 subbasal setae ; on *Shorea* ..... *shoreae*
- B_1 on T_9 long, more than 2.0 as long as B_2 ; A_3 2.3-2.7 as long as wide ; fore wing without subbasal B_1 ; on *Cinnamomum* ..... *medangteja*
4. B_3 on T_9 (Fig. 1.6) long, 1.9-2.1 as long as T_9 ; mesopresternum clearly reduced ; fore wing without subbasal B_1 ; on *Dryobalanops* ..... *keladan*
- B_3 on T_9 (Figs. 2.6, 3.6) short and thin, 0.3-0.4 as long as T_9 ; mesopresternum well represented ; fore wing normally with 3 subbasal setae ; on *Castanopsis* 5
5. Mid and hind tibiae dark brown ..... *pasaniae*
- Mid and hind tibiae yellow 6
6. A_4 with 2 major sense cones ; B_2 on T_9 0.6-0.7 as long as T_9 ..... *kochummeni*
- A_4 with 3 major sense cones ; B_2 on T_9 1.2-1.3 as long as T_9 ..... *berangan*

Second instar larva

1. Meso- and metanotum (Fig. 5.1) each submedially with 2 pairs of brown patches besides setal patches ; B_1 and B_2 on T_8 (Fig. 5.3) arising from a large brown patch ; B_1, B_2 and B_4 on T_9 clearly expanded apically, subequal in length 2
- Meso- and metanotum (Fig. 7.1) with only setal brown patches ; B_1 and B_2 on T_8 (Fig. 7.3) arising each from a brown patch ; B_1, B_2 and B_4 on T_9 not expanded, B_2 clearly shorter than B_1 and B_4 ; on *Cinnamomum* 4
2. B_3 on T_6 and T_7 (Fig. 9.3) long, gradually tapering ; B_3 on T_7 2.4-3.1 as long as B_1 ; cephalic B_1 longer, 1.5-1.8 as long as B_2 ; on *Castanopsis* ..... *pasaniae*
- B_3 on T_6 and T_7 (Fig. 10.3) shorter, expanded apically ; B_3 on T_7 1.5-1.7 as long as B_1 ; cephalic B_1 shorter, 1.2-1.3 as long as B_2 3
3. Head with B_3 ; pronotal B_1 more than 2.0 as long as B_2 ; mesonotal DB_1-B_1/DB_1-B_2 0.9-1.1 ; on *Engelhardtia* ..... *pinanganus*
- Head (Fig. 10.1) without B_3 ; pronotal B_1 less than 2.0 as long as B_2 ; mesonotal DB_1-B_1/DB_1-B_2 1.5-2.0 ; on *Quercus* ..... *roberti*
4. B_1, B_2 and B_4 on T_9 (Fig. 7.3) blunt apically ; A_7 4.8-5.7 as long as wide ; pronotal B_1 3.0-4.0 as long as B_2 ; pronotal B_7 pointed, shorter than B_1 ; B_3 on T_7 2.5-2.9 as long as B_1 ..... *medangteja*
- B_1, B_2 and B_4 on T_9 (Fig. 8.3) pointed apically ; A_7 3.1-3.9 as long as wide ; pronotal B_1 1.0-1.7 as long as B_2 ; pronotal B_7 blunt, at least as long as B_1 ; B_3 on T_7 1.8-2.1 as long as B_1 ..... *rotundus*

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