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Frankliniella minuta (Moulton) (Thysanoptera: Thripidae): an American species newly recorded in Asia, with a key to *Frankliniella* species from Malaysia

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ABSTRACT. The New World insect species *Frankliniella minuta* (Moulton, 1907) is reported from Asia for the first time. This is a member of the Order Thysanoptera and is placed in the subfamily Thripinae of the Thripidae. A total of 45 female and 14 male adults were found on *Tridax procumbens* (Asteraceae) at the Malaysian Agricultural Research and Development Institute (MARDI) in Selangor, Peninsular Malaysia. Both sexes were taken from the capitula of *T. procumbens*. The potential threat of this species to the horticultural industry is inconclusive, but the discovery will alert horticulturalists and quarantine entomologists to possible invasion pathways. Diagnostic characters, relevant figures and a key to *Frankliniella* species in Malaysia are provided.

Key words: Asteraceae, flower thrips, horticulture, identification key, alien species, quarantine

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INTRODUCTION

The Thysanoptera genus *Frankliniella* Karny currently comprises approximately 240 species (Pal et al., 2023; Skarlinsky & Rugman-Jones, 2023). These species are almost entirely native to the American continent, with only six species native to the Old World (Wang et al., 2019). However, several species originally from the Nearctic and Neotropical regions are widespread around the world and recognized as pests in horticulture and agriculture (Mound et al., 2022). In Malaysia, four of these pest species have been recorded, of which three species (*Frankliniella occidentalis*, *F. schultzei*, *F. williamsi*) are American in

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origin, and one is widespread across the Holarctic (*F. intonsa*). The aim of this work here is to record that an additional species with an American origin namely *Frankliniella minuta,* has recently been found in Peninsular Malaysia, in Selangor for the first time.

MATERIAL AND METHODS

Sampling was done at the starfruit research plot at Malaysian Agricultural Research and Development Institute (MARDI) Serdang, Selangor, Peninsular Malaysia (2°59'01.8"N 101°41'47.7"E) between June 2020 to May 2021 and October to November 2021 from several weed species such as *Ageratum conyzoides*, *Cyanthillium cinereum*, *Emilia sonchifolia*, *Tridax procumbens* and *Youngia japonica*. The apex portion or the capitulum of the weed plants was individually sampled using the concealment technique via a 100ml centrifuge tube (38 × 114mm: BIPEE, USA). The tubes were gently tapped to settle thrips, then filled with ± 40ml 90% ethanol and labelled with collection data. In the lab at the Institute of Biological Sciences, the thrips were dislodged from plant material under a stereomicroscope (Olympus SZ61) using featherweight forceps and transferred to 1.5ml vials containing 90% ethanol for mounting. The permanent slide mounting follows the protocol of Mound & Marullo (1996). The identification of the slide-mounted thrips was done under phase contrast microscopy using a compound microscope (Olympus CX41) and, using keys and figures from Sakimura & O'Neill (1979), Cavalleri & Mound (2012), Wang et al. (2010, 2019), and Mound et al. (2019). Photographs of specimens were taken using DIC Olympus BX 41 attached to a ToupCam 12 Mb camera and each photo was stacked using ToupTek software. Images of specimens were also compared to slide-mounted reference specimens from California, Costa Rica, and Trinidad housed in the Australian National Insect Collection (ANIC), Canberra. To validate our original key, we tested the final version against numerous specimens of the mentioned species in the ANIC. Permanent slides were deposited at the Museum of Zoology, Universiti Malaya (MZUM) and the Center of Insect Systematics, Universiti Kebangsaan Malaysia (CIS-UKM).

RESULTS

Taxonomic hierarchy

Class Insecta Linnaeus, 1758

Order Thysanoptera Haliday, 1836

Suborder Terebrantia Haliday, 1836

Family Thripidae Stephens, 1829

Genus *Frankliniella* Karny, 1910

Type-species: *Thrips intonsa* Trybom, 1895, by subsequent designation (Hood, 1914:37).

Diagnosis. Antennae 8-segmented with forked sense cones on segments III and IV; head with 3 pairs of ocellar setae, S1 directly in front of the fore ocellus; pronotum with two pairs of longer setae on the anterior margin, and two pairs of longer posteroangular setae, these setae are considerably longer than the discal setae; metanotum with median setae arising at anterior margin; fore wings with complete row of setae on both longitudinal veins; abdominal tergites V–VIII with paired ctenidia laterally, on tergite VIII the ctenidia are anterolateral to the spiracles; sternites III–VII with no discal setae.

Frankliniella minuta (Moulton, 1907)

Euthrips minutus Moulton, 1907:56; Holotype, deposited in the California Academy of Sciences and collected from grass at Berkeley, California on 1st March 1906.

Materials Examined: 45♀♀, 14♂♂, MALAYSIA: Selangor, MARDI Serdang [2°59'01.8"N 101°41'47.7"E], on *T. procumbens* capitula (Asteraceae), coll.: Abdul M. Munir-Zaki; 2♀♀, 1♂, 9.ix.2020; 2♀♀, 16.xii.2020; 1♀, 3.iii.2021; 3♀♀, 17.iii.2021; 1♀, 7.iv.2021; 1♀, 21.iv.2021; 1♀, 28.iv.2021; 15♀♀, 5♂♂, 24.x.2021; 10♀♀, 4♂♂, 31.x.2021; 8♀♀, 4♂♂, 7.xi.2021 (in MZUM); 1♀, 24.x.2021 (in CIS-UKM).

Diagnosis. **Female** (macroptera): Body brown (Figs 1A–E, 2A–C), all legs brown, except foretibia and tarsi yellow (Fig. 1A); antennal segments uniformly brown (Fig. 1B); forewings slightly uniformly shaded (Fig. 2A). Antennae 8-segmented, segments III–IV with forked sensoria (Fig. 1B). Head wider than long; areas in front of first ocellus and ocellar area smooth, vertex with fine transverse striations (Figs 1A, 1C); head with 3 pairs of ocellar setae, S2 arising near margins of compound eyes, S3 short (about as long as the diameter of hind ocelli), arising outside the ocellar triangle; 5 pairs of short postocular setae, S1 as long as the diameter of hind ocelli. Pronotum short, wider than long, sublateral area smooth, with more than 20 short scattered discal setae (Figs 1A, 1C); without anteroangular setae; with 2 pairs of long posteroangular setae, posterior margin with 7 pairs of setae, S5 and S7 longer than others. Mesonotum with a few weak transverse striations; anterior campaniform sensilla present (Fig. 1D). Metanotum with irregular reticulate medially, lateral areas with longitudinal lines; with 2 pairs of setae (Fig. 1D), median setae slightly longer than submedian setae, all setae arising at anterior margin, without campaniform sensilla (Fig. 1D); mesofurca with metafurca without spinula (Fig. 1E). Forewing first vein complete with 18–20 setae; second vein complete with 10–11 setae; forewing clavus with 6 veinal and 1 discal setae (Fig. 2A). Abdominal tergites V–VIII with a pair of lateral ctenidia; weakly developed on IV, positioned anterolaterally to spiracle on VIII (Fig. 2B). Tergite VIII with a complete posteromarginal comb of long and slender microtrichia (Fig. 2B). Sternites III–VII without discal setae, with 3 pairs of marginal setae; sternite VII with S1 arising in front of posterior margin (Fig. 2C).

Measurements (in micrometer)**.** Female: Body length 1300. Head, length/width 101/137. Antennal segments III-VIII lengths 34,32,25,36,6,11. Pronotum length/width 108/172. Fore wing length 559. Metanotum length 61. Tergite X length 56.

Male (macroptera)**.** Similar to female; body pale; abdominal sternites VI–VII with oval-shaped pore plates (Fig. 2D). Sternite VI pore plate width 35.

Key to species of the genus *Frankliniella* Karny, 1910 in Malaysia

1 Abdominal tergite VIII without a posteromarginal comb of microtrichia. ..... ***schultzei*** **(Trybom)**

– Abdominal tergite VIII with comb of microtrichia in posterior margin. **2**

2 Metanotum without a pair of campaniform sensilla; postocular setae S4 short, usually shorter than distance between hind ocelli. **3**

– Metanotum with a pair of campaniform sensilla; postocular setae S4 long, as long or longer than distance between hind ocelli. **4**

3 Head with longest pair of ocellar setae 3.0 to 4.0 times as long as the diameter of a hind ocellus; pronotum with five pairs of very long setae, the longest more than 0.5 as long as median length of pronotum. ..... ***intonsa*** **(Trybom)**

– Head with longest pair of ocellar setae equal in length to diameter of a hind ocellus; all pronotal setae short, 0.2 to 0.4 as long as median length of pronotum. ..... ***minuta*** **(Moulton)**

4 Abdominal tergite VIII posteromarginal comb with long microtrichia, about 3 times as long as the width of their triangular base; sternite II usually with 1–2 discal setae; body of female uniformly pale. . ..... ***williamsi*** **Hood**

– Abdominal tergite VIII posteromarginal microtrichia short, about twice as long as width of their triangular base; sternite II without discal setae; female usually light brown to bicoloured, if paler than tergites with median dark spots and tergite X with dark apex. ..... ***occidentalis*** **(Pergande)**

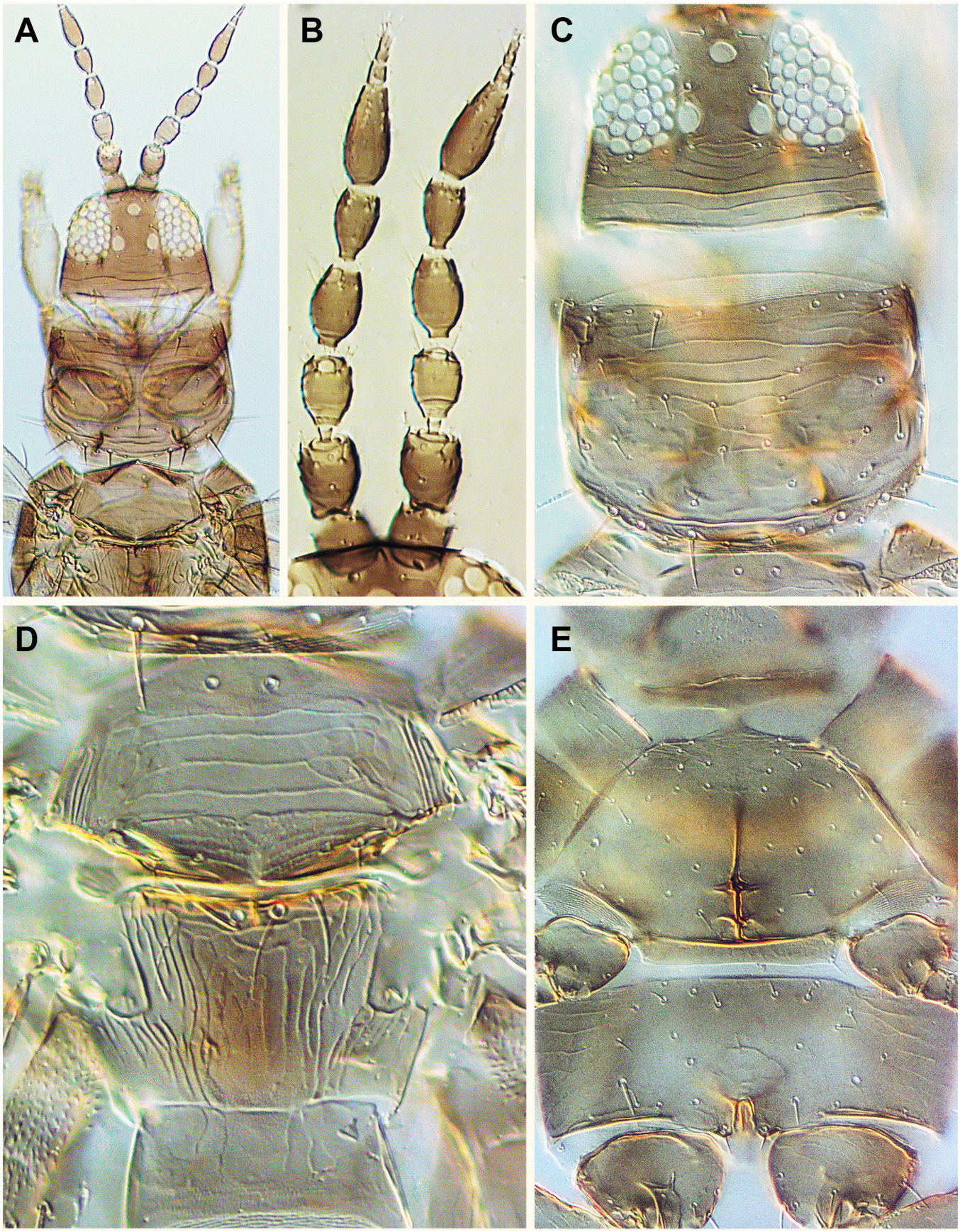

Figure 1. *Frankliniella minuta* (Moulton, 1907) (female). **A.** Head and thorax; **B.** Antennal segments; **C.** Head and pronotum; **D.** Meso and -metanotum; **E.** Meso and -metasternum.

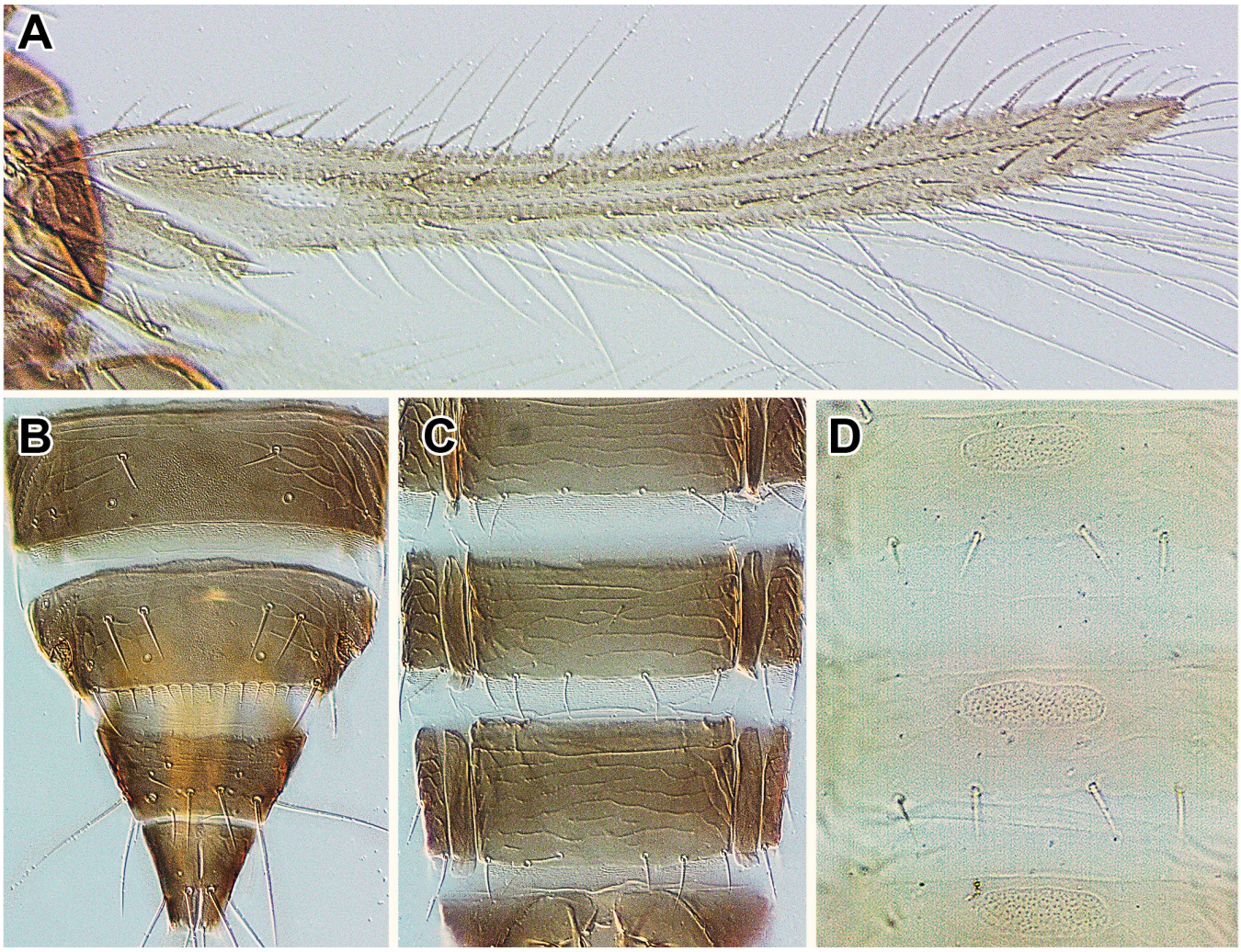

Figure 2. *Frankliniella minuta* (Moulton, 1907). **A.** Female, forewing; **B.** Female, tergites VII–X; **C.** Female, sternites V–VIII (segment VIII, slightly shown); **D.** Male, sternal pore plates.

DISCUSSION

Frankliniella minuta is one of a particular group of about 25 Neotropical species within the genus *Frankliniella* (Sakimura & O'Neill, 1979; Retana-Salazar & Mound, 1994; Retana-Salazar et al., 2010; Cavalleri & Mound, 2012). These species occur primarily in South America, but some are known only from the Caribbean or from Western North America (Sakimura & O'Neill, 1979). Members of this species group are particularly associated with the flowers of various Asteraceae species, and *F. minuta* has only ever been found in numbers in the flowers of such plants (Mound et al., 2019), where presumably the species breeds. However, it is often difficult to determine the precise host relationships of a thrips species unless larvae are found with adults and thus provide evidence of breeding. Many species fly around and drift on the wind, landing on various plants on which they cannot breed, with the result that many published "host-associations" are based on one or a few transient adults not on breeding populations. *Frankliniella minuta* is not known to be a serious pest on any plants, but because it is currently recorded only from continental America and Hawaii, this record in Malaysia is sufficiently significant to alert horticulturalists and quarantine entomologists in other countries, particularly with regard to the potential invasion pathway. The potential threat to horticulture in Malaysia by the presence of *F. minuta* remains entirely unknown because the pest status of most thrips is usually unpredictable between sites and seasons (Mound et al., 2022). However, during two years of ecological examination, it did not infect or attack starfruits. Nevertheless, *F. minuta* may have the potential to be

pestiferous on cultivated plants of the family Asteraceae, even though there are no reports of such problems yet from the Americas including Hawaii (Mound et al., 2016). In contrast, both *F. occidentalis* and *F. schultzei* are serious crop pests (Schellhorn et al., 2010; Kakkar et al., 2012; Healey et al., 2017) by direct feeding and transmitting Orthotospoviruses. Little evidence of yield reduction is caused by *F. williamsi* even if it sometimes produces large populations on the leaves of *Zea mays*. The Holarctic species *F. intonsa* is mainly abundant in cooler regions between Europe and Taiwan and, usually is known as a minor pest in flower crops (Wang et al., 2019). Recently however, *F. intonsa* has emerged as a pestiferous threat to strawberry production in Denmark (Nielsen et al., 2021) and Canada (Canovas et al., 2023), raising concerns about potential economic losses for growers.

Of greater concern than the mere presence of this species, and its taxonomic relationships, is the unknown invasion pathway. According to the latest quarantine record by the Department of Agriculture Malaysia (Thysanoptera Interception List: 2016–2020, Plant Biosecurity Division, *F. minuta* has never been listed as an intercepted species. Since the invasion pathway and the point of entry of this species remain unknown, this record warrants further investigation to ascertain both the risk status and potential establishment of *F. minuta* in Malaysia and across the Southeast Asia region.

AUTHOR'S CONTRIBUTION

The authors confirm their contribution to the manuscript as follows: AMMZ: field work, mounting the specimen, identification, writing–original draft preparation, writing–review and editing; YFN: specimen verification, photography, writing–original draft preparation; LAM: specimen verification, writing–original draft preparation, writing–review and editing; VLL: supervision, writing–review and editing, project administration; AAA: specimen verification, supervision, writing–review and editing, project administration, funding acquisition. All authors approved the final version of the manuscript.

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AVAILABILITY OF DATA AND MATERIAL

The specimens listed in this study are deposited at the Museum of Zoology, Universiti Malaya (MZUM) and the Center of Insect Systematics, Universiti Kebangsaan Malaysia (CIS-UKM) and are available from the curator, upon request.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

CONSENT FOR PUBLICATION

Not applicable.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this paper.

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تریپس *Frankliniella minuta* (Moulton) (Thysanoptera: Thripidae)، یک گونهٔ امریکایی کشف شده در آسیا، به همراه کلید شناسایی گونه‌های جنس *Frankliniella* در مالزی

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چکیده: یک گونه حشره متعلق به منطقه دنیای جدید به نام *Frankliniella minuta* (Moulton, 1907) برای اولین بار از قاره آسیا گزارش شد. این گونه متعلق به راسته بال‌ریشک‌داران (Thysanoptera)، خانواده Thripidae و زیرخانواده Thripinae می‌باشد. مجموعاً ۴۵ نمونهٔ نر و ۱۴ ماده بالغ از روی گیاه دکمه کتی، *Tridax procumbens* خانواده Asteraceae واقع در محوطه مؤسسه پژوهش و توسعه کشاورزی مالزی (MARDI)، در شبه‌جزیره سلانگور یافت شدند. همهٔ نمونه‌ها از کاپیتولوم گیاه میزبان جداسازی و جمع‌آوری شدند. پتانسیل تهدید این گونه به عنوان آفت محصولات باغی قطعی نیست، اما حضور آن باید باعث توجه کشاورزان و متخصصین قرنطینه حشرات به مسیرهای ورود آن باشد. خصوصیات افتراقی و تصاویر مربوطه همراه با یک کلید برای شناسایی گونه‌های جنس در مالزی *Frankliniella* ارایه شد.

واژگان کلیدی: مرکبیان، تریپس گل، باغبانی، کلیدشناسایی، گونهٔ مهاجم، قرنطینه