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Tetranychidae (Acari: Prostigmata) of Malay Peninsula: Checklist, key to genera and species and description of three new species

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Abstract

Tetranychid mites previously recorded in Malaysia consist of eight genera with 21 species. This paper records a genus new to Malaysia and three new species (*Schizotetranychus hidayahae* Yusof & Zhang **sp. nov.**, *Tetranychus arifi* Yusof & Zhang **sp. nov.** and *Tetranychus ismaili* Yusof & Zhang **sp. nov.**) to the tetranychid fauna of Malaysia. New hosts and localities of many other species are also recorded. Keys to genera and species of tetranychid mites of Malaysia are provided.

Key words: Acari, Tetranychidae, Malaysian fauna, identification, new species, new records

Introduction

The Tetranychidae is an important acarine family in the order Prostigmata; many species of which often cause heavy losses to major food crops and ornamental plants. This family is commonly known as spider mites and is characterized by a stylophore and a pair of long whip-like recurved chelae (stylets). The peritremes arise from the base of the stylophore, ending simply or anastomosing distally.

There are about 1,200 described species of spider mites in the world (Bolland *et al.* 1998). In Malaysia, Greenstreet & Lambourbe (1933) identified the first tetranychid on *Manihot esculenta*. Jeppson *et al.* (1975), Rajaratnam & Hock (1975) and Flechtmann (1981) added three more species to the Malaysian record; and in 1988 Ehara & Tho (1988) treated 16 more species. Yusof & Zhang (2003) added another new genus new to Malaysia and a new species. Until now 21 Malaysian species of this family belong to eight genera: *Aponychus*, *Eutetranychus*, *Oligonychus*, *Panonychus*, *Schizotetranychus*, *Stylophoronychus*, *Tetranychus* and *Tenuipalponychus.*

In this paper, we report on the results of a recent survey of spider mites from the Malay Peninsula. We also provide a review of tetranychid mites recorded from Malaysia, with keys to genera and species.

Material and methods

Mite samples were collected from infected leaves in the north, east and central parts of the Malay Peninsula between October 2001 and February 2003. Infected foliage was cut and placed in plastic

bags. The leaves were brought to the laboratory and examined under a dissecting microscope. All mites found on the leaves were removed into a vial of 70% alcohol. Each vial was labelled with the locality and date of collection and host plant information.

All the vials were brought to Landcare Research, Auckland, New Zealand. All mites from each vial were then mounted on slides in Hoyer's medium and dried in the oven for 7 to 14 days at 40°C.

The mites were studied using an interference phase-contrast microscope. Line drawings were prepared with the aid of a drawing tube attached to the microscope. Measurements listed below were made in micrometers (μm). Terminology follows that of Lindquist (1985).

All published literature of tetranchid mites from Malaysia was acquired and is listed in this paper. Keys to the genus and species of these were developed during the course of the study.

In cases where new species are described, the holotype will be deposited in the Insect Museum, Entomology Section, Department of Agriculture, Jalan Gallagher, Malaysia. A paratype is deposited in the New Zealand Arthropod Collection (NZAC) at Landcare Research, Auckland.

Key to genera of Tetranychidae found in Malay Peninsula

1. Empodium claw-like or split distally; tarsus I with 2 pairs of duplex setae and tarsus II with 1 pair of duplex setae 2
   Empodium claw-like when present, tarsus I with loosely associated setae or with 1 pair of duplex setae, when 2 pairs of duplex setae on tarsus I, then no pair on tarsus II 3
2. Opisthosoma with f_1 in marginal position; empodium simple claw; tarsus II with distal member of duplex setae a long solenidion ..... *Tenuilpalponychus* Channabasavanna & Lakkundi
   Opisthosoma with f_1 in normal dorsal position 5
3. Opisthosoma with 9 pairs of dorsal setae ..... *Stylophoronychus* Prasad
   Opisthosoma with 10 pairs of dorsal setae 4
4. With 2 pairs of anal setae (ps_{1-2}) ..... *Eutetranychus* Banks
   With 1 pair of anal setae ..... *Aponychus* Rimando
5. With 2 pairs of para-anal setae (h_{2-3}) 6
   With 1 pair of para-anal setae 8
6. Empodium a single claw-like structure as long or longer than the proximoventral hairs, which is set at right angles to the claw ..... *Panonychus* Yokohama
   Empodium ending in a tuft of hairs or claw-like but split into 2 prongs 7
7. Claw-like empodium split into prongs near the middle ..... *Schizotetranychus* Trägårdh
   Empodium split into 3 pairs of proximoventral hairs; 2 pairs of anal setae; ophisthosoma with transverse striae ..... *Eotetranychus* Oudemans
8. Claw-like empodium as long as or longer than proximoventral hair; tarsus I with 2 pairs of duplex setae adjacent ..... *Oligonychus* Berlese
   Empodium not claw-like, divided distally; tarsus I with 2 pairs of duplex setae well separated apart *Tetranychus* Dufor

***Aponychus* Rimando**

1. *Aponychus corpuzae* Rimando, 1966

Aponychus corpuzae Rimando, 1966: 107, Figs 1–4; Rimando, 1968: 7, Fig 1.; Ehara 1969: 87, Figs 12–18; Ehara & Tho, 1988: 3.

Rimando (1966) separated *Aponychus* from *Eutetranychus* by the presence of one instead of two pairs of anal setae. The female is characterized by a laterally concave idiosoma and two groups of setae different in shape and size. The hysterosoma bears 10 pairs of setae and setae e_2, f_1 and f_2 are situated marginally. The leg empodium is reduced to a knob-like protuberance.

Host and locality: Ehara & Tho (1988) recorded this mite in Malaysia on *Bambusa vulgaris* and *Thyrsostachys siamensis* from Kepong, Selangor, and Kuala Lumpur, Wilayah Persekutuan. In this study it was also collected on *Syzygium aquaeum* from Sungai Udang, Melaka.

Specimen examined: One female, Sungai Udang, Melaka, collected by Abu Bakar Dawam, 10 January, 2003 on *Syzygium aquaeum* (Myrtaceae)

Eotetranychus Oudemans

2. *Eotetranychus* sp.

Eotetranychus Oudemans, 1931: 221–236; Pritchard & Baker, 1955: 138; Meyer 1987: 110.

This genus can be identified by the presence of two pairs of anal setae (ps_{1-2}) and two pairs of para-anal setae (h_{2-3}) in the female. The duplex setae on tarsus I are distal and adjacent. This genus is here recorded in Malaysia for the first time. However, the lack of male specimens in the collection prevented further identification of the specimen to species level.

Host and locality: This species was found on *Lancium domesticum*, Jasin, Melaka.

Specimens examined: Eight females, Jasin, Melaka, collected by Abu Bakar Dawam, 16 January, 2003 on *Lancium domesticum.*

Eutetranychus Banks

3. *Eutetranychus orientalis* (Klien, 1936)

Anychus orientalis Klien, 1936, 21:3.
Eutetranychus orientalis, Baker & Prichard, 1960: 464, Fig 5; Ehara, 1969: 86, Figs. 4–11; Ehara & Lee, 1971: 75, Figs. 48–50; Ehara & Tho, 1988: 2.

This genus has a rudimentary empodium consisting of a small rounded knob. Tarsi I and II bear a pair of loosely associated setae. The prodorsal striae in *E. orientalis* are longitudinal and tuberculate. The striation pattern between setae d_1 and e_1 vary from longitudinal to v-shaped. The hysterosoma has 10 pairs of dorsal setae arising from tubercles. The terminal eupathium of palpal tarsus in the female is about three times as long as wide and that in the male is about twice longer than wide.

Host and locality: This species was recorded on *Bauhinia purpurea* and *Manihot* sp. from Kepong, Selangor, *Carica papaya, Derris* sp. and *Hevea brasiliensis* from Port Dickson, Negeri Sembilan (Ehara & Tho, 1988). In this study, this species is recorded for first time on *Averrhoa bilimbi* (Averrhoaceae) from Sungai Udang, Melaka.

Specimen examined: One female, Sungai Udang, Melaka, collected by Abu Bakar Dawam, 10 January, 2003 on *Averrhoa bilimbi*

***Oligonychus* Berlese**

Key to species

1. Tibia I with 7 tactile setae, tibia II with 5 tactile setae ..... *coffeae* (Nietner)
- Tibia I with 9 tactile setae, tibia II with 7 tactile setae; peritremes hooked distally .... *biharensis* (Hirst)

4. *Oligonychus biharensis* (Hirst, 1925)

Paratetranychus biharensis Hirst, 1924: 69, Fig. 15.
Oligonychus biharensis, Pitchard & Baker, 1955: 364, Figs. 316–318; Ehara & Tho, 1988: 17, Fig. 68.

The distally retrorse peritremes differentiate the female of this species from other species in this group. The male aedeagus is enlarged distally with its axis parallel to the shaft. The knob dorsal margin is convex and its acute posterior end pointing downward.

Host and locality: This species was recorded infesting *Bauhinia purpurea* and *Manihot* sp. from Kepong, Selangor, and also *Grewia paniculata* and *Tamarindus indicus* from Kuala Lumpur, Wilayah Persekutuan (Ehara & Tho, 1988). In this study the specimen was collected from *Artocarpus comminis* from Tangkak, Johor. This is the first record of this species on fruit crops in Malaysia.

Specimens examined: Three females and four males, Tangkak, Johor, collected by Abu Bakar Dawam, 19 February, 2003 on *Artocarpus comminis* (Moraceae*)*

5. *Oligonychus coffeae* (Nietner, 1861)

Acarus coffeae Nietner, 1861: 1–31.
Oligonychus coffeae, Pritchard & Baker, 1955: 315, Figs. 268–269; Ehara & Tho, 1988: 18.

The female hysterosoma striae are mostly transverse with v-shape or irregular pattern between setae e_1. The male aedeagus bends ventrad at the right angle to the shaft and gradually narrows to a slender truncate tip.

Host and locality: *Oligonychus coffeae* was found on *Hydnocarpus woodi* and *Saraca thaipingensis* from Kepong, Selangor, *Ixora javanica* and *Litsea umbellata* from Port Dickson, Neger Sembilan (Ehara & Tho, 1988). The species is here recorded for the first time on the fruit tree *Syzigium aqueum* from Sungai Udang, Melaka.

Specimens examined: Five females and 4 males, Sungai Udang, Melaka, collected by Ng King Ong and Abu Bakar Dawam, 9 January, 2003 on *Syzigium aqueum* (Myrtaceae).

***Panonychus* Yokoyama**

6. *Panonychus citri* (McGregor 1916)

Tetranychus citri McGregor 1916, 9: 286, plate 14, Figs. 1–9.
Panonychus citri, Ehara, 1956: 500; Ehara & Tho, 1988: 3, Fig. 67.

This species has dorsal setae borne on strong tubercles and the setae are longer than the distances to the insertions of the next setae. *Panonychus citri* can be separated from *P. ulmi* by having the same length of the setae f_2 and h_1 while setae f_2 are a third length of h_1 in *P. ulmi*.

Host and locality: *Panonychus citri* is here reported on *Colocasia* sp., from Temerloh, Pahang and *Fragraria virginia, Rosa chinensis* and *Hedycarya angustica* from Cameron Highland, Pahang. Previously this species was found on *Argyreia* sp. from Kuala Lumpur, Wilayah Persekutuan (Ehara & Tho, 1988).

Specimens examined: Two females, Temerloh, Pahang, collected by Yusof Othman, June 20, 2002 on *Colocasia* sp.; one female, Cameron Highlands, Pahang, collected by Yusof Othman, 14 July, 2002 on *Fragraria virginia*; 12 females, Cameron Highlands, Pahang, collected by Yusof Othman, 16 July, 2002 on *Rosa chinensis* (Rosaceae); one female, Cameron Highlands, collected by Yusof Othman, 16 July, 2002 on *Hedycarya angustica.*

Stylophoronychus Prasad

7. *Stylophoronychus vannus* (Rimando)

Aponychus vannus Rimando, 1968: 8, Fig. 3.
Stylophoronychus vannus, Meyer, 1987: 88; Ehera & Tho, 1988: 3; Zhang *et al.*, 2000: 44.
Sinotetranychus vannus, Bolland, Gutierrez & Flechtmann, 1998: 174.

The female has nine pairs of hysterosomal setae and three pairs of caudal setae at the marginal position. Their setae are palmate and subcircular.

Host and locality: This species was recorded on *Bambusa vulgaris*, *Thyrsostachys siamensis* and *Gigantochloa levis* from Kepong, Selangor (Ehara & Tho, 1988).

Schizotetranychus Trägårdh

Key to species

1. Tibia II with 7 tactile setae; aedeagus with a terminal knob 2
   Tibia II with 4 or 5 tactile setae; aedeagus without a terminal knob 3
2. Aedeagal knob with posterior projection tapering, not obviously differentiated from the neck . ..... *colocasiae* Ehara & Tho
   Aedeagal knob with posterior projection obviously differentiated from the neck; dorsal margin of the projection subparallel to the ventral margin ..... *malayanus* Ehara & Tho
3. Tibia II with 5 tactile setae 4
   Tibia II with 4 tactile setae 5
4. Distance between pair of c_1 about 3 times as long as distance c_1 and c_2 .... *kochummeni* Ehara & Tho
   Distance between pair of c_1 about one third as long as distance c_1 and c_2 ... *hidayahae sp. nov.*
5. Distance between pair of c_1 about half as long as distance between c_1 and c_2 .... *approximatus* Ehara & Tho
   Distance between pair of c_1 about as long as or slightly shorter distance between c_1 and c_2 6

6. Idiosoma without striae on the dorsocentral area except for the caudal portion; setae sc_1 noticeably longer than sc_2 ..... *laevidorsatus* Ehara & Tho
Idiosoma with striae on the dorsocentral area; setae sc_1 as long as sc_2 ..... *saitoi* Ehara & Tho

8. *Schizotetranychus approximatus* Ehara & Tho

Schizotetranychus approximatus Ehara & Tho, 1988: 10–12, Figs. 31–43.

This genus is characterized by having the empodium bifid. The dorsocentral setae of this species are longer than the dorsolateral setae. The distance between c_1 is about half the distance between c_1 and c_2. The male aedeagus is abruptly upturned posteriorly and ending in a rather truncate tip.

Host and locality: This species was recorded on *Bambusa vulgaris* from Kepong, Selangor and *Thyrsostachys siamensis* Kuala Lumpur, Wilayah Persekutuan (Ehara & Tho, 1988).

9. *Schizotetranychus colocasiae* Ehara & Tho

Schizotetranychus colocasiae Ehara & Tho, 1988: 4–6, Figs. 1–8, 11–14.

The length of the dorsal setae is approximately the same as the distance to the insertions of the next setae. The knob of the male aedeagus is tapering and not differentiated from the neck.

Host and locality: This species was found on *Colocasia* sp. from Kepong, Selangor (Ehara & Tho, 1988).

10. *Schizotetranychus kochummeni* Ehara & Tho

Schizotetranychus kochummeni Ehara & Tho, 1988: 7–9, Figs. 19–30.

The dorsal setae are longer than the distance to the insertions of the next setae. The distance between c_1 is about three times the distance between c_1 and c_2. The male aedeagus turns dorsad at right angle to the shaft, ending in a rather truncate tip.

Host and locality: The species was recorded on *Bambusa* sp. from Kuala Lumpur, Wilayah Persekutuan (Ehara & Tho, 1988).

11. *Schizotetranychus laevidorsatus* Ehara & Tho

Schizotetranychus laevidorsatus Ehara & Tho, 1988: 12–14, Figs. 44–54.

The dosorcentral setae are longer than the remaining setae of the body. The peritremes are hooked distally. The distance between c_1 is equal to the distance between c_1 and c_2. The male aedeagus is sigmoid at the distal part with the axis directed at about the right angle to the shaft.

Host and locality: This species was recorded on *Gigantochloa levis* from Kepong, Selangor, and *Bambusa* sp. from Kuala Lumpur, Wilayah Persekutuan (Ehara & Tho, 1988).

12. *Schizotetranychus malayanus* (Ehara & Tho)

Schizotetranychus malayanus Ehara & Tho, 1988: 6–7, Figs. 9–10, 15–18.

The peritremes are dilated distally. The hysterosomal setae are longer than the distance to the insertion of the next setae. The aedeagus is tiny, bent dorsad, with terminal knob slender and as long as the dorsal margin of the shaft. The anterior projection of the knob is angular and very small, but the posterior projection is elongate.

Host and locality: This species was found on *Manihot* sp. from Kuala Lumpur, Wilayah Persekutuan (Ehera & Tho, 1988).

13. *Schizotetranychus saitoi* Ehara & Tho

Schizotetranychus saitoi Ehara & Tho, 1988: 14–16, Figs. 55–66.

The dorsal setae are slender and pubescent with c_1 the longest. The peritremes are hooked distally. The aedeagus is gently bent dorsad to form a sigmoid distal portion. This species differs from *S. laevidorsatus* by having transverse striae in the dorsocentral area and the similar length of d_1 and e_1.

Host and locality: This species was recorded on *Bambusa vulgaris* from Kepong, Selangor (Ehara & Tho, 1988).

14. *Schizotetranychus hidayahae* Yusof & Zhang sp. nov.

Description

Female. Idiosoma 300–325 long, 215 wide. Colour in life orange whitish.

Prodorsal striae longitudinal (Fig. 1). Prodorsal setae awl-shaped and short. Length of prodorsal setae: v_2 45, sc_1 40, sc_2 30. Distance between setal insertions: $v_2 - v_2$ 80, $sc_1 - sc_1$ 95, $sc_2 - sc_2$ 200. Peritreme simple distally (Fig. 1).

Palptarsus (Fig. 3): Terminal eupathidium ($su'\zeta$) 7 long and 7 in diameter. Two lateral eupathidia ($ul'\zeta$ and $ul''\zeta$) 7 long. Solenidion (ω) 5 long.

Hysterosomal striae transverse and longitudinal between d_1-e_1 setae with 10 pairs of short setae dorsally (c_{1-3}, d_{1-2}, e_{1-2}, f_{1-2}, h_1; Fig. 1). Para-anal setae h_{2-3} located ventrally (Fig. 2). Length of setae: c_1 30, c_2 35, c_3 45, d_1 35, d_2 35, e_1 35, e_2 35, f_1 40, h_1 40, h_2 25, h_3 25. Distance between setal insertions: $c_1 - c_1$ 20, $d_1 - d_1$ 25, $e_1 - e_1$ 25, $f_1 - f_1$ 70, $h_1 - h_1$ 30.

Ventral idiosoma with transverse striae (Fig. 2). Length of coxal-sternal setae; *1a* 28, *1b* 28, *2a* 25, *2b* 25, *2c* 25, *3a* 25, *3b* 35, *4a* 25, *4b* 35. Anal setae (*ps*) 2 pairs, nude, 15 long. Genital setae 2 pairs, nude; g_1 18, g_2 18. Pregenital setae (*ag*) nude, 20 long (Fig. 2).

Number of normal tactile setae on leg segments: trochanters 1-1-1-1; femora 9-6-3-3; genua 5-5-2-1; tibiae 7-5-4-4; tarsi 9 -7-7-7 (Figs. 6–9). Number of solenidia on leg segments: tibiae 1-0-0-0; tarsi 3-2-1-1. Number of eupathidia on leg segments: tarsi 3-3-0-0.

Length of leg segments: femur I 78; genu I 38; tibia I 40; tarsus I 48; femur II 55; genu II 35; tibia II 35; tarsus II 45; femur III 53; genu III 33; tibia III 33; tarsus III 50; femur IV 53 genu IV 30; tibia IV 33; tarsus IV 50 (Figs. 6–9)

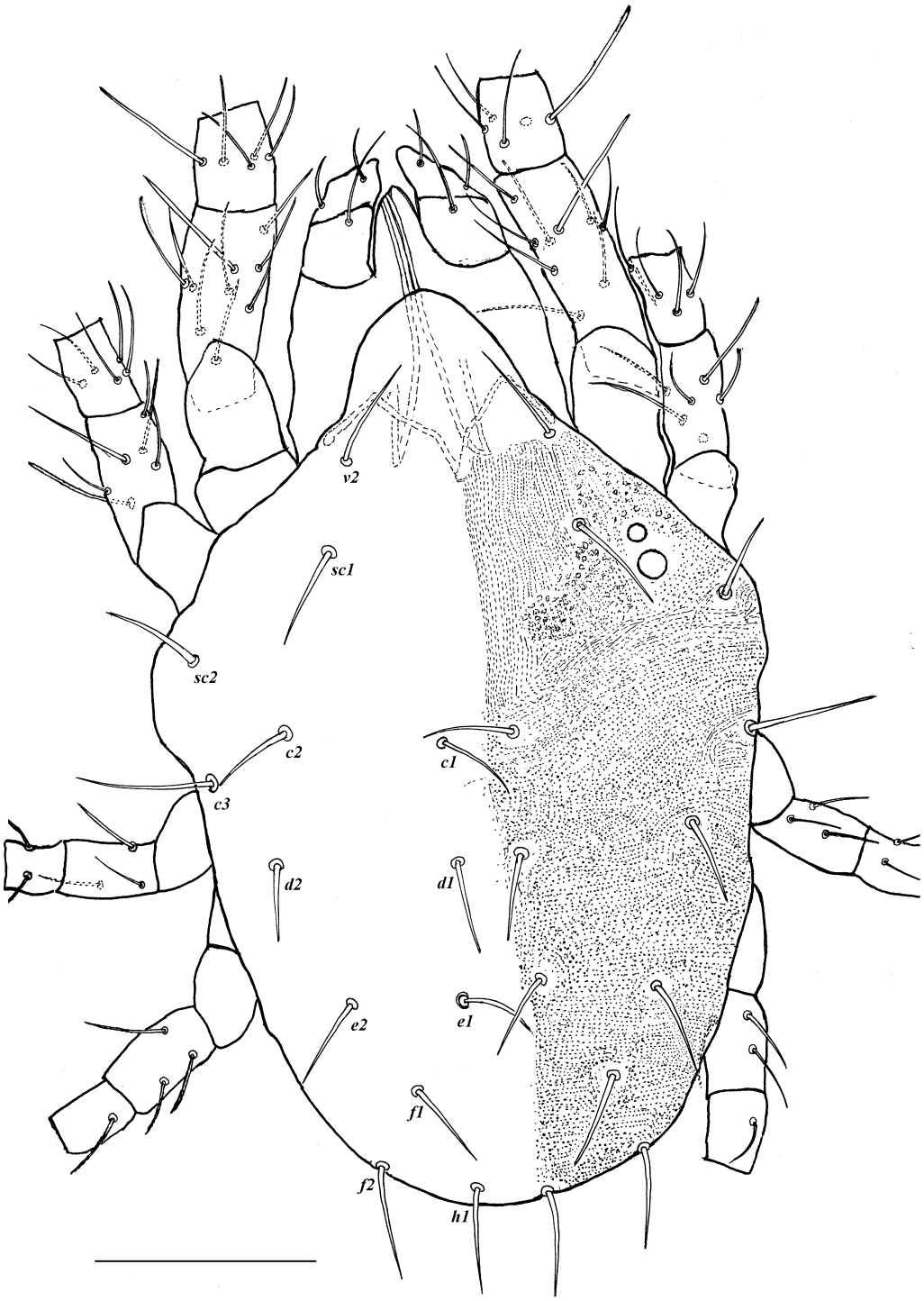


FIGURE 1: Female *Schizotetranychus hidayahae* **sp. nov.** (female) dorsal view (100 μm).

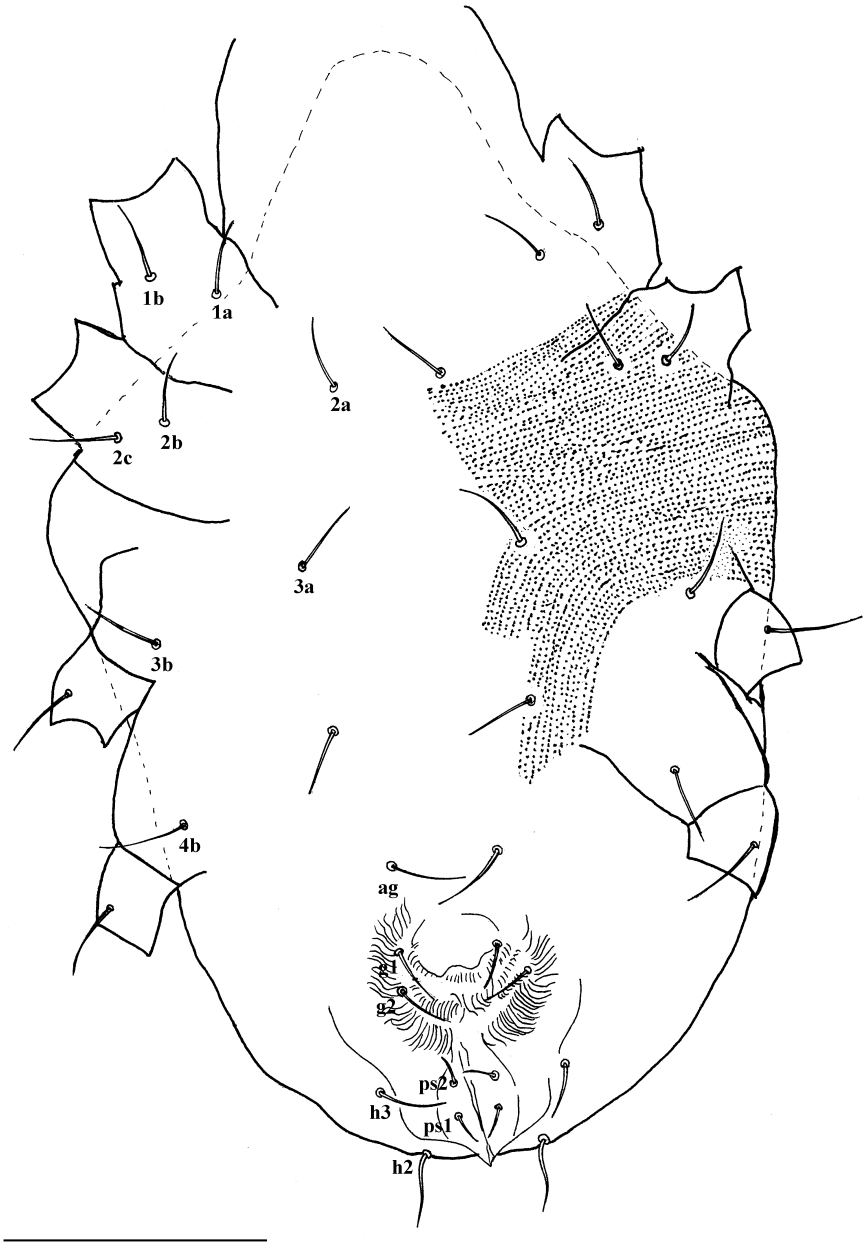


FIGURE 2: *Schizotetranychus hidayahae* **sp. nov.** (female) ventral view (100 μm).

Male. Idiosoma 225 long, 130 wide. Colour in life, orange-whitish. Prodorsal striae longitudinal. Prodorsal setae awl-shaped and short. Length of prodorsal setae: v_2 30, sc_1 30, sc_2 35. Distance between setal insertions: $v_2 - v_2$ 50, $sc_1 - sc_1$ 70, $sc_2 - sc_2$ 120. Peritreme is simple distally.

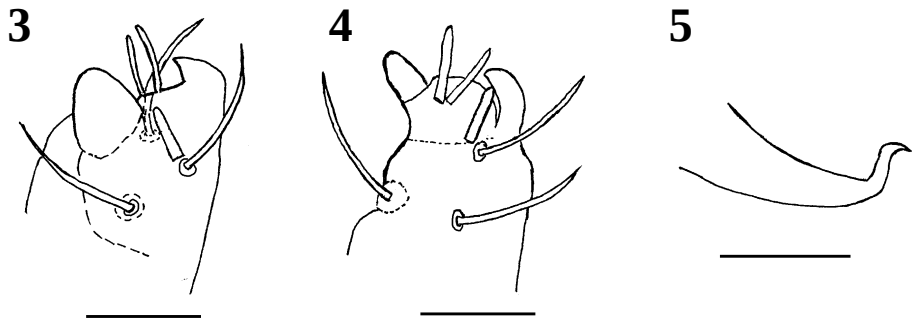


FIGURE 3-5: *Schizotetranychus hidayahae* **sp. nov.** 3. Female distal palpus segment (10 μm); 4. Male distal palpus segment (10 μm); 5. Aedeagus (5 μm).

Palptarsus (Fig. 4): Terminal eupathidium (*su'ζ*) 5 long and 3 diameter. Two lateral eupathidia (*ul'ζ* and *ul"ζ*) 5 long. Solenidion (*ω*) 7 long.

Hysterosomal striae transverse with 10 pairs of short setae dorsally (c_{1-3}, d_{1-2}, e_{1-2}, f_{1-2}, h_1; Fig. 1). Para-anal setae h_{2-3} located ventrally (Fig. 3). Length of setae: c_1 20, c_2 20, c_3 20, d_1 20, d_2 20, e_1 20, e_2 20, f_1 20, f_2 25 h_1 25, h_2 25, h_3 25. Distance between setal insertions: $c_1 - c_1$ 20, $d_1 - d_1$ 15, $e_1 - e_1$ 15, $f_1 - f_1$ 40, $h_1 - h_1$ 8.

Ventral idiosoma with transverse striae. Length of coxal-sternal setae; *1a* 20, *1b* 20, *2a* 20, *2b* 20, *2c* 20, *3a* 20, *3b* 25, *4a* 20, *4b* 25. Anal setae (*ps*) 4 pairs, nude, 5 long. Pregenital setae (*ag*) nude, 15 long.

Aedeagus without knob, gradually narrowing and curved dorsad to form a sigmoid (Fig. 5).

Number of normal tactile setae on leg segments: trochanters 1-1-1-1; femora 9-6-3-3; genua 5-5-4-4; tibiae 7-5-4-4; tarsi 9-7-7-7. Number of solenidia on leg segments: tibiae 3-0-0-0; tarsi 3-2-1-1. Number of eupathidia on leg segments: tarsi 3-3-0-0.

Length of leg segments: femur I 80; genu I 50; tibia I 50; tarsus I 50; femur II 50; genu II 40; tibia II 30; tarsus II 45; femur III 40; genu III 30; tibia III 35; tarsus III 45; femur IV 50 genu IV 30; tibia IV 35; tarsus IV 53.

Type material

Holotype female was collected by Yusof Othman from *Lansium domesticum*, Jasin, Melaka, Malaysia, on 8 January, 2003. Three paratype males with same data as the holotype.

Etymology

Named after the daughter of the senior author.

Remarks

This species resembles *S. saitoi* Ehara & Tho, 1988 but can be readily distinguished from the latter by the differences in setal length of the dorsocentral setae (see key above) and the number of leg tactile setae. The aedeagus is quite similar in both species; it is sigmoid distally with a truncate tip.

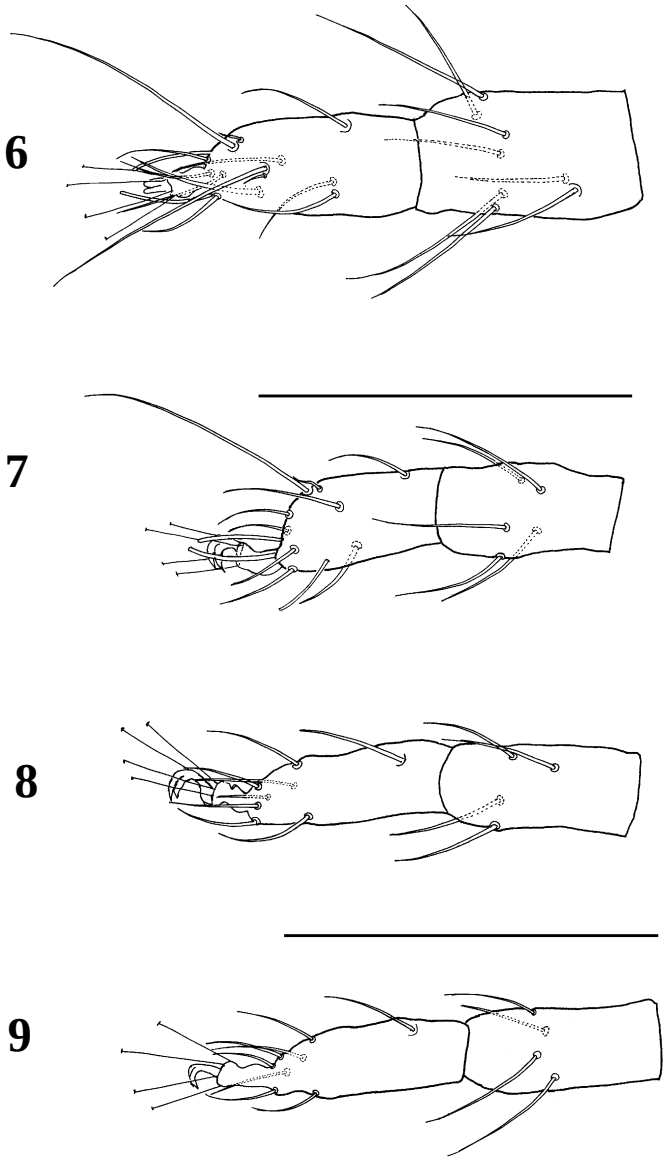


FIGURE 6-9: *Schizotetranychus hidayahae* **sp. nov.** (female, showing tarsi and tibiae) 6. Leg I; 7. Leg II; 8. Leg III; 9. Leg IV (100 µm).

15. *Tenuipalponychus rosae* Yusof & Zhang

Tenuipalponychus rosae Yusof & Zhang, 2003: 3, Fig. 1-7.

The dorsal idiosomal setae are broadly spatulate; the dorsocentral setae are short, not extending to the insertion of the next setae. There are 10 pairs of hysterosomal setae with setae f_1 in the marginal position. The peritreme is dilated distally. This species resembles *T. citri*, but can be readily

distinguished from the latter by the different patterns of dorsal striae, the relative length of dorsal setae and the relative position of setae f_1 that is anterioriad of the f_2.

Host and locality: This species was found on *Rosa chinensis*, Cameron Highlands, Pahang (Yusof & Zhang 2003).

Tetranychus Dufor

Key to species

1. Empodia with 2 pairs of proximoventral hairs; aedeagus with distal part very long, flagellate ..... *fijiensis* Hirst
   Empodia with 3 pairs of proximoventral hairs; aedeagus with distal part not flagellate 2
2. Aedeagal knob tiny compared with the neck and shaft 3
   Aedeagal knob not tiny 5
3. Female with proximal set of duplex setae in line with most of the proximal setae ..... *malaysiensis* Ehara & Tho
   Female with proximal set of duplex setae not in line with most of the proximal setae 4
4. Aedeagus less than a fourth the length of the dorsal shaft margin, anterior knob angulation inconspicuous and obtuse ..... *piercei* McGregor
   Aedeagus more than one-fourth the length of the dorsal shaft margin, anvil-shaped; Empodium I with strong mediodorsal spur about a third the length of the proximoventral hairs ..... *urticae* Koch
5. Female with terminal eupathidium of palptarsus less than twice the width; aedeagal knob medium sized with axis forming a small angle with the dorsal margin of shaft 6
   Female with terminal eupathidium of palptarsus about twice as long as the width; aedeagal knob very large, with axis subparallel to dorsal margin shaft ..... *kanzawai* Kishida
6. Distance between pair c_1 is about twice the distance between c_1 and c_2; terminal eupathidium of palptarsus just a little longer than wide; aedeagal knob medium sized with axis forming a small angle with the dorsal margin of shaft ..... *bambusicola* Ehara & Tho
   Distance between pair c_1 compare to the distance between c_1 and c_2 is not as above;terminal eupathidium of palptarsus longer than wide but its length less than twice the width 7
7. Aedeagal knob with acute anterior projection …… 8
   Aedeagal knob rounded projections both anteriorly and posteriorly, and with small dorsal indentation *neocaledonicus* André
8. Distance between all the dorsocentral setae pairs c_1, d_1, e_1 and f_1 are similar; dorsal margin of aedeagal knob straight ..... *arifi* **sp. nov.**
   Distance between dorsocentral setae pairs of c_1, e_1 and f_1 similar except the pair d_1, which is wider; dorsal margin of aedeagal knob rounded ..... *ismaili* **sp. nov.**

16. *Tetranychus bambusicola* Ehara & Tho

Tetranychus bambusicola Ehara & Tho, 1988: 21–23, Figs. 81–91.

The hysterosomal striae are longitudinal between pair of setae e_1 and between the pair f_1, forming a diamond-shaped figure. The peritremes are hooked distally. Female terminal eupathidium of the palptarsus is slightly longer than wide. The male aedeagus is upturned distally; the knob is medium-

sized, slightly wider than the neck. The anterior projection of the knob is broadly rounded and acute posteriorly.

Host and locality: This species was recorded on *Bambusa glaucescens* from Port Dickson, Negeri Sembilan and *Thyrsostachys siamensis* from Kepong, Selangor (Ehara & Tho, 1988).

17. *Tetranychus fijiensis* (Hirst)

Tetranychus fijiensis Hirst, 1924: 523, plate 17.

This species is distinctive because the empodia are split into two instead of three proximoventral hairs. The female of this species has longitudinal dorsal striae between setae e_1 and between the pair f_1, forming a diamond-shaped figure between these setae. The male aedeagus is very long, slender, tapering distally and upcurved (flagellate).

Host and locality: This species was recorded on *Elaeis guineensis* palm from Port Dickson, Negeri Sembilan (Ehara & Tho 1988). In this survey it was recorded from *Citrus microcarpus* from Muar, Johor. This is the first record on a fruit tree in Malaysia.

Specimens examined: Three females and one male, Muar, Johor, collected by Ng King Ong and Abu Bakar Dawam, 20 Febuary, 2003 on *Citrus microcarpus.*

18. *Tetranychus kanzawai* Kishida

Tetranychus kanzawai Kishida, 1927: 105; Ehara, 1956: 504, Figs. 15–25; Ehara, 1960: 240; Ehara, 1963: 230, Figs. 12–15; Ehara, 1969: 98, Figs. 65–67; Ehara & Wongsiri, 1975: 182, Figs. 115–116; Ehara & Tho 1988: 23.

The peritremes are strongly hooked distally. The longitudinal dorsal striae between the pair of setae e_1 and between the pair f_1 form a diamond-shaped figure. The male aedeagus is about twice the width of the neck with a terminal knob about 4“m in diameter. The anterior end of the knob is broadly rounded and acute at the posterior end.

Host and locality: Ehara & Tho (1988) recorded this mite on *Manihot* sp. from Kuala Lumpur, Wilayah Persekutuan and *Manihot glaziovii* from Port Dickson, Negeri Sembilan.

19. *Tetranychus malaysiensis* Ehara & Tho

Tetranychus malaysiensis Ehara & Tho, 1988: 19, Figs. 71–77.

The female of this species is characterized by tarsus I with proximal duplex setae located more or less in line with 3 proximal tactile setae. The peritremes are hooked distally. The hysterosomal longitudinal striae between pair of setae e_1 and between the pair f_1 form a diamond-shaped figure. Aedeagus gradually bends dorsad with a minute knob. The knob is slightly wider than the neck.

Host and locality: This mite was found on Argyreia sp. Kuala Lumpur, Wilayah Persekutuan. The specimens examined in the study were collected from Carica papaya, Sabak Bernam, Selangor, Citrus paradisi from Raub, Pahang, and Artocarpus champeden from Degong, Perak. This is a new record of this species infesting economic crops.

Specimens examined: 12 females, Sabak Bernam, Selangor, collected by Ng King Ong, 15 January, 2003 on *Carica papaya*; three females, Raub, Pahang, collected by Yusof Othman, 21 November, 2002 on *Citrus paradisi*; two females, Degong, Perak, collected by Abu Bakar Dawam, 16 January, 2003 on *Artocarpus champeden.*

20. Tetranychus neocaledonicus André

Eotetranychus neocaledonicus André, 1933: 302.
Tetranychus neocaledonicus, André, 1959: 53–55, Figs.1, 5.

The female *T. neocaledonicus* has longitudinal striae between pair of setae e_1 and between the pair f_1, forming a diamond-shaped figure between these setae. The aedeagus bends dorsad at nearly a right angle to the shaft. Both the anterior and posterior projections of the knob are rounded and separated by a small dorsal indentation.

Host and locality: This is the first record of this species in Malaysia. The sample examined was collected from a laboratory culture in Serdang Selangor.

Specimens examined: Two females and two males, Serdang, Selangor, collected by Zhi-Qiang Zhang, 12 October, 2001 from a laboratory culture on a Leguminosae.

21. *Tetranychus piercei* McGregor

Tetranychus piercei McGregor, 1950: 257–420.

The aedeagus is distinctive in that the terminal knob is diminutive and scarcely discernible, forming an angle with the axis of the shaft. The anterior knob angulation is inconspicuous and obtuse. The knob has an acute posterior projection.

Host and locality: This species was first reported in Malaysia on *Manihot esculenta* from Ibin, Perak and *Elaeis guineensis* from Selangor (Ehara & Tho, 1988). In this study the specimen was collected on *Rosa chinensis* from Serdang, Selangor.

Specimens examined: Six females and 4 males, Serdang, Selangor, collected by Zhi-Qiang Zhang, 12 October, 2001 on *Rosa chinensis*.

22. *Tetranychus urticae* Koch, 1836

Tetranychus urticae Koch 1836: 10; Meyer 1987: 136, Fig. 641.

Female hysterosomal striae between setal pairs e_1 and f_1 are longitudinal and form a diamond-shaped figure. The male empodium I bears a strong mediodorsal spur about one-third the length of the proximoventral hairs. The knob of the aedeagus is small and not less than one-fourth of the length of the dorsal margin of the shaft. The margin of the knob is parallel or forming a small angle with the axis of the shaft.

Host and locality: This species was firstly recorded on *Manihot esculenta* (Greenstreet & Lambourbe, 1933). In this study we could not find any specimens although this species is widespread throughout the world.

23. *Tetranychus arifi* Yusof & Zhang sp. nov.

Description

Female. Idiosoma 380–400 long, 260–280 wide. Colour in life yellowish white.

Prodorsal striae longitudinally (Fig. 10). Prodorsal setae long, slender and pubescent, reaching beyond the base of next setae. Length of prodorsal setae: v_2 65, sc_1 120, sc_2 100. Distance between setal insertions: $v_2 - v_2$ 70, $sc_1 - sc_1$ 85, $sc_2 - sc_2$ 210. Peritreme hooked distally (Fig. 10).

Palptarsus (Fig. 12): Terminal eupathidium (*su'ζ*) 10 long and 5 in diameter. Two lateral eupathidia (*ul'ζ* and *ul"ζ*), 10 long. Solenidion (*ω*) 5 long.

Hysterosomal striae transverse with longitudinal striae between the pairs of e_1 and f_1, forming a diamond-shaped figure between these setae. Hysterosoma with10 pairs of long setae dorsally ($c_{1\text{-}3}$, $d_{1\text{-}2}$, $e_{1\text{-}2}$, $f_{1\text{-}2}$, h_1; Fig. 10). Para-anal setae h_3 located ventrally (Fig. 11). Length of setae: c_1 110–125, c_2 110–125, c_3 90–100, d_1 110–120, d_2 110–120, e_1 110–120, e_2 110–120, f_1 100–110, h_1 40–45, h_3 35–38. Distance between setal insertions: $c_1 - c_1$ 85, $d_1 - d_1$ 90, $e_1 - e_1$ 65, $f_1 - f_1$ 55, $h_1 - h_1$ 30.

Ventral idiosoma with transverse striae (Fig. 11). Length of coxal-sternal setae; *1a* 75, *1b* 60, *2a* 40, *2b* 55, *2c* 65, *3a* 60, *3b* 70, *4a* 70, *4b* 70. Anal setae (*ps*) 2 pairs, nude, 25 long. Genital setae 2 pairs, nude; g_1 45, g_2 45. Pregenital setae (*ag*) nude, 75 long (Fig. 3).

Number of normal tactile setae on leg segments: trochanters 1-1-1-1; femora 10-6-4-4; genua 5-5-4-4; tibiae 9-7-6-7; tarsi 12 -11-9-9. Number of solenidia on leg segments: tibiae 1-0-0-0; tarsi 3-2-1-1. Number of eupathidia on leg segments: tarsi 3-3-0-0.

Length of leg segments: femur I 95–100; genu I 45–50; tibia I 55–60; tarsus I 95–100; femur II 65–75; genu II 45–50; tibia II 45–50; tarsus II 75–80; femur III 60–80; genu III 40–45; tibia III 45–50; tarsus III 85–90; femur IV 85–90 genu IV 45–50; tibia IV 55–60; tarsus IV 95–100 (Figs. 15–18).

Male. Idiosoma 310 long, 200 wide. Colour in life, yellowish white. Prodorsal striae longitudinal. Prodorsal setae long and slender. Length of prodorsal setae: v_2 55, sc_1 95, sc_2 65. Distance between setal insertions: $v_2 - v_2$ 50, $sc_1 - sc_1$ 70, $sc_2 - sc_2$ 140. Peritreme is hooked distally.

Palptarsus (Fig. 12): Terminal eupathidium (*su'ζ*) 7 long and 5 diameter. Two lateral eupathidia (*ul'ζ* and *ul"ζ*), 7 long. Solenidion (*ω*) 5 long. Hysterosomal striae transverse with 10 pairs of long setae dorsally ($c_{1\text{-}3}$, $d_{1\text{-}2}$, $e_{1\text{-}2}$, $f_{1\text{-}2}$, h_1). Para-anal setae h_3 located ventrally. Length of setae: c_1 85, c_2 85, c_3 85, d_1 85, d_2 85, e_1 80, e_2 75, f_1 85, h_1 20, h_3 25. Distance between setal insertions: $c_1 - c_1$ 55, $d_1 - d_1$ 60, $e_1 - e_1$ 35, $f_1 - f_1$ 30, $h_1 - h_1$ 17.

Ventral idiosoma with transverse striae. Length of coxal-sternal setae; *1a* 50, *1b* -50, *2a* 40, *2b* 55, *2c* 60, *3a* 40, *3b* 50, *4a* 40, *4b* 50. Anal setae (*ps*) 4 pairs, nude, 10 long. Pregenital setae (*ag*) nude, 45 long.

The aedeagus shaft gradually narrowing and turning dorsad at a right angle to form a neck and knob. The aedeagal knob about twice as wide as the neck, with a rounded anterior base and an acute posterior projection (Fig. 13).

Number of normal tactile setae on leg segments: trochanters 1-1-1-1; femora 10-6-4-4; genua 5-5-4-4; tibiae 9-7-6-7; tarsi 12-11-9-9. Number of solenidia on leg segments: tibiae 3-0-0-0; tarsi 3-2-1-1. Number of eupathidia on leg segments: tarsi 3-3-0-0.

Length of leg segments: femur I 75; genu I 45; tibia I 45; tarsus I 75; femur II 50; genu II 35; tibia II 40; tarsus II 68; femur III 55; genu III 30; tibia III 38; tarsus III 65; femur IV 68 genu IV 38; tibia IV 45; tarsus IV 70.

Type material

Holotype female was collected by Yusof Othman from *Zea mays*, Sabak Bernam Selangor, Malaysia on 10 July, 2002. Eight females and three male paratypes with same data as the holotype.

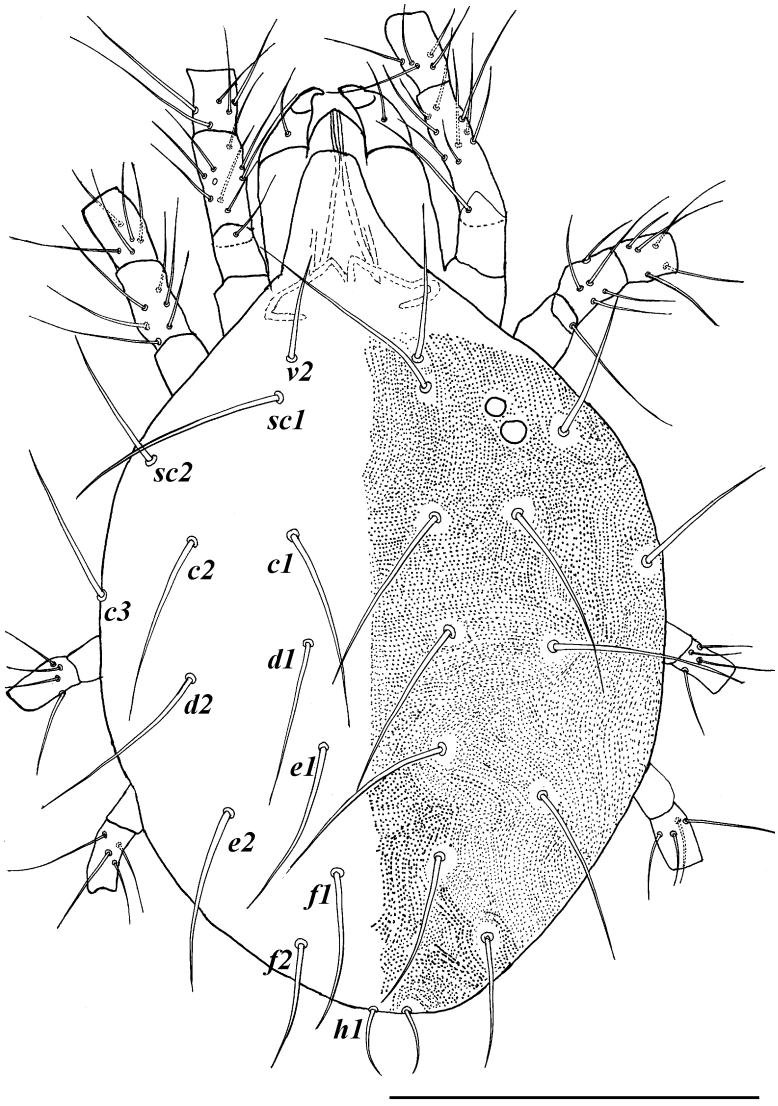


FIGURE 10: Female *Tetranychus arifi* **sp. nov.** (female) dorsal view (100 μm).

Etymology

Named after the son of the senior author.

Remarks

This species resembles *T. kanzawai* but can be readily distinguished from the latter by the following features of its aedeagal knob: the anterior projection is acute, the posterior projection rounded and dorsal margin straight. The terminal eupathidium of the palptarsus is less than twice as long as wide in the male. It also differs from *T. papakanzawai* (Ehara) in the aedeagal knob shape. The tactile setae on tibia IV of this species number nine tactile setae instead of 10 in *T. kanzawai* and *T. papakanzawai.*

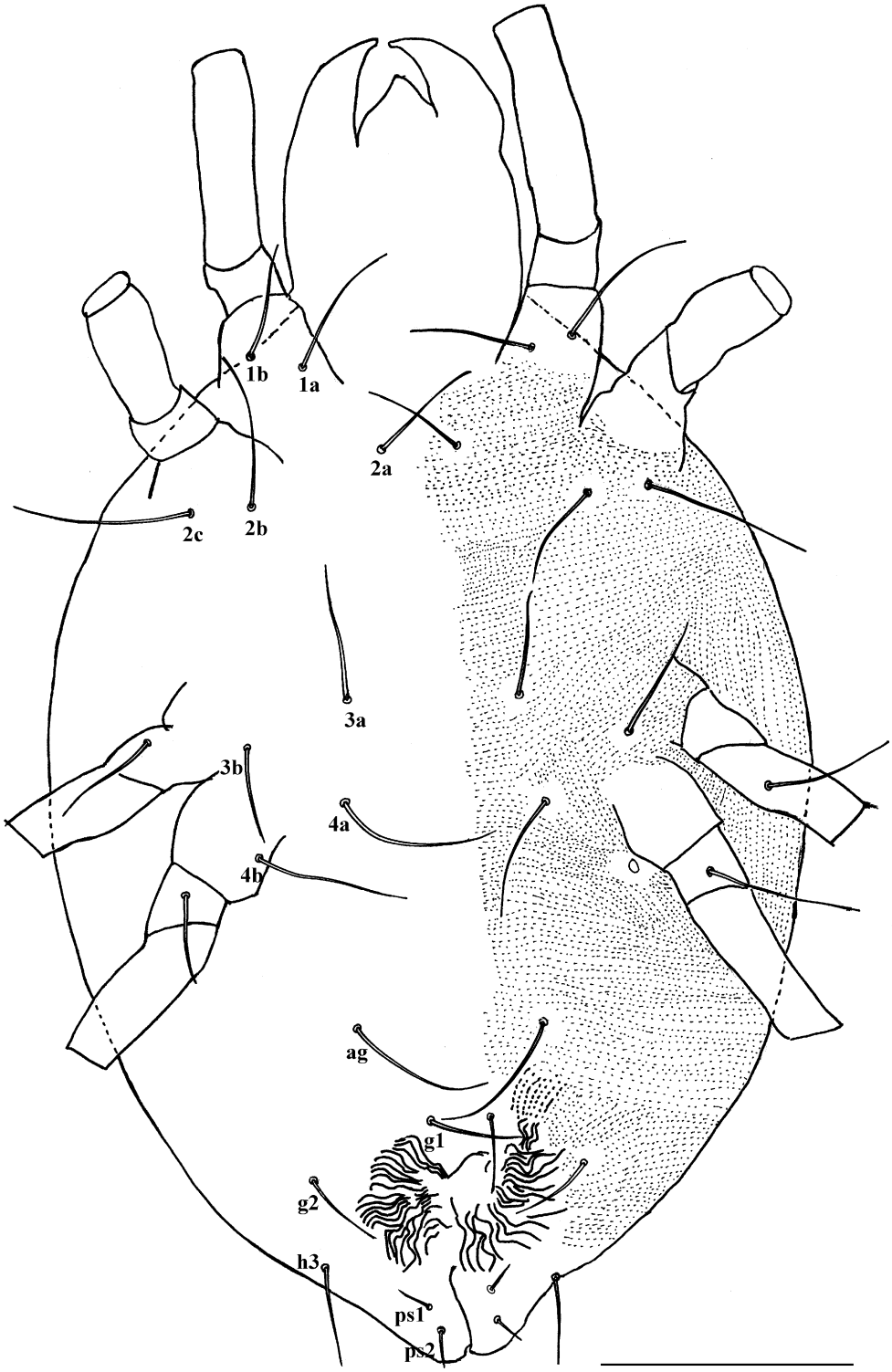
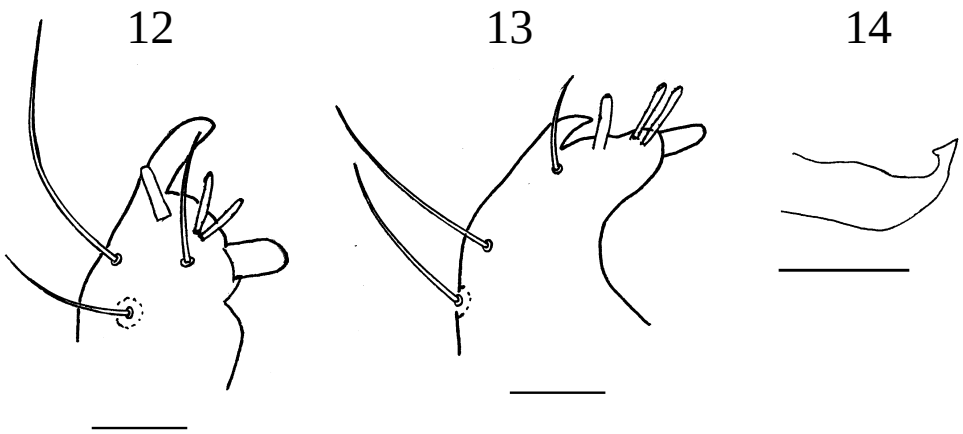
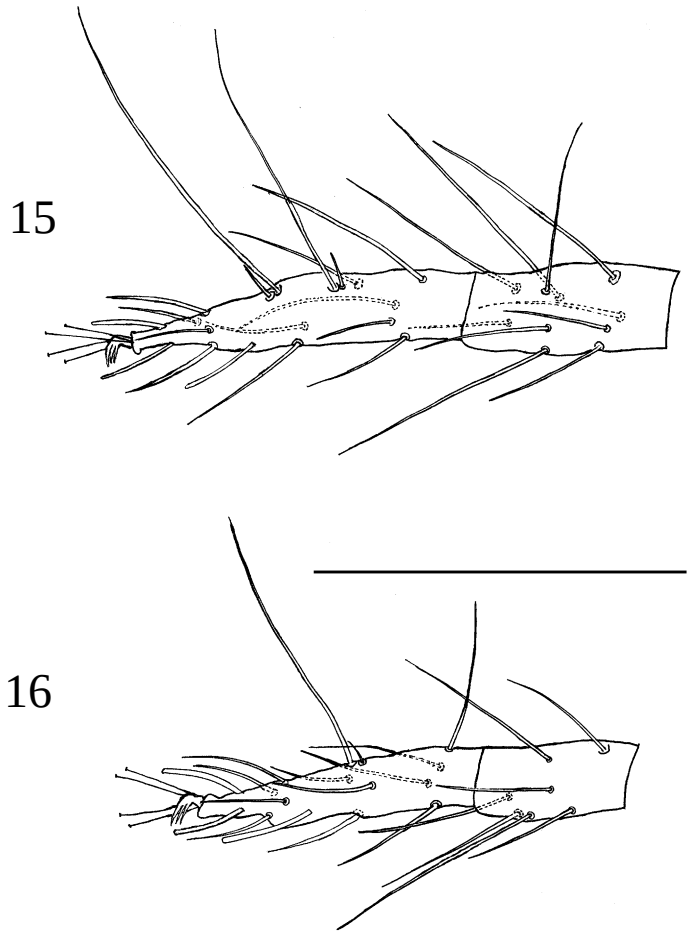


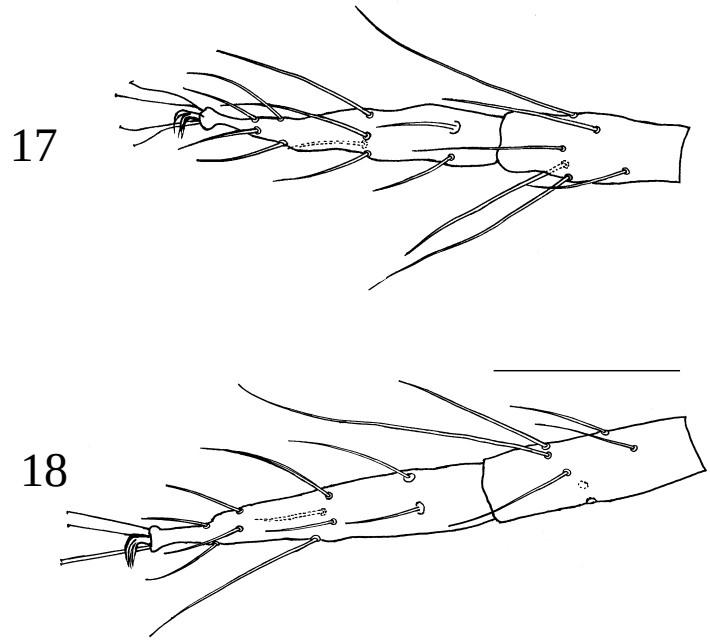
FIGURE 11: *Tetranychus arifi* **sp. nov.** (female) ventral view (100 μm).



FIGURES 12-14: *Tetranychus arifi* **sp. nov.** 12. Female distal palpus segment (10 μm); 13. Male distal palpus segment (10 μm); 14. Aedeagus (5 μm).



FIGURES 15-16: *Tetranychus arifi* **sp. nov.** (showing female tarsi and tibiae) 15. Leg I; 16. Leg II (100 μm).



FIGURES 17-18: *Tetranychus arifi* **sp. nov.** (showing female tarsi and tibiae) 17. Leg III; 18. Leg IV (100 μm).

23 *Tetranychus ismaili* Yusof & Zhang sp. nov.

Description

Female. Idiosoma 380–420 long, 300–350 wide. Colour in life yellowish white.

Prodorsal striae longitudinally (Fig. 19). Prodorsal setae long, slender and pubescent. The length of prodorsal setae: v_2 70, sc_1 160, sc_2 110. Distance between setal insertions: $v_2 - v_2$ 70, $sc_1 - sc_1$ 90, $sc_2 - sc_2$ 280. Peritremes curved distally (Fig. 19).

Palptarsus (Fig. 21): Terminal eupathidium (*su'ζ*) 10 long and 5 diameter. Two lateral eupathidia (*ul'ζ* and *ul"ζ*) 10 long. Solenidion (*ω*) 5 long. Hysterosomal striae transverse with 10 pairs of long setae dorsally (c_{1-3}, d_{1-2}, e_{1-2}, f_{1-2}, h_1; (Fig. 19). Para-anal setae h_3 located ventrally (Fig. 20). Length of setae: c_1 130-140, c_2 125-130, c_3 110-120, d_1 125-130, d_2 125-135, e_1 125-130, e_2 125-135, f_1 105-110, h_1 40-45, h_3 40-45. Distance between setal insertions: $c_1 - c_1$ 70-75, $d_1 - d_1$ 100-110, $e_1 - e_1$ 45-50, $f_1 - f_1$ 40-45, $h_1 - h_1$ 20.

Ventral idiosoma with transverse striae (Fig. 20). Length of coxal-sternal setae; *1a* 70, *1b* 70, *2a* 50, *2b* 70, *2c* 75, *3a* 65, *3b* 65, *4a* 70, *4b* 70. Anal setae (*ps*) 2 pairs, nude, 25 long. Genital setae 2 pairs, nude; g_1 45-50, g_2 45-50. Pregenital setae (*ag*) nude, 80 long (Fig. 20).

Number of normal tactile setae on leg segments: trochanters 1-1-1-1; femora 10-6-4-4; genua 5-5-4-4; tibiae 9-7-6-7; tarsi 12-10-9-10. Number of solenidia on leg segments: tibiae 1-0-0-0; tarsi 3-2-1-1. Number of eupathidia on leg segments: tarsi 3-3-0-0.

Length of leg segments: femur I 100-105; genu I 50-55; tibia I 55-60; tarsus I 105–110; femur II 70–75; genu II 45–50; tibia II 45–50; tarsus II 85–90; femur III 70–75; genu III 35–40; tibia III 45-50; tarsus III 90-95; femur IV 95-100 genu IV 45-50; tibia IV 60-65; tarsus IV 110 (Figs. 24–27).

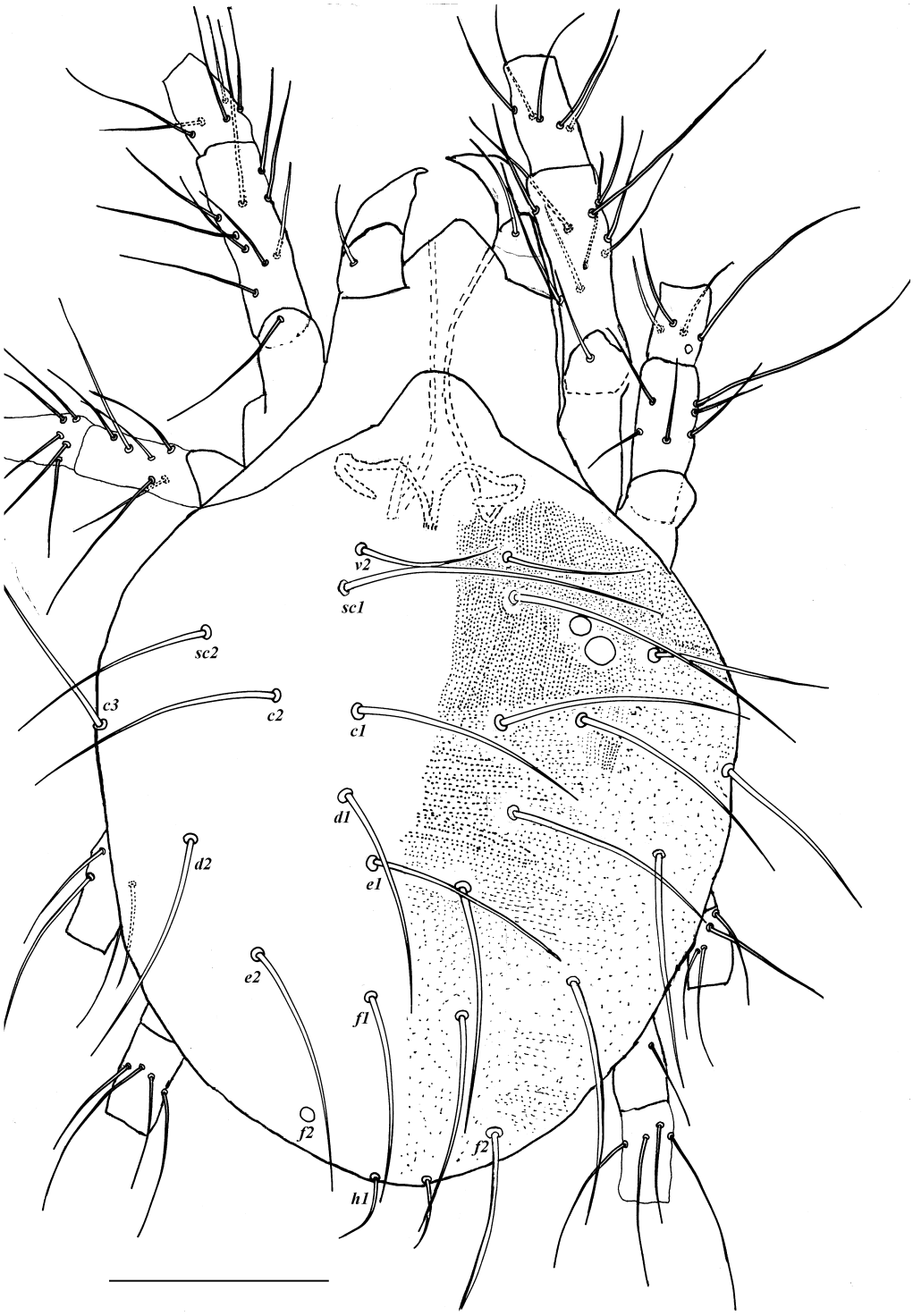
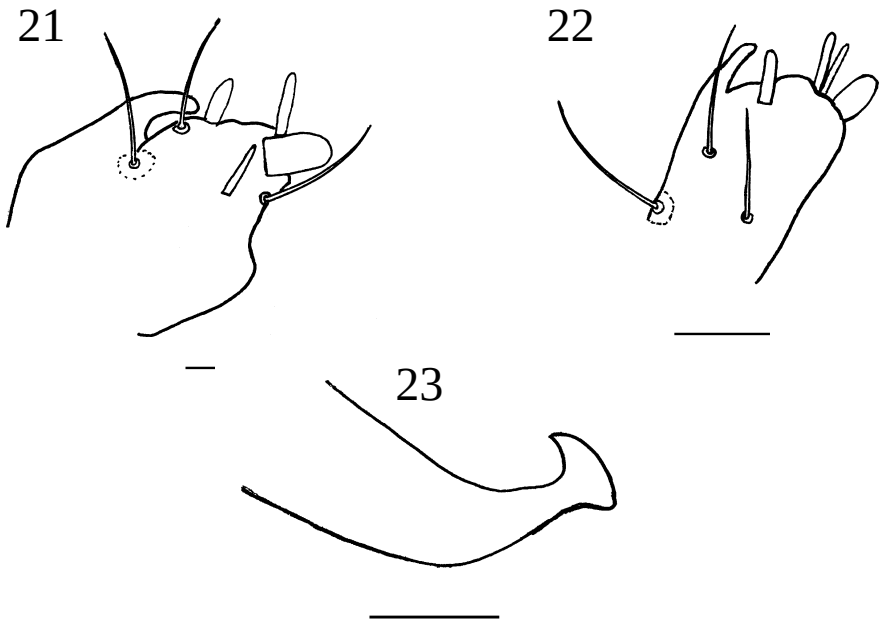


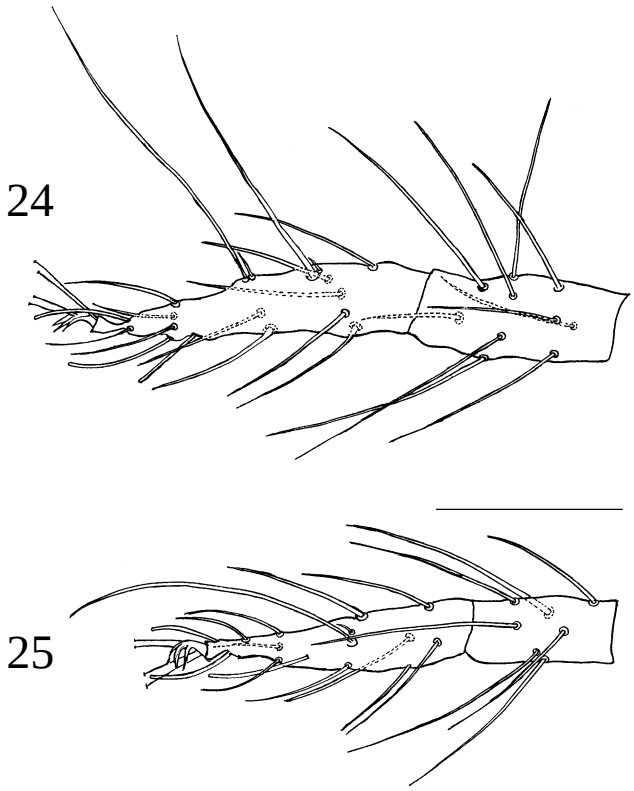
FIGURE 19: Female *Tetranychus ismaili* **sp. nov.** (female) dorsal view (100 μm).

FIGURE 20: *Tetranychus ismailis* **sp. nov.** (female) ventral view (100 μm).

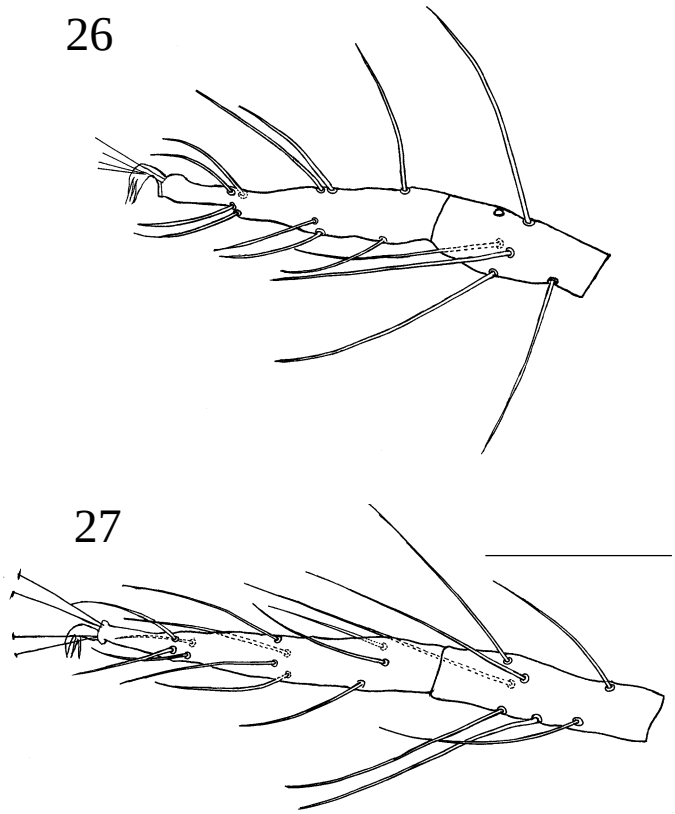
Male. Idiosoma 275 long, 180 wide. Colour in life yellowish white. Prodorsal striae longitudinally. Prodorsal setae long and slender. Length of prodorsal setae: v_2 45, sc_1 105, sc_2 70. Distance between setal insertions: $v_2 - v_2$ 50, $sc_1 - sc_1$ 60 $sc_2 - sc_2$ 145. Peritremes curved distally.



FIGURES 21-23: *Tetranychus ismaili* **sp. nov.** 21. Female distal palpus segment (10 μm) ; 22. Male distal palpus segment (10 μm); 23. Aedeagus (5 μm).



FIGURES 24-25: *Tetranychus ismaili* **sp. nov.** (showing female tarsi and tibiae) 24. Leg I; 25. Leg II (100 μm).



FIGURES 26-27: *Tetranychus ismaili* **sp. nov.** (showing female tarsi and tibiae). 26. Leg III; 27. Leg IV (100 μm).

Palptarsus (Fig. 22): Terminal eupathidium (*su'ζ*) 7 long and 5 diameter. Two lateral eupathidia (*ul'ζ* and *ul"ζ*) 7 long. Solenidion (*ω*) 5 long. Hysterosomal striae transverse with 10 pairs of long setae dorsally (c_{1-3}, d_{1-2}, e_{1-2}, f_{1-2}, h_1). Para-anal setae h_3 located ventrally. Length of setae: c_1 85, c_2 85, c_3 75, d_1 85, d_2 85, e_1 80, e_2 80, f_1 65, h_1 20, h_3 20. Distance between setal insertions: $c_1 - c_1$ 50, $d_1 - d_1$ 60, $e_1 - e_1$ 35, $f_1 - f_1$ 35, $h_1 - h_1$ 20.

Ventral idiosoma with transverse striae. Length of coxal-sternal setae; *1a* 50, *1b* -50, *2a* 40, *2b* 55, *2c* 60, *3a* 40, *3b* 50, *4a* 40, *4b* 50. Anal setae (*ps*) 4 pairs, nude, 15 long. Pregenital setae (*ag*) nude, 50 long.

The aedeagal shaft narrowing and turning at a right angle to the form a neck and knob. The knob approximately twice wider than the neck with semicircular dorsal margin. The knob acute anteriorly and rounded posteriorly (Fig. 23).

Number of normal tactile setae on leg segments: trochanters 1-1-1-1; femora 10-6-4-4; genua 5-5-4-4; tibiae 11-7-6-6; tarsi 12-10-9-10. Number of solenidia on leg segments: tibiae 3-0-0-0; tarsi 3-2-1-1. Number of eupathidia on leg segments: tarsi 3-3-0-0.

Length of leg segments: femur I 75; genu I 35; tibia I 45; tarsus I 50; femur II 50; genu II 35; tibia II 45; tarsus II 60; femur III 50; genu III 30; tibia III 60; tarsus III 70; femur IV 70 genu IV 35; tibia IV 50; tarsus IV 75.

Type material

Holotype female was collected by Zhi-Qiang Zhang on *Bambusa* sp. from Cameron Highlands, Pahang, Malaysia on 14 October, 2001. Paratype males and females with same data as holotype.

Etymology

Named in honour of the Director General of Agriculture, Malaysia, Dato' Ismail Ibrahim.

Remarks

This species resembles *T. parakazawai* (Ehara) and *T. kanzawai* (Kishida) (Ehara 1999), but can be readily distinguished from the latter by its aedeagal knob, which has an acute anterior projection and rounded posterior projection. It is different from *T. arifi* in that the aedeagal knob has a dorsal semicircular margin and tibia IV has 10 tactile setae.

Acknowledgements

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