



國立台灣大學生物資源暨農學院昆蟲學系

博士論文

Department of Entomology

College of Bioresources and Agriculture

National Taiwan University

Doctoral Dissertation

臺灣產植綫蟎科分類學研究

Taxonomy of Phytoseiidae (Acari: Mesostigmata) in
Taiwan

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中華民國 108 年 7 月

June, 2019

口試委員會審定書

國立臺灣大學博士學位論文 口試委員會審定書

臺灣產植綫蟎科分類學研究

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本論文係廖治榮君（學號 D04632007）在國立臺灣大學昆蟲學系完成之博士學位論文，於民國 108 年 7 月 17 日承下列考試委員審查通過及口試及格，特此證明。

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謝辭



記得在大四時的路光輝老師與楊正澤老師的鼓勵與引薦之下，何琦琛老師開始領著我進入這個微小的世界。踏入八隻腳的世界已經超過十年了。感謝這段日子給我幫助的所有人，有了你們的支持與鼓勵，才能有這篇論文的誕生，也才能有現在的我。首先要感謝兩位指導老師，我還是稚嫩（無知）時期，就對我有無比的耐心，期待有朝一日也能成為這麼好的老師。感謝昆蟲分類室的各位學長、學弟妹，昌旺、A. K. Dubey、佳宏、葉鳥、施董、宜弦、華德、瑞帆、君玳、保成、勇伯、有方、怡儂、宜婷、曉芹、建宇、方俞、又仁、證翔、景雅、育脩、佑昇、亞琍。感謝口試委員許洞慶、黃國靖、陳文華、詹美鈴、葉信廷老師們對於論文的指正與建議。感謝以下的老師、學長姐、同學、朋友給予的幫助：系上楊平世、吳文哲、張俊哲、蔡志偉、吳岳隆老師、系辦公室的連姊、吳姊、曹姐、曉嬋、智喬、生態室邱名鐘。中興昆蟲楊正澤、楊曼妙、葉文斌老師、林聖豐、蔡正隆、廖一璋、唐昌迪、嘉義大學林明瑩老師、屏科大陳文華、張萃嫻老師、馬佩琴、科博館鄭明倫、蔡經甫學長、農試所李奇峰、石憲宗學長、林鳳琪、陳淑佩、陳怡如學姊。感謝台東改良場許育慈、花蓮改良場呂柏寬、苗栗改良場李念臻、嘉義分所王泰權、陳柏宏、台南改良場張淳淳、吉田田曾鈺芳。感謝國外的朋友 Gregory Evans (APHIS-USDA)、Gilberto Jose de Moraes (ESALQ-USP)、Peterson Demite (UFAM)、Francisco Ferragut (UPV)、Farid Faraji (MITOX)、Vikram Prasad (Indira Publishing House)、Leonila Corpuz-Raros (UPLB-MNH)、Jeremy Naredo (UPLB-MNH)、İsmail Döker (CU)、Sergey Ermilov (UT)、Marie-Stephane Tixier (UM)、Pavel Klimov (UMICH)、Fred Beaulieu (CNC)、Shingo Toyoshima (NARO)、Satoshi Shimano (HU)、Katsuyuki Eguchi (TMU)、Shimpei Hiruta (NSMT)、Hirotsugu Ono (NSMT)、廖浩全 (TMU)、Masahiro Ohara (HUM)、Hiroshi Kajihara (HUM)、吳偉南 (GIABR)、范青海 (MPI)、張智強老師 (Manaaki Whenua - Landcare Research)、方小端 (GIABR)、馬敏 (SAU)、Danuta Knihinicki (OAI)。最後要感謝科技部經費 NSC102-2628-B-002-019-MY3、MOST105-2621-B-002-002-MY3、MOST 108-2621-B-002-005-MY3。感謝在各個方面給予過我幫助的夥伴們，在此我再一次真誠地向幫助過我的老師和同學表示感謝！

中文摘要



植綏蟎科 (捕植蟎) (Phytoseiidae)，是世界聞名的蟎類之一，已經紀錄超過 2,700 種。部分種類是生物防治時常被以應用的捕食性天敵，在田間能捕食植食性的微小害蟲，如葉蟎、節蟎及小型昆蟲，對於農業生態系提供重要的貢獻。為了能妥善的應用植綏蟎，基礎的分類學研究是不可或缺的。錯誤的鑑定將使得非標的之天敵被釋放於田間，無法確實偵測田間天敵與害蟲之密度，掌握施用時機，甚至在新天敵的開發上均將造成問題。臺灣地區自 1970 年代開始，由曾義雄與數位蟎類學家在植綏蟎分類上有重大的貢獻，截至目前為止已經記錄 53 種。然而往昔研究有些許問題亟需解決：1. 調查多侷限於農地或郊區。2. 大部份研究只描述雌成蟎。3. 往昔的描述與繪圖與現行分類方式不同。4. 所有曾義雄的採集標本包括模式標本已遺失。5. 許多種類僅有形態描述，缺少基礎生物學資訊，在本土天敵的篩選上造成困難。本研究將針對臺灣地區與鄰近島嶼之植綏蟎科進行完整的分類學與外部形態回顧。從 2009 至 2019 逾 10 年間，共採集超過 2,500 樣本與超過 20,000 個蟎類個體。本研究將針對臺灣產植綏蟎科進行完整重新描述，已發表 5 新種 5 新紀錄種，總共包含三亞科、14 屬、62 種。提供形態描述、繪圖，並增加寄主植物、食性等資訊。此外將針對以下五點進行討論：1. 臺灣產植綏蟎多樣性。2. 曾氏標本的謎團。3. 額外增加的形態特徵對於本類群分類之探討。4. 是否仍有其他有潛力之捕食性天敵。5. 蟎類標本製作技術探討。本研究預期將可充實臺灣生物多樣性資料庫，更能對未來植綏蟎之應用提供重要基礎。

關鍵詞：植綏蟎科、分類、背毛、重新描述

ABSTRACT



The Phytoseiidae, one of the most well-known mite families, contains more than 2,700 recorded species worldwide. Certain phytoseiids are used as biocontrol agents. They prey on phytophagous pests, including spider mites, eriophyid mites, and small insects, thus valuably contributing to the agroecosystem. In order to study, apply and monitor accurately on the appropriate species, a reliable Taxonomy of Phytoseiidae is urgently needed. Fifty-three species of Taiwanese phytoseiids have been recorded since the 1970s, with major contributions from Tseng and other acarologists. However, several problems must be solved: (1) previous investigations have mostly been restricted to agricultural areas or suburbs; (2) descriptions of adult males for most species are lacking; (3) some parts of the descriptions, drawings, and synonyms are ambiguous; (4) all collections by Tseng, including type specimens, are missing; (5) biological information on phytoseiids is lacking. This study comprised a general review of the classification and external morphology of the family Phytoseiidae in Taiwan and neighboring islands. During 2009–2019, more than 20,000 specimens with 2,500 collection records were found. This study dealt with 62 species belonging to 3 subfamilies, 14 genera, including 5 new species and 5 newly recorded species were reported before. It was provided descriptions, illustrations, and also informations on habitat plants and food habits were recorded. Five points were discussed separately: 1. biodiversity of phytoseiid mites from Taiwan; 2. Tseng's specimens mystery; 3. additional characters in Taxonomy of Phytoseiidae; 4. any possible potential predator species? 5. mite slide preparation. This study will not only extend biodiversity database of Taiwan but provide framework for future biological control of phytoseiids.

Key words: Phytoseiidae, Taxonomy, dorsal seta, redescription.

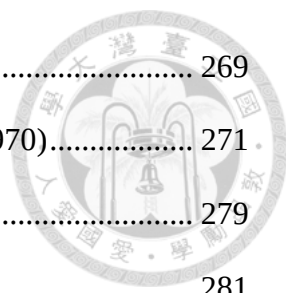
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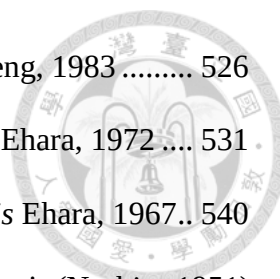
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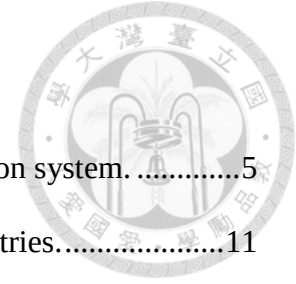


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Chapter 1 Introduction



Phytoseiidae is a mite family, which belongs to subclass Acari, superorder Parasitiformes, order Mesostigmata, superfamily Phytoseioidea (Chant & McMurtry 2007). The family is divided into three subfamilies, Amblyseiinae, Phytoseiinae, and Typhlodrominae (Chant & McMurtry 2007). More than 90 genera 2,700 species have been recorded in the world to date (Demite *et al.* 2019). Phytoseiid mites have received considerable attention for their role as biological control agents of phytophagous mites and other arthropods (e.g. thrips, whiteflies and scale insects) that are involved in losses to agronomic, medicinal, forestry, textile, fruit, and ornamental and forage crops (Huffaker *et al.* 1970; McMurtry *et al.* 1970; 2013). They occur on variable plants, for instance, weeds, crops, and bushes. They exploited the foliage habitat of higher plants extensively, and can be discovered from any places covered with vegetation (Chant 1985; Chant & McMurtry 2007; Wu *et al.* 2009). Sometimes, they can be found in flowers (e.g. *Amblyseius tamatavensis* usually occurs on flowers), and also inhibit in leaf domatia (Walter & Proctor 2013). Besides, some of them are also soil-dwelling mites (e.g. *Neoseiulus barkeri*), with diverged habitats from tundra to tropical rain forest (Chant 1985; 2007; Chant & McMurtry 2007). Aquatic mesostigmatids have been reported (e.g. *Phaulodinychus mitis* from Uropodidae) (Krantz 1974; Walter & Proctor 2013). However, no swimming phytoseiids were found, but some of them live on rocky shore (e.g. *Typhlodromus (Anthoseius) crossostephium*) (Liao *et al.* 2017c) and wetland habitats (e.g. *Neoseiulella paralias*) (Stathakis *et al.* 2016), and also in pitcher of pitcher plant (e.g. *Macroseius biscutatus*) (Muma & Denmark 1967). McMurtry & Croft (1997) and McMurtry *et al.* (2013) categorized phytoseiids to four main types: type I, specialized mite predators; type II, selective predators of tetranychid mites; type III,

generalist predators; and type IV, pollen feeding generalist predators.

Moraes *et al.* (1986) compiled a catalog of Phytoseiidae and recorded 1,500 species. The number of species increased to 2,250 in eighteen years later in their revised catalog (Moraes *et al.* 2004a), and was added with seventy five more species in the following three years (Chant & McMurtry 2007). The online Phytoseiidae Database recorded more than 2,700 species in the world (Demite *et al.* 2019). The Phytoseiidae is about 20% of the known diversity of the order Mesostigmata (Kostianinen & Hoy 1996). This number is still increasing as new species are found all over the world.

Taxonomy of family Phytoseiidae began in 1970s in Taiwan (Ehara 1970). Yi-Hsiung Tseng provided the most complete survey of phytoseiid mites in this country from the 1970s to the early 1980s; he recorded 47 species including 20 newly described endemic species. Thus far, fifty-eight species of phytoseiid mites had been recorded from Taiwan (Ehara 1970; Lo 1970; Tseng 1972; 1973; 1975; 1976; 1983; Chang & Tseng 1978; Ho & Lo 1989; Ho *et al.* 2003; Liao *et al.* 2013; 2017a; 2017b; 2017c; 2018). The majority of these species were collected from plant foliage, and mostly from lower altitude areas (e.g. agricultural area). Habitats such as ground litters, lichens, mountain area of higher altitude are rarely exploited.

The present work includes comprehensive data on 62 species of phytoseiids in Taiwan and neighboring islands. Emphasis has been placed on the correct illustration of each species and the data has been presented, as far as possible, in a standardized way to make it easy for even non-specialist taxonomists of phytoseiids to determine the identity of species.

Chapter 2 Historical taxonomic review

2.1 Historical taxonomic research of Phytoseiidae

Because of their potential for biological control, phytoseiid mites got much attention since 1960s. There were lots of phytoseiid mite studies related to different fields, such as their biology, ecology, and taxonomy (Kostiainen & Hoy 1996). The first phytoseiid mite was described by Koch (1839), *Zercon obtusus*. After Koch described the first species, the classification of Phytoseiidae was chaotic. Systematics were often proposed on a limited geographic basis, and made the researchers more confused in application. There were 4 possible reasons: 1. definition of characters were different; 2. type specimens were lost or unobservable; 3. description and illustration were simple and ambiguous; 4. taxonomists seldom changed their opinions (Wu *et al.* 2009).

In the following 100 years, most contributions were given from A. Berlese, A. C. Oudemans, C. Ribaga, and A. Scheuten, who described species but in different taxonomic groups (Chant 1985; Wu *et al.* 2009). The descriptions at this period were considered to be too simple and unclear (Chant 1959; 1985; Wu *et al.* 2009). The first supragenic research was proposed by Berlese (1913). He proposed the phytoseiid mites to be a tribe Phytoseiini, belonged to the family Laelaptidae. Vitzthum (1941) suggested the phytoseiid mites should elevate to subfamily status and comprised 6 genera, after that, many acarologists proposed their own classification systems. Garman (1948) supported the previous opinions from Vitzthum, the phytoseiid mites were subfamily status and belonged to Laelapidae, but the containing genera were different (Nesbitt 1951; Chant 1959b).

In the first review of phytoseiid mites by Nesbitt (1951), species were described, and biology and ecology were concerned only for a few species due to their potential of

biological control. Nesbitt (1951) considered the phytoseiid mites to be a subfamily Phytoseiinae, belonged to the family Laelaptidae, comprised 7 genera, and also genus *Blattisocius*. Baker & Whaton (1952) were the first acarologists, who suggested to elevate the subfamily Phytoseiinae to family status, and comprised 2 subfamilies, Phytoseiinae and Podocininae. Evans (1957) isolated the Podocininae to family status, and transferred the three genera *Garmania*, *Blattisocius*, and *Kleemania* to the family Aceosejidae. But these three families are different. Podocinidae is characterized by having leg I much longer than other legs (Wu *et al.* 2009), members of Phytoseiidae are plant-inhabiting, and the family Aceosejidae is a group living in store food products (Chant 1959b).

After these studies, the debate of classification in the family Phytoseiidae turned to two schools respectively, “Chant school” and “Muma school” (McMurtry 2010). Chant (1959) accepted the phytoseiids were family status, dividing them into Phytoseiinae and Macroseiinae, whose dorsal shield two shields. Muma (1961) suggested the family Phytoseiidae containing 4 subfamilies, Macroseiinae, Aceodrominae, Amblyseiinae, Phytoseiinae, and 43 genera. Chant (1965) proposed a new system with 2 subfamilies 14 genera, reduced the subfamily Macroseiinae to only of generic significance, and added the subfamily Otopheidomeninae. Chant & Yoshida-Shaul (1986) isolated the Otopheidomeninae to family status, and isolated other three subfamilies from Phytoseiinae, including Chantiinae, Cydnodromelinae, and Amblyseiinae. Chant & McMurtry (1994) reviewed the family worldwide basis, and revised the generic classification. The family of Phytoseiidae consists of 3 subfamilies, Amblyseiinae, Phytoseiinae, and Typhlodrominae. With subsequent supplements of theirs (Chant & McMurtry 2004a; 2004b; 2007), the classification system, with 84 genera in 16 tribes, has been generally accepted by most taxonomists of phytoseiids (Fig. 1).

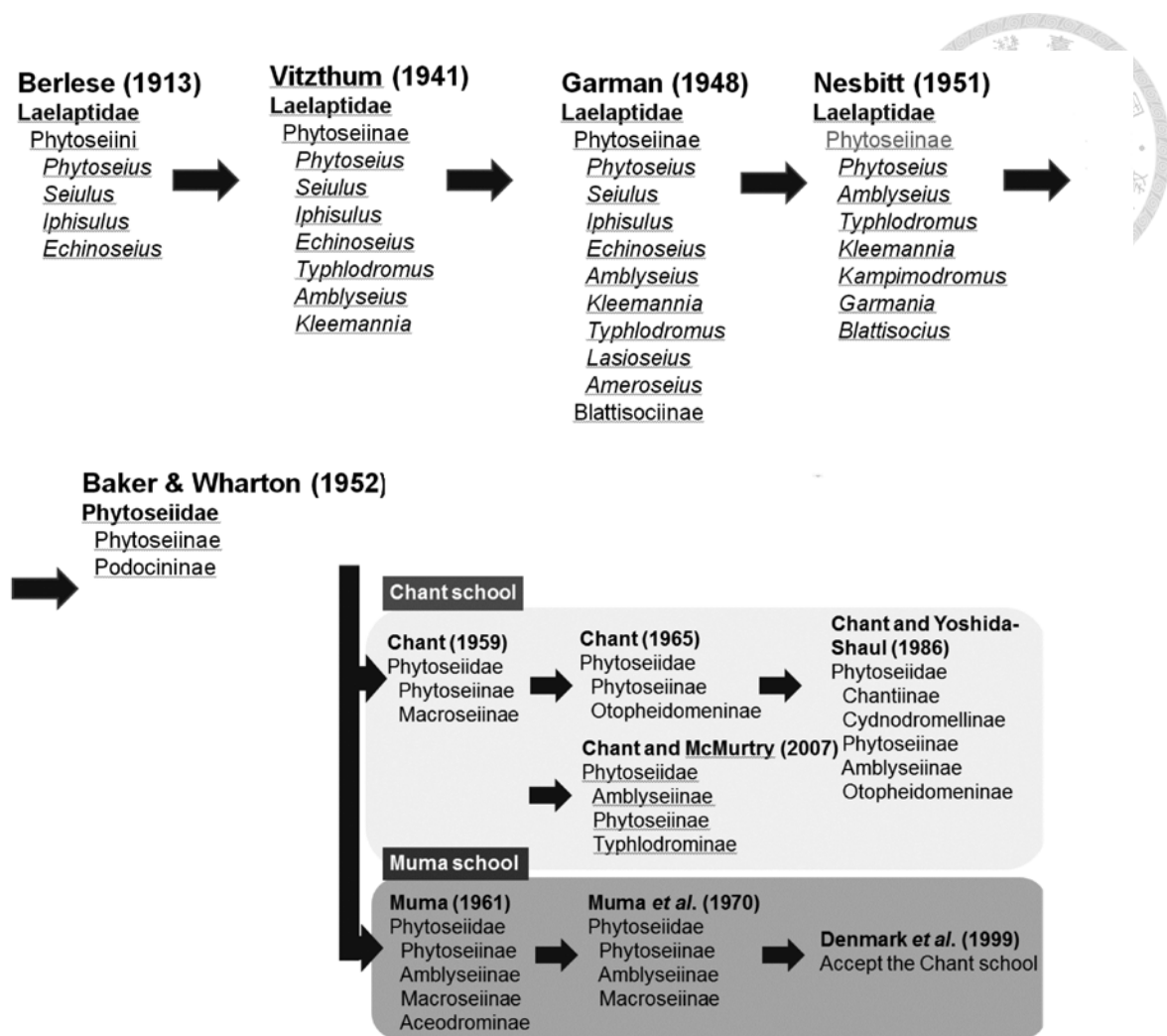


FIGURE 1. Historical taxonomic review of Phytoseiidae classification system.

On the other hand, Muma (1961) proposed a different opinion with Chant school, which isolated three subfamilies, Amblyseiinae, Macroseiinae, and Aceodrominae from Phytoseiinae. Muma & Denmark (1970) revised their generic classification, divided the family Phytoseiidae into 3 subfamilies, Macroseiinae, Amblyseiinae, and Phytoseiinae. The major debates between these two schools were the taxonomic status of Amblyseiinae. The classification system of Muma school was accepted by many researchers due to they consider the Amblyseiinae should be subfamily status. On special, Moraes *et al.* (1986) proposed a catalog which was accepted by Muma School. However, after the series review of phytoseiid mites by Chant & McMurtry (1994;

2003a; 2003b; 2004a; 2004b; 2005a; 2005b; 2005c; 2006a; 2006b), most acarologists accepted the classification system by Chant & McMurtry (2007). They also used morphological characters to construct the cladogram to study the phylogeny, and their classification system can reflect these relationships. Chant & McMurtry (1994) proposed the backbone of phylogeny in the Phytoseiidae. The Phytoseiidae is diverged into two clades, Amblyseiinae and Phytoseiinae+Typhlodrominae, Phytoseiinae and Typhlodrominae are sister clades. They considered the first clade of Amblyseiinae was ancestral neoseiuline after Amblyseiinae diverged from others two subfamilies.

Yi-Hsung Tseng also proposed his own classification system disagreed with all classification system in that time (Tseng 1975; 1976). In his classification system, the family Phytoseiidae was composed of 3 subfamilies, Opheidomeninae, Macroseiinae and Phytoseiinae, and the current accepted three subfamilies, Amblyseiinae, Phytoseiinae, and Typhlodrominae were of generic level under Phytoseiinae. In addition, Wu *et al.* (1997; 2009) reviewed the fauna of phytoseiid mites in China, and proposed a different system with some genera been descended to subgenera, for instance, genus the *Neoseiulus* was considered a subgenus within genus *Amblyseius*.

Karg (1960) proposed the family Typhlodromidae to contain the previously overall phytoseiid mites. Karg (1965) considered the Phytoseiidae comprised by subfamilies Blattisociinae and Phytoseiinae. Karg (1976) added the subfamily Otopheidomeninae to Phytoseiidae, a classification system had also been accepted by Chant (1965), Tseng (1975), and Schicha (1987). Karg (1983) revised the generic classification, considered the family comprising 4 subfamilies, Phytoseiinae, Macroseiinae, Blattisociinae, and Treatiinae, which transferred from the Otopheidomenidae, and total 32 genera (Karg 1983). Hirschmann (1962) proposed a different opinion, who putted the members of phytoseiids under genus *Typhlodromus* that belonged to family Gamasidae, subfamily

Melicharinae. The family Otopheidomenidae, moth-parasiting mites, is now a distinct group belonged to Phytoseioidea. In addition, Blattisocidae was a group of mites that shared common ancestor with Phytoseiidae and was once considered as a subfamily of Phytoseiidae (Nesbitt 1951; Lindquist & Evans 1965; Karg 1983).

Generic concept of Athias-Henriot should also be noticed (Tsolakis & Ragusa 2010). She provided wider view of phytoseiid classification, not only focused on phytoseiids, but from the gamasids. In her systematic work, shape of spermatheca was used for taxonomic purposes and generic concept. Besides, dorsal setation, adenotaxy, sigillotaxy and ecological information were also applied for define natural evolutionary lineages. Although these characters were used for identification, but the generic concepts were not accepted by other acarologists. Her concept is inflexible so many paraphyletic groups would be created. Therefore, only a few proselytes of her generic classification (Tsolakis & Ragusa 2010). The first work of Phytoseiidae from Athias-Henriot, she started to discuss the chaos of the systematics of Phytoseiidae and Aceosejidae (Athias-Henriot 1957). In this work, she considered ecological information provided important role in phylogeny, closely species should live in similar ecological niches and also externally morphological characters. Phytoseiidae and Aceosejidae were identified by dorsal setation and different lifestyles. Besides, Athias-Henriot (1957) also discussed the setal homologies, and revised the seta nomenclature system.

2.2 Historical taxonomic research in the neighboring countries

2.2.1 Eastern Asia

In China, research on phytoseiid mite fauna started from those of Hong Kong



(Chant 1959; Swirski & Shechter 1961; Swirski & Amitai 1966; Ehara & Lee 1971). The study of phytoseiid mites in mainland starts from 1978, Xi-Wen Chen, Cheng-yie Hu, Jun Lao, Cheng-Jun Lu, Li-Sheng Ke, Lai-Rong Liang, Yuan-Min Wang, Wei-Nan Wu, Jie-Liu Xin, Jun Xu, Sui-Gong Yin, Zhi-Min Zhu, described many new species, respectively. Until 1997, Wu *et al.* (1997) published the fauna of Phytoseiidae from China, recorded more than 100 species with Taiwanese species included. Wu (1997) reviewed the genus *Phytoseius* in China, and dealt with 31 species, 1 new species was described. Ma Li-ming also described 7 new species to China's fauna (Ma 2002; 2004; Ma & Lin 2007). Wu *et al.* (2009) revised the Phytoseiidae fauna of China; recorded nearly 300 species included again the Taiwanese phytoseiid mites. Recently, Min Ma, Xiao-Duan Fang provided several articles about phytoseiids from China respectively (Fang & Wu 2017; Fang *et al.* 2018; Ma *et al.* 2016; 2018). Until now, 279 valid phytoseiid species recorded in China (Demite *et al.* 2019).

In Japan, the most powerful researcher of Phytoseiidae and Tetranychidae was Shozo Ehara. He began to study phytoseiid mites since 1950s. Ehara (1958) reported three species for Japan phytoseiid fauna. During several decades' survey, Ehara *et al.* (1994) provided the first complicated review of Phytoseiidae in Japan, and recorded 74 species. Ehara & Amano (1998) also added 3 species. Ehara & Amano (2002) investigated the fauna of phytoseiid mites from Ishigaki and Taketomi Islands; they recorded 16 species including 1 new species. Ehara & Amano (2004) compiled a checklist of Japanese Amblyseiinae, recorded 49 species. Ehara *et al.* (2006) described 3 new species from Japan. Ehara & Kishimoto (2007) described a new species belonged to genus *Phytoscutus* in Kyushu. Until now, 98 species have been recorded in Japan (Demite *et al.* 2019). In addition, "Phytoseiid mite Portal" website was build for introduction of Japanese phytoseiids, provided descriptions and photos (Toyoshima *et al.*

2018).

Studies on Korean phytoseiids had been started from the work of Lee (1961). After that, Lee & Ryu (1989), Denmark & Muma (1989), Ryu & Ehara (1990; 1991; 1992) and Ryu & Lee (1992) gave contribution to phytoseiids fauna in Korea. In the review work of Ryu (1993), 27 species of phytoseiid mites were recorded from Korea. Ryu & Lee (1995) described 2 new species of the genus *Amblyseiulella* from Korea. Ryu (2007) proposed 29 Amblyseiinae species from Korea, comprised 4 genera, *Amblyseiulella*, *Amblyseius*, *Okiseius*, and *Proprioseiopsis*. Ryu (2012) published a book of Korean fauna of Phytoseiidae, and reported 47 species in Korea. Ryu (2013) recorded a new species and one new recorded species of genus *Typhlodromips*. Up to date, 49 species were recorded in Korea (Demite *et al.* 2019).

2.2.2 Southeast Asia

Philippine studies of phytoseiid mites can be traced back to 1962, the taxonomic study on phytoseiid mites of L. C. Rimando and L. A. Corpuz-Raros. They published two articles in 1966, and recorded 18 species of phytoseiid mites based on the collection of Dr. John Matthysse in 1967 (Corpuz-Raros & Rimando 1966; Corpuz 1966). Corpuz-Raros & Garcia (1994) described two new records from Philippines. After that, Schicha & Corpuz-Raros (1992) published a book of fauna of phytoseiid mites. They collected 2,454 specimens, and recorded 78 species in Philippines, with 49 species were new to science. Corpuz-Raros (1995a) described two new species of *Amblyseiulella* from Philippine. Up to date, 94 valid species were recorded in Philippine (Demite *et al.* 2019).

Shozo Ehara had studied phytoseiid mites from Thailand (Ehara & Bhandhufalck 1977), and recorded 29 species in Thailand. Moraes *et al.* (1989b) reported 13 species from the Far East area, including 4 species from Thai's fauna. Moraes *et al.* (2004)



increased the number of species to 32 species. Oliveira *et al.* (2012) reported the survey result between 1991 and 2011, and reported 26 phytoseiid species, including 6 species recorded for the first time. Up to date, 37 species have been reported in Thailand (Demite *et al.* 2019). Evans (1953) and Muma (1967) described 6 species of phytoseiid mites from Malaysia. Schicha (1982b) described a new species related with *Amblyseius newsami*, *A. cantonensis* in Malaysia. Ehara (2002b) reviewed the phytoseiids from west Malaysia, and added 2 new species from West Malaysia, the number of species increased to 17 species. Until now, 25 species were recorded in Malaysia (Demite *et al.* 2019). On the other, Corpuz-Raros (1995b) recorded 10 species from Singapore. Ehara (2002a) recorded 12 species in Sumatra, including one new species, *A. sumatrensis*. Ehara (2005) reviewed the fauna of phytoseiid mites from Java, recorded 23 species, including 1 new to science and 4 new recorded species. The phytoseiid fauna of Papua New Guinea had started from Collyer (1980) reported one species *Euseius ovalis*. Schicha & Gutierrez (1985) described 3 new species, and several new recorded species, increased the species number to 8 species. After that, McMurtry & Moraes (1985) described 6 new species.

2.2.3 Australia

The history of phytoseiid mites studies in Australia can trace back to Womersley (1954), who described 12 species from the area. Readshaw (1969) recorded 15 phytoseiid species that were useful to control the pest in orchards. The species *Typhlodromus occidentalis*, *Neoseiulus fallacis*, *T. pyri* was introduced to control spider mite in orchards (Schicha, 1987). And then, Schicha (1987) reviewed the family of Phytoseiidae, and recorded 126 species. Beard & Walter (1996) revised the genera *Paraphytoseius* and *Paraamblyseius* in Australia. Walter & Beard (1997) reviewed the subfamily Phytoseiinae in Australian, who recorded 22 species in the subfamily. Walter

(1999) reviewed the genera *Asperoseius*, *Euseius*, *Okiseius*, and *Phytosecutus* in Australia. Beard (1999) revised the genus *Australiseiulus* in Australia. Beard (2001) reviewed the genera *Neoseiulus* and *Typhlodromips* in Australia. Up to date, 157 valid species were recorded in Australia (Demite *et al.* 2019).

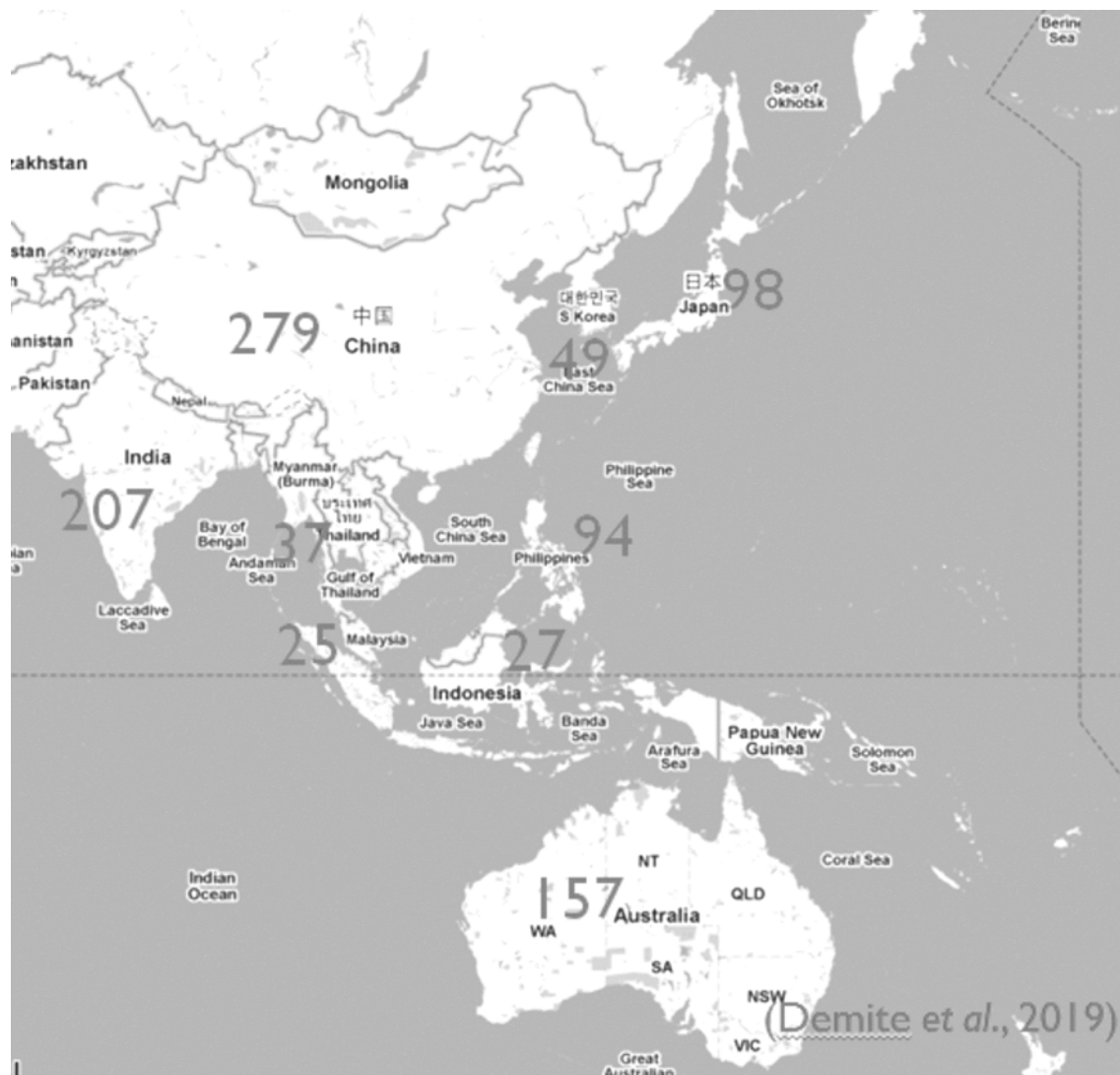
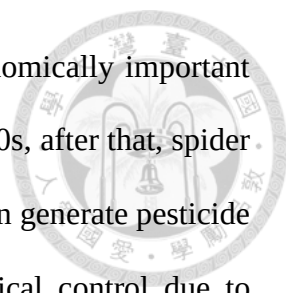


FIGURE 2. Number of valid phytoseiid species of neighboring countries.

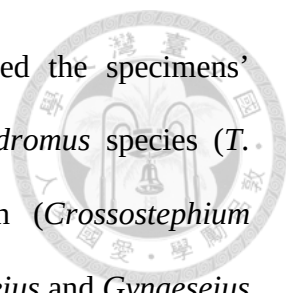
2.3 Historical taxonomic research in Taiwan

The studies of mites in Taiwan and neighboring islands began in 1930s by Japanese researchers. A few spider mites (e.g. *Bryobia* sp., *Tetranychus* sp., *T. executor*, *T. telarius*, and *Paratetranychus* sp.) had been recorded (Kishida 1935; Anonymous



1937; Shiraki 1937; Takahashi 1938), but none of them were economically important (Ho 2000). Chemical pesticides were used to control pests since 1950s, after that, spider mites became one of major pests gradually in Taiwan, due to they can generate pesticide resistance quickly (Ho 2000). Researchers began to study biological control due to pesticide resistance. Since then, phytoseiid mites have received attention; acarologists investigated the fauna of family Phytoseiidae in Taiwan. Ehara (1970) reported phytoseiid mites from Taiwan first time. He surveyed in 1966, recorded seven species, including 3 new species (*Typhlodromus* (*Anthoseius*) *ryukyuensis*, *Amblyseius* (*Amblyseius*) *longispinosus*, *A. (A.) taiwanicus*, *A. (A.) largoensis*, *A. (A.) ovalis*, *Iphiseius formosanus*, *Phytoseius* (*Phytoseius*) *huangi*). Lo (1970) recorded 6 species, including one new species and two new recorded species (*Phytoscutus taoi*, *Phytoseius coheni*, *A. longispinosus*, *A. okinawanus*, *A. largoensis*, *A. ovalis*). After that, encompassing surveys of phytoseiid mites were done by Y. H. Tseng during 1970s to 1980s. He provided a revised taxonomic system, which contained 3 subfamilies, 14 genera, and also recorded 47 species (including 20 new species) as of the review of phytoseiid mite in series researches (Tseng 1972; 1973; 1975; 1976; 1983; Chang & Tseng, 1978). After that, Ho & Lo (1989) reported five species (*Parapaphytoseius hyalinus*, *Parap. multidentatus*, *Parap. chihpenensi*, *Parap. hualienensis*, *Parap. cracentia*) in the genus *Parapaphytoseius* from Taiwan. Ho *et al.* (2003) reported the phytoseiid fauna in Matsu Islands first time. Eight species had been recorded.

Since 2009, the authors began to investigate the phytoseiid fauna. Liao *et al.* (2013) provided a phytoseiid checklist, and recorded 53 species from Taiwan. Liao *et al.* (2017a) reported Taiwanese *Euseius* species; six species had been recorded, including three new species and two new recorded species (*E. daluensis*, *E. macaranga*, *E. paraovalis*, *E. aizawai*, *E. circellatus*). Liao *et al.* (2017b) designated a neotype and



provided redescription of *Amblyseius bellatulus* and also reported the specimens' mystery of Tseng. Liao *et al.* (2017c) discovered a new *Typhlodromus* species (*T. (Anthoseius) crossostephium*) from coastal region on seremban (*Grossostephium chinense*). Liao *et al.* (2018) provided information about genera *Euseius* and *Gynaeseius*, including one new species (*E. oolong*) and three new recorded species (*E. nicholsi*, *E. sojaensis*, *G. santosoi*). Besides, three alien species (*Phytoseiulus persimilis*, *Neoseiulus fallacis*, *N. californicus*) were imported for biological control purpose.

Not only phytoseiid mites, Yi-Hsiung Tseng made great taxonomic work of several different taxonomic groups (e.g. Cheyletidae, mushroom mite, Tetranychidae, Oribatida), provided important basis of mite researches in Taiwan. He recorded 47 phytoseiid species including 20 newly described endemic ones. All collections of Tseng, including type specimens, were deposited at the Tainan Branch of the Bureau of Commodity Inspection and Quarantine (BCIQ) (Tseng 1983). However, the Tainan Branch of BCIQ no longer possesses Tseng's collections and type specimens. The plant and animal quarantine work was transferred from Bureau of Commodity Inspection and Quarantine to the newly established Bureau of Animal and Plant Health Inspection and Quarantine (BAPHIQ) since 1998 and BCIQ was renamed to Bureau of Standards, Metrology and Inspection (BSMI). Tseng retired from BSMI in 2008. The profile column of BAPHIQ Quarterly, a journal issued by BAPHIQ, had interviewed Yi-Hsiung Tseng in 2009 due to his great contribution to plant quarantine and talked about the mite collection of him. Tseng mentioned that he had discarded the whole mite collection of him after his retirement (BAPHIQ 2009; Liao *et al.* 2017). Until now, Dr. I. Döker found one specimens (*A. maai*) from H. A. Denmark's collection (Döker 2017 personal communication), other Tseng's specimens were missing.

To collect the species described by Y. H. Tseng, extensive survey in entire Taiwan

and surrounding islands are necessary. Concurrently, this study were tried to collect phytoseiid mites in type localities and type habitat plants since 2009. However, difficulties were coming because of typing errors in the names of the localities of collection, the old vague phonetic English transcription of the localities, and the use of general descriptive terms for plants (e.g., weeds, grasses). Landscape greatly changed in the past 30 years. Nonetheless, most of species were found during these surveys, in future, all redescrptions will be provided.

2.4 Historical review of setal chaetotaxy researches of Phytoseiidae

There are 13-23 pairs of setae on dorsum of phytoseiid mites. The chaetotaxy of these dorsal setae forms the base of the taxonomy of family Phytoseiidae (Chant & Yoshida-Shaul 1992; Chant & McMurtry 2007; Wu *et al.* 2009). There are two mainstreams about naming of dorsal setae, the letter-number system (DMLS) and JZSR systems. Appendix I provided the comparison of all setal system.

2.4.1 Early period of setal chaetotaxy system

Garman (1948) first proposed a setal nomenclature “letter-number system” for phytoseiid mites. He considered the each row of seta is relative, and grouped these dorsal setae into six longitudinal rows, namely from central to lateral, two longitudinal rows (D, dorsal setae), two median rows (M, median setae), and two lateral rows (L, lateral setae) on dorsal shield; in addition, scapular row (S, S setae) on each side on the membrane or dorsal shield. He considered setae on each rows are continuous, so named the setae from 1 to 10. However, this system did not identify setal homologies or distinguish between podosomal and opisthosomal setae (Chant & Yoshida-Shaul 1992; Wu *et al.* 2009; Prasad 2013). Nevertheless, the system was unsuitable to some

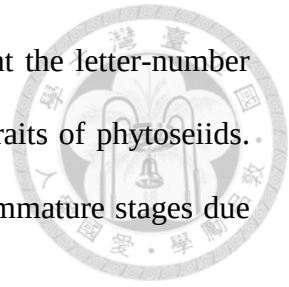
members of phytoseiids.

At the same time, several acarologists also proposed their opinion for the setal nomenclature. B. A. Wainstein also devised a different number-letter system for the dorsal setae on the idiosoma (e.g. D-, AM-, PM-, AL-, PL-, S- rows (Wainstein 1958; 1959; 1962). Schuster & Pritchard (1963) proposed setal nomenclature consisting of dorsocentral, mediolateral, and lateral setae, addition to vertical setae and clonal setae. Muma & Denmark (1970) proposed 3 series of setae on dorsal shield: D, dorsal, L, lateral, M, median, V, Vertical, Cl, Clunals. They considered the anteriormost setal pair on dorsal shield as verticals (V), the posterior most setal pair on dorsal shield as clunals (Cl).

It should be noted that Athias-Henriot (1957) & Hirschmann (1957) independently were the first to identify setal homologies among the setae on the dorsal shield. Both postulated 6 transverse rows of setae on the podonotum or podoscutum reflecting ancestral metameres. According to Athias-Henriot (1957), the idiosoma in the adult Phytoseiidae consisted of the podosoma having 6 and opisthosoma having 5 ancestral metameres. In modern Phytoseiidae, these fused metameres in single idiosoma were represented only by setae arranged, roughly, in transverse rows on each primitive metamere and thus assigned different letters of setal nomenclature. Today, all adult Phytoseiidae have a single dorsal shield except *Macroseius biscutatus* Chant, Denmark & Baker that has 2 separate dorsal shields (podonotum or podoscutum and opisthonotum or opisthoscutum) and has retained setae *r5* and *J1*. This unusual presence of 2 dorsal shields in the adult stage, similar to immatures, is the only species of Phytoseiidae considered an example of paedomorphosis in the subfamily Amblyseiinae (Chant 1993).

Although, the letter-number system had been revised on the base of every known

species at then, some researchers were still dissatisfied, and thought the letter-number system cannot reflect the homology of setae and the evolutionary traits of phytoseiids. Besides, this system only can apply on adult stage, unsuitable for immature stages due to the setae variable in different immature stages.



2.4.2 Hirschmann and Karg system

At that time, Hirschmann (1957) devised extensive systems stating that all parasitiform mites, in general, conformed to a fixed setal pattern and showed variations in different groups. He was the first to adopt the idea of distinguishing podosomal and opisthosomal setae in his system for all families in the Parasitiformes.

In another attempt, Hirschmann (1957) advanced the system of Sellnick (1944) with separate paired rows of longitudinal setae on the prodorsum and the postdorsum. The symbols for the setal rows are mainly based on Sellnick (1944) and comprise a dorsocentral row (i-I = 'Innenreihe'), a mediolateral row (z-Z = 'Zwischenreihe'), a lateral row (s-S = 'Seitenreihe') and a marginal row (r-R = 'Randreihe'). The setae on the prodorsum are written in lower case letters and the setae on the postdorsum in capital letters. Each subseries are numbered consecutively from anterior to posterior.

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2.4.3 Schicha system

It would be unfair not to mention the work of Schicha (1987) and Schicha & Corpuz-Raros (1992) who used the old system (before wide acceptance of the system of Rowell *et al.* (1978)). In these works, he called vertical setae as D, and clunal setae as

D6. Also, similar to Denmark (1992b), he labeled median, lateral and sub lateral setae but did not use system of Rowell *et al.* (1978) either on his Figure or numerous species he described by himself or with different coauthors. The most unique point about his work was that he not only recognized the missing setae on the dorsal idiosoma in many species, he showed these with circles. In addition, he drew macrosetae on leg IV showing details of the tip for several species.

2.4.4 Chant system

Rowell *et al.* (1978) revised the dorsal setation system from Lindquist & Evans (1965) for Gamasida, JZSR system. The system differ to letter-number system by separating dorsal shield into the podonotum part and the opisthonotum part, and name the setae in accordance to these two parts, respectively. The podonotal dorsal setae were named by lowercase letter, and the opisthonotal setae were named with capital letter. Podonotal setae are presumed to be the setae of the six prosomal segments, and the opisthosomal setae are those of the six opisthosomal segments. Each segment with eight dorsal setae, named from the central row lateralward with j-J, z-Z, s-S, r-R letter to form eight dorsal setae rows. This name system is generally accepted to name the dorsal setae of Mesostigmata.

However, scholars interpreted differently on which setae were lost, which were retained in evolution, and the relative position of certain setae. Chant & Yoshida-Shaul (1989, 1992b) reviewed the dorsal and ventral setation of the phytoseiids in the world, generalized the dorsal setae into variable setae and stable setae followed their phylogenetic traits and proposed 85 setation patterns.

Rowell *et al.* (1978) were the first who gave the setal designations and proposed the setal homologies and setal patterns on the dorsal shield in the family Phytoseiidae relating with other closely related mites. Later, Chant & Yoshida-Shaul (1989b, 1991b)

proposed caudoventral setal patterns and Chant & Yoshida-Shaul (1992) provided designations for these setae. Their systems were used extensively in works of Chant & McMurtry (1994, 2003-2007) which are widely used and accepted today.

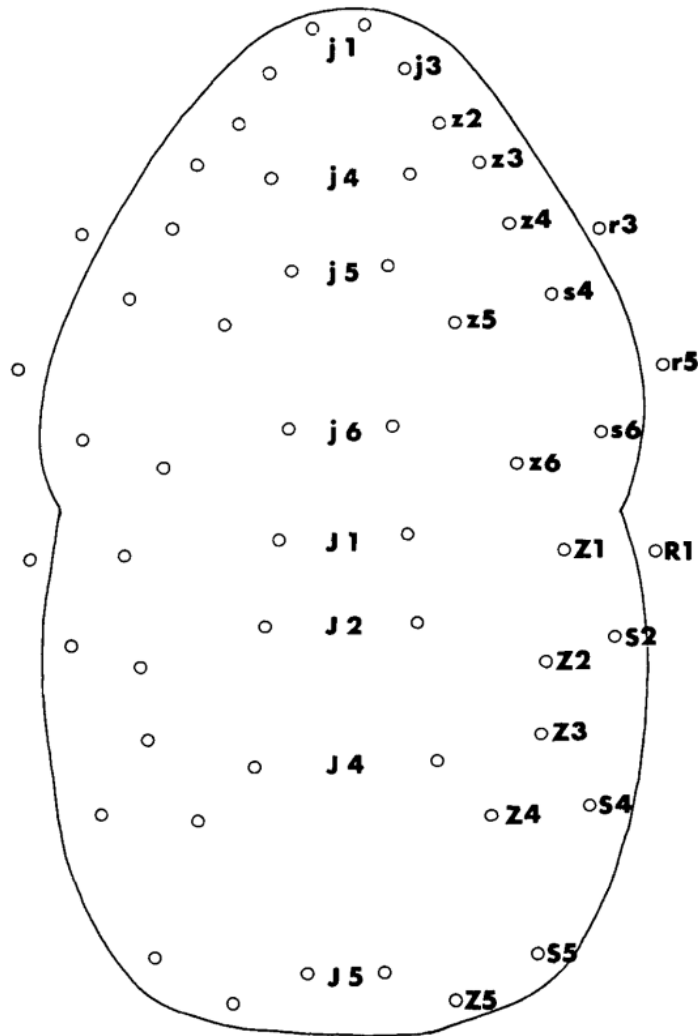
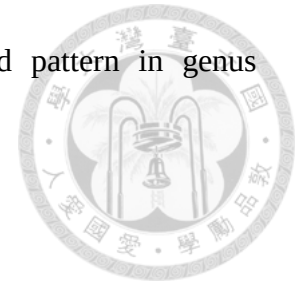


FIGURE 3. Hypothetical holotrichous setation of the dorsal shield in the family Phytoseiidae (after Chant & Yoshida 1989b).

2.4.5 Denmark and Evans system

Denmark & Evans (2011) proposed a simple pattern of idiosomal setae rather than the number of setal pattern (e.g. 10A:9B) proposed by Chant & Yoshida-shaul (1992). They proposed a “Standard Pattern” of different three subfamilies (ASP, PSP TSP, and MSP). Besides, they suggested use the minus sign after pattern for representing the

setae absent, for example, ASP [-S4] is Amblyseiinae standard pattern in genus *Kampimodromus*.



2.5 Biology

Some phytoseiid species are common natural enemies in the ecosystem (e.g. *Phytoseiulus persimilis*). They usually lived in plant or soil, feed on small arthropods (e.g. spider mites, aphids, and thrips), provided important contribution in ecological balances, and also famous biological control enemies in agroecosystem (Moraes *et al.* 2004b; Chant & McMurtry 2007; Demite *et al.* 2019). However, they have very different food habits and lifestyles. They could be carnivorous, and some species also feed on pollens, fungi spores, or plant debris (Huffaker *et al.* 1970; Chant 1985; McMurtry 2010; McMurtry *et al.* 1970; 2013). Since 1960s, they have received much attention, more than 4,000 articles discussing the application value of phytoseiids (Kostianinen & Hoy 1996).

Although phytoseiid mites are famous due to their biological control potential, but many of them are very different lifestyles. McMurtry & Croft (1997) provided the first time to review the diversity of lifestyles of Phytoseiidae. They categorized four types of lifestyles: Type I, specialized predator of *Tetranychus* spider mites (e.g. *Phytoseiulus* species); Type II, selective predators of tetranychid mites (e.g. *Galendromus*, *Neoseiulus*, *Typhlodromus* species); Type III, generalist predator (e.g. *Neoseiulus*, *Typhlodromus*, *Amblyseius* species); Type IV, specialized pollen feeder/generalist predators (e.g. *Euseius* species). Among them, *Phytoseiulus* species were most popular for biological control, and also were imported to many countries. McMurtry (2010) proposed the evolution of lifestyles based on currently classification system by Chant & McMurtry (2007). The prototype phytoseiid should live on soil surface or tree bark with

original morphology, widely food habits. For examples, *Austroseiulus australicus*、*Chiloseius camposi*、*Macrocaudus multisetatus*. After that, polyphagous phytoseiids who lived on plants were evolved. And then, phytoseiids were evolved different morphology to adapted different habitat plants. Finally, phytoseiids were evolved two different ways, pollen feeder or specialized predators, respectively.

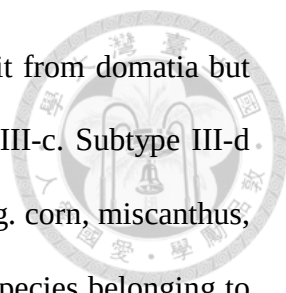
McMurtry *et al.* (2013) revised the lifestyles of phytoseiids according to their food preferences, microhabitat and morphology. The four main types were divided into ten different types:

Type I: Specialized mite predators, the types were divided into three different styles by different food sources: I-a. Specialized predators of *Tetranychus*. I-b. Specialized predators of web-nest producing mites. I-c. Specialized predators of tydeoids. The I-a species have the ability to adapt the CW-u (complicated web) spider mites (e.g. *Tetranychus* spp. or some *Eotetranychus* sp.). They are probably as effective predators for these spider mites, such as *Phytoseiulus persimilis* has been used commercially for control *Tetranychus urticae*. However, although this species are famous for controlling spider mites, but several studies (e.g. Sato *et al.* 2011) reported the performance is limited on tomato, due to trichomes on leaves. Species in I-b subtype have adapted for WN-u (Web nest) type spider mites (e.g. *Schizotetranychus* spp., *Stigmaeopsis* spp, and some *Oligonychus* spp.). For example, *Typhlodromus* (*Anthoseius*) *bambusae* has been found co-evolution with *Schizotetranychus celarius*, and also an effective natural enemy (Saito 2010). Subtype I-c is a group for preying tydeoid mites, which comprised *Paraseiulus* and *Typhlodromina*, and some *Proprioseiopsis* species. For example, *Paraseiulus talbii* show the effective control the density of tydeoid population in vineyard (Camporese & Duso 1995).

Type II: Selective predators of tetranychid mites. Type II species are selective

predators of tetranychid mites, associated with dense web producing species (e.g. *Oligonychus* and *Tetranychus* species) (McMurtry & Croft 1997; McMurtry *et al.* 2013). It comprised *Neoseiulus*, *Galendromus* and apparently, the *rickeri* group of *Typhlodromus* (*Anthoseius*). These species are associated with different life-type spider mites, including CW-u, WN-u, WN-c. In addition, they also provided a wider range of food preference than type I, including Eriphyidae, Tarsonemidae, Tydeoidea, pollens of plants. *Neoseiulus californicus* is the most famous species in this group, and many commercial products in the world.

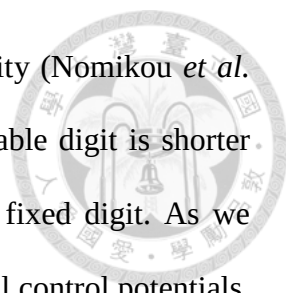
Type III: Generalist predators. This is a diverse group, with wider food range, and also different habitats. Most of phytoseiid species belong to this category. III-a. Generalist predators living on pubescent leaves. III-b. Generalist predators living on glabrous leaves. III-c. Generalist predators living in confined space on dicotyledonous plants. III-d. Generalist predators living in confined spaces on monocotyledonous plants. III-e. Generalist predators living in soil/litter habitats. Subtype III-a comprised *Paraphytoseius*, *Phytoseius*, *Kampimodromus*, *Typhlodromalus*, *Typhlodromus* spp.. These species are usually found on pubescent leaves. Previous studies (e.g. Duso 1992) found these phytoseiid mites show smaller and flatter body shapes, and some species have strong and serrated setae. Acarologists considered these characters can provide them ability to move and live among leaf trichomes. Rather than III-a, species of subtype III-b are not particularly small (McMurtry *et al.* 2013). It comprised *Amblyseius* and *Neoseiulus* and *Amblydromalus* species. In this subgroup, *Amblyseius swirskii*, *A. andersoni*, *Amblyd. limonicus* have been used commercially for control pests. Subtype III-c species are living in confined spaces of dicotyledonous plants, such as galled leaves, domatia, growing tips. Gall-forming eriophyids are often being food sources for these phytoseiids. Their microhabitats are different with other lifestyles. In some cases,



Ferreira *et al.* (2008) reported that some phytoseiids may get benefit from domatia but domatia is unnecessary. These species are not included in subtype III-c. Subtype III-d species are found in restricted space of monocotyledonous plants (e.g. corn, miscanthus, rice). In Taiwan, *Neoseiulus baraki*, and *N. taiwanicus* are famous species belonging to this subtype, and always found in leaf sheath. They are smaller and flatter body shapes. Species of subtype III-e are found on low-growing plant and also soil, litter. In this subtype, *N. barkeri* and *N. cucumeris* are used commercially for controlling thrips. In addition, species of *Proprioseiopsis* are also belonging to this group; Ho & Chen (2001) reported the life history of *Prop. aetus*.

Type IV: Pollen feeding generalist predators. This type means these phytoseiids use pollen as an important diet, including genera *Euseius*, *Iphiseius*, and *Iphiseiodes* spp.. They usually observed on glabrous leaves. *Euseius ovalis* is famous member of this type in Taiwan. In addition, some species are observed the piercing ability for plant leaf (Adar *et al.* 2012).

Although McMurtry *et al.* (2013) provided a complicated revision of phytoseiid lifestyles; two special circumstances are not included in the frame, aquatic and plant cell piercing phytoseiids. Until now, no swimming phytoseiids were found, but some species were reported from coastal area on rocky shore (e.g. *Typhlodromus* (*Anthoseius*) *crossostephium*) (Liao *et al.* 2017c) and wetland habitats (e.g. *Neoseiulella paralias*) (Stathakis *et al.* 2016), and also in pitcher of pitcher plant (e.g. *Macroseius biscutatus*) (Muma & Denmark 1967). In addition, *Evansoseius macfarlanei* and *Macrocaudus multisetatus* (tribe Neoseiulini) were found on floating plants, and also have uncommon setae on dorsal shield (Sheals 1962; Moraes *et al.* 2003). The first report about plant feeding ability of phytoseiid can trace back to Chant (1959b). *Typhlodromus* (*Anthoseius*) *rhenanus*, *T. (A.) pyri* and *Euseius finlandicus* were tested for plant feeding



ability. Recently, *E. scutalis* was reported about plant piercing ability (Nomikou *et al.* 2003). Adar *et al.* (2012) reported the plant feeder phytoseiid movable digit is shorter than the fixed digit; and non-plant feeder phytoseiid have shorter fixed digit. As we know, phytoseiid have received much attention due to their biological control potentials, more than 4,000 articles were reported for the application value (Kostianinen & Hoy 1996). Despite the extensive practical applications of phytoseiids for the biological control for pests, we still understand the limited knowledges about microhabitats and food preferences of phytoseiids.

2.6 Review of biological control from Taiwan

The family Phytoseiidae has been studied for six decades due to their potential as biological control agents of spider mites and also other small insects (Huffaker *et al.* 1970; Chant 1985; McMurtry 2010; McMurtry *et al.* 1970; 2013). Several researchers studied biological control by phytoseiid mites in Taiwan (e.g. P. K. C. Lo, C. I. T. Shih, C. C. Ho, W. T. Lee). In 1970s, P. K. C. Lo and C. I. T. Shih studied the efficiency of *Neoseiulus longispinosus* control spider mites, separately (Lo & Ho 1979; Shih & Shieh 1979). After that, they both corrected the scientific name of the phytoseiid they studied to *N. womersleyi* according to Schicha (1975). In 1981, phytoseiid mites were mass released to control kanzawai spider mites (*Tetranychus kanzawai*) on strawberry. Prey population was reduced in the experimental field, but efficiency of biological control to two-spotted spider mite (*T. urticae*) was different in strawberry farm in Miaoli (Lo *et al.* 1984).

To control spider mites in the field, Lo *et al.* (1986) reported three phytoseiids were introduced to Taiwan, including *Phytoseiulus persimilis* (from USA, but no detailed information), *N. californicus* from Hawaii, *A. fallacis* from Michigan, and also

developed mass-rearing technique (Lo *et al.* 1984; Shih 1985; Lee & Lo 1989). They released *N. fallacis* and *P. persimilis* to control spider mites on strawberry (Lee & Lo 1989; Lo *et al.* 1990), in pear orchard (Lo *et al.* 1986), in protected culture papaya (Hao *et al.* 1996), tea plantation (Ho 1990).

At the same time, researchers also tried to find a suitable local biological control agent. Chen (1988) reported the efficiency of *N. womersleyi* to control kanzawai spider mite. In 1990s, S. I. T. Shih started to study the mass-rearing of *N. womersleyi*, and also *Euseius ovalis* (Shih *et al.* 1993; Shih & Wang 1997). C. C. Ho compared several natural enemies (e.g. *Oligota flavicornis*, *Feltiella minuta*, *Scolothrips indicus*, and *N. womersleyi*) of spider mites in series researches (Ho & Chen 2001; 2002a; 2002b; Ho 2005). Although *N. womersleyi* fed on less spider mite eggs, nevertheless, Ho (2005) found the phytoseiid will stay to feed preys when prey populations lower rather than other natural enemies. This characteristic will make *N. womersleyi* easier to establish in the field. Ho & Chen (1999) reported the comparison among *N. womersleyi* and two introduced species (e.g. *N. fallacis*, *P. persimilis*), *N. womersleyi* showed the good efficiency of control spider mites. Besides, *N. womersleyi* stayed on the plant even the prey populations low. C. C. Ho re-evaluated the control efficiency and adaptation of *N. womersleyi*, and reported this species could be an important native natural enemy (Ho 2005). Shih (2001) reported the automatic mass-rearing technique, and the phytoseiid commercial products had on the market in 2006.

Chapter 3 Materials and Methods



3.1 Collecting specimens and preparing mounted slides

3.1.1 Specimens collection

Specimens examined in this study were collected from various plants and soils from Taiwan and surrounding islands during 2009–2019. Previous studies mainly focused on agricultural areas in the main island of Taiwan, and included little information from mountain areas (Liao *et al.* 2017a). To gain a more comprehensive understanding of phytoseiids of Taiwan, mountain areas of higher altitude were received more attention.

Phytoseiid mites usually occur in two major habitats, on plants or in the substrate (and soil) (Krantz & Walter 2009; McMurtry *et al.* 2013). Two different methods apply for mite collection separately. When collecting phytoseiid mites from plants, leaves were examined by naked eyes or 15x magnifier in the field, both the ventral and dorsal sides of leaf were checked, especially the lateral side of leaf veins. Symptom of the infestation of herbivores that is in the diet list of phytoseiid mites, such as spider mites, thrips, provided very good helps to locate certain species (e.g. *Neoseiulus womersleyi*). Plants that had collected some phytoseiid mites from were paid attention to for more individuals or for various life stages or for the lacking opposite sexes. The plant samples with phytoseiid mites were put into plastic bags with tissue papers to absorb water vapor, sealed, and brought to the laboratory for examination and collecting mites under an optical microscope. The leaves were examined usually; branches or barks were also checked if present. Mites can be picked up with a hair brush or a number 1 insect pin for rearing, biological observation, or mounted directly in a mounting medium on a glass slide for microscopic examination.

On the other hand, phytoseiid mites also occur on the surface of ground, on the litter or soil. Some phytoseiid mites that live on leaves drop to the ground with the fallen leaves. Samples were collected by hand method and extracted into 95% ethanol using Berlese's funnels with/without (depends on purpose) use of electric lamp during seven days in laboratory.

3.1.2 Slide-mounting

Mite specimens were mounted in Hoyer's medium for examination by using a stereoscopic microscope. Before that, mite samples were picked up with minute pin or mini spatula from plant materials or alcohol, and transferred to Nesbitt's fluid or lactic acide for clearing (the dipping time required for the mite to clear properly is dependent upon its degree of sclerotization and the dirty surface). Lactic acids also apply for softening specimens, especially specimens preserved in alcohol. High concentration (50%) H_2O_2 for bleaching the heavily sclerotized mites until the cuticle color change back to normal condition, and rinsed in ethanol (75%) (Liao *et al.* 2017b; Yeh *et al.* 2008). After cleaning, mite specimens were mounted in Hoyer's medium on glass slides. Set the cover slip gently on top of the specimen for allowing the leg and chelicerae extension and the medium to spread to the edge of the cover slip. The bubblesrre removed and the egg was squeezed out of body if the egg present. Besides, poor condition slide specimens were soaked with water and remounted in Hoyer's medium.

The formulas in preparing order are listed:

Nesbitt's fluid

Chlodro hydrate 40 g

Dist. water 25 ml

HCl (high conc.) 2.5 ml



Lactophenol

Lactic acid 50 parts

Phenol 25 parts

Dist. water 25 parts

Hoyer's medium

Dist. water 50ml

Gum arabic (granule) 30g

Chloro hydrate 200g

Glycerin 20g

Specimens were placed in 45°C drying oven for one to two weeks for drying. The slide specimens were allowed to cool down to room temperature after drying, then the cover glass was ringed up with the Red Insulating Varnish (or nail varnish) to avoid the absorption of moisture from the air contact to Hoyer's medium. Finally, label slide with pertinent collection data.

The specimens were preserved in the electronic dry cabinet or low humidity indoor environments; remaining specimens were preserved in ethanol and stored at -20°C for further experimental purpose.

3.2 Locality

The locality names were translated using the Geographic Name Information System, Department of Land Administration, Ministry of the Interior (Taiwan) (<http://gn.moi.gov.tw/geonames/Translation/Translation.aspx>).

3.3 Depository

ASCU (Scientific Collections Unit, Orange Agricultural Institute, Orange, Australia)

(formerly BCRI, Biological and Chemical Research Institute, Rydalmere, Australia)

ESALQ-USP (Escola Superior de Agricultura Luiz de Queiroz, Piracicaba, State of São Paulo, Brazil)

GIABR (Guangdong Institute of Applied Biological Resources, Guangzhou, Guangdong, China) (former GEI (Guangdong Entomological Institute))

HUM (Hokkaido University Museum, Sapporo, Japan)

NCHU (Department of Entomology, National Chung Hsing University, Taichung, Taiwan)

NMNS (National Museum of Natural Science, Taichung, Taiwan)

NSMT (National Museum of Nature and Science, Tsukuba, Japan)

NTU (Department of Entomology, National Taiwan University, Taipei, Taiwan)

NPUST (National Pingtung University of Science and Technology, Pingtung County, Taiwan)

TARI (Taiwan Agricultural Research Institute, Taichung City, Taiwan)

TARL (Taiwan Acari Research Laboratory, Taichung City, Taiwan)

UPLB-MNH (Museum of Natural History of University of the Philippines Los Baños, Los Baños, Philippines)

3.4 Description

Nine species, *Okiseius formosanus*, *Amblyseius trisetosus*, *Proprioiseiopsis pubes*, *Neoseiulus monomacrosetus*, *N. spineus*, *Scapulaseius vestificus*, *Phytoseius minutus*, *P. rugatus*, *Typhlodromus (Anthoseius) eleglidus* were described by references due to lack of specimens.

This study followed the generic classification that proposed by Chant & McMurtry

(2007). The general terminology used for morphological descriptions in this study followed that of Chant & McMurtry (2007), while for idiosomal seta terminology followed Rowell *et al.* (1978) and Chant & Yoshida-Shaul (1991; 1992); for adenotaxy and poroidotaxy terminology followed Beard (2001).

Specimens are examined and illustrated under an optic microscope (Olympus BX51), and measured using stage-calibrated ocular micrometers and ImageJ 1.47 (Schneider *et al.* 2012). All measurements are given in micrometers. Additionally, digital microscope images were photographed using by the Electronic eyepiece PMS 3.0, and were fold and edited by the software package Auto-Montage®. Holotype measurements are shown in bold type, followed by their mean and range in parentheses. Measurements of the paratypes are provided in square brackets.

3.5 Terminology

Phytoseiid mites are about 300-600 μm in length and whitish to light brown in color (Chant 1985; Krantz & Walter 2009). Body of phytoseiid mite can be divided into two parts, gnathosoma and idiosoma. Gnathosoma is the structure located in the front end of mite. It comprises of a pair of pedipalps, a pair of chelicerae, and the subcapitulum, and also a pair of spermatodactyl in adult males. The functions of gnathosoma are sensation, predation, and feeding, and in male, copulation (Chant 1985). Idiosoma is the major body part includes all parts behind gnathosoma. It comprises four pairs of legs and also dorsal shield and ventral shields. Besides, the female spermatheca is located between the coxa III and coxa IV of adult female.

Phytoseiid mites are sexual dimorphic. Nevertheless, the earlier researchers always described just adult female, rarely studied about male (but some species are opposite, *Amblyseius californicus* was described by male (McGregor 1954). One reason for this is

the numbers of male are relatively fewer. Another reason is some researchers considered the male are of little taxonomic importance (Tseng 1983). In fact, there are differences between the two sexes of phytoseiid mites. Adult males are relative smaller, with shorter dorsal setae, a fused sterno-genital shield, a copulatory organ, spermatodactyl, growing side-armed to the moveable digit of chelicerae, and the genital orifice opened on the anterior margin of the sterno-genital shield. The taxonomic characters of Phytoseiidae are as follows:

1. Gnathosoma (Fig. 4):

a. Pedipalp (Fig. 4): The pedipalp is divided into 6 segments, coxa, trochanter, femur, genu, tibia, and tarsus. There is a bifurcate seta on the end of tarsus. It is used to sense and assist to detect diets.

b. Chelicera (Fig. 4, 8): Movable digit and fixed digit comprise chelicera. The inner part of digits (fixed digits and movable digits) with teeth; the number of teeth is an important characters. Fixed digit usually has one pilus dentilus. The chelicerae are used to grasp and capture prey.

c. Spermatodactyl (Fig. 8): The spermatodactyl arises from the membranous junction of the movable digit of the male chelicera. It consists of shaft and foot. The foot consists of the heel, the actual foot, the toe, and thorn or hook-like structure which projects laterally from the foot (Beard 2001). This structure is introducing spermatophore into female. It may have different shapes, foot-shaped, horseshoe-shaped, L-shaped, penile shaped, rod-shaped, T-shaped, U-shaped and wand-shaped. This character is not species specific but group specific (Prasad 2013). Chant and McMurtry (2007) considered this character has little taxonomic value due to homoplasy (except genus *Graminaseius* and *Neoseiulus*).

2. Idiosoma:

a. Dorsal shield (Fig. 4): The sclerotization of dorsal shield is varied among species. Its surface may be smooth, reticulated, or rugose. There are some solenostomes and lyrifissures on dorsal shield.

b. Dorsal setation (Fig. 3): Dorsal setae were considered as an important character in Phytoseiidae for a long time, this character could reflect the evolutionary history of Phytoseiidae (Chant & Yoshida-Shaul 1992). However, many different setation systems were applied by different acarologists in the past. Until now, J-Z-S-R system was accepted by most acarologists. In this study, we will describe all species by this system, and also provided comparison among different systems in following paragraph. Fig. 3 shows the hypothetical holotrichous setation of the dorsal shield in the family Phytoseiidae. It provides all dorsal setae known to occur in this family, though there is no known species has this full complement of setae. In taxonomic studies, dorsal setation is of greater value than ventral setation; due to few studies discuss the ventral setation.

c. Dorsal setation pattern:

The dorsal setation pattern is divided to two parts, previous one for podosomal setae, and latter one for opithosomal setae. For example, 10A:9B means 10 setae on podosoma, 9 setae on opithosoma; besides, A, B (or C, D) means more than one pattern in the same number of setae (Chant & Yoshida-Shaul 1989b).

d. Solenostomes and lyrifissures (Fig. 4): Solenostomes (pores) and lyrifissures (poroids) were ignored before because of difficulty of examination. Since some phytoseiid researchers discuss (Hirschmann (1960); Athias-Henriot (1969b; 1970; 1975)), these naming system of these pores were developed. Solenostomes (pores) is defined as the external opening of a gland or gland-like internal structure. They were named by Athias-Henriot (1975) as follows: *gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8* and *gd9*.

Beard (2001) proposed an adenotaxy on genus *Neoseiulus*. Solenostomes *gd3* are located on the peritremal shield while solenostomes *gd7* are absent in the Phytoseiidae. The shapes of the solenostomes can be crateriform, crescent, or punctiform. Lyrifissures is defined as a cuticular proprioceptor structure (Walter 2005) or just as sense organ. Under light microscopy, these may look like a round pit (cupule) in soft cuticle, or or a slit in hard cuticle.

e. Ventral setation (Fig. 5, 6): Fourteen pairs of setae and a single post-anal seta are known to occur on the ventral surface of the idiosoma of adult Phytoseiidae.

f. Ventral setation pattern: *st1* to *st5* are fixed setae, and also *JV1*, *JV5*, *ZV2* also fixed, the formula only focus on present/absent variable setae (*JV2*, *JV3*, *JV4*, *ZV1*, *ZV3*). For example: *JV3,4: ZV-1,3*, which means this species lacks the *JV3*, *JV4*, *ZV1*, *ZV3*. *JV:ZV* means none of the variable setae absent (Chant & Yoshida-Shual 1991).

f. Sternal shield (Fig. 5): The sternal shield is located behind the tritosternum, in between coxae I-II, with 3 pairs of setae (*st1*, *st2*, *st3*), two pairs of pores (*pst1*, *pst2*), sometimes, posterior margin reduced, *t3* off the shield. The shape of sternal shield and ratio of length and width are used to distinguish species. Besides, posterior margin of sternal shield is also important for identification (e.g. straight, with rounded median lobe, with median projection). Male have 5 pairs of sternal setae on sternogenital shield.

g. Metasternal shield (Fig. 5): A pair of metasternal shields are postero-lateral to sternal shield, may absent in some species, with 1 pair of setae (*st4*) and 1 pair of lyrifissures (*pst3*). Metasternal shield sometimes is absent.

h. Genital shield (Fig. 5): The genital shield located behind metasternal shield, with genital opening in the front end, and one pair of setae (*st5*).

i. Ventrianal shield (Fig. 5, 6): The ventrianal shield is behind the genital shield, and is formed by the fusion of ventral shield and anal shield. Only few species retained

the two separate shields (e.g. *Chanteius separatus*), or only anal shield (e.g. *Honduriella maxima*). The shape of ventrianal shield, level of reticulation, pre-anal setae are important to identification of species or different genera (Prasad, 2013). The shape of ventrianal shield is variable among species, such as triangle, rectangle, pentagonal, or vase-shaped. The extent of the sclerotization of ventrianal shield is also used to diagnose species, for example, ventrianal shield of *Gynaseius liturivorus* with unclear margin. Ventrianal shield bears four pairs of pre-anal setae (*JV1*, *JV2*, *JV3*, *ZV2*), one pair of para-anal setae (*Pa*) and one post-anal seta (*Pst*). Four pairs of setae (*ZV1*, *ZV3*, *JV4*, *JV5*) are set on the membranous integument surround the ventrianal shield.

j. Metapodal plate (Fig. 5): Behind coxa IV and lateral to anterior part of ventrianal shield, there may have 1 or 2 small plates, primary plate and secondary plate, on each side.

k. Peritreme (Fig. 4, 5): The peritreme is a furrow-shape elongation of stigma extend forward up to the level of seta *j1*, or shorter in some species. It is enveloped by peritremal shield which may extend to the posterior end of coxa IV. Usually, one pairs of solenostomes (*gd3*) and one pairs of lyrifurres (*id3*) on preitremal shield.

l. Spermatheca (Fig. 5, 7): Spermatheca locates between the coxa III and IV of adult female. The spermatheca consists of five sections, including vesicle, calyx, atrium, minor and major ducts (Beard 2001). Besides, neck, cannot be found in some species, is the connection between the calyx and the atrium. Most North American acarologists suggest the calyx substitute to cervix, and care should be taken not to confuse this term or structure with the term neck (cervix) as used by European acarologists for the connection between the calyx. The calyx is a sclerotized structure, and the shape is variable, such as tubular, bowl-shaped, bell-shaped, U-shaped etc. The atrium may be small or large, incorporated into the base of the calyx; bifurcate at the junction with

major duct; ring-like; separate from calyx and major duct.

3. Leg (Fig. 4): Adult phytoseiids have 4 pairs of legs, and consist of 7 segments, coxa, trochanter, femur, genu, tibia, tarsus, and apotele. Leg I is longer with the tarsal segment well-endowed with sensory setae and sensillae, and is usually hold up to wavering, functioning as antenna, not for walking. Leg chaetotaxy is followed by Evans (1963). In the study, the segments of leg are described respectively. Coxa is described the coxal formula in the ventral view. In addition, the segments are illustrated and described the chaetotactic formula, including femur, genu, tibia and basitarsus.

a. Macroseta (Fig. 4): The macroseta is a longer and stronger seta on Legs, the present and length of macroseta, especially on leg IV (genu, tibia, tarsus), are important characters for distinguishing species. Beard (2001) provided a clear definition of macrosetae “*describe a seta (usually on the legs) that is obviously morphologically differentiated from though not always longer than, the other setae (normally thin, setaceous) on the same body part*”.

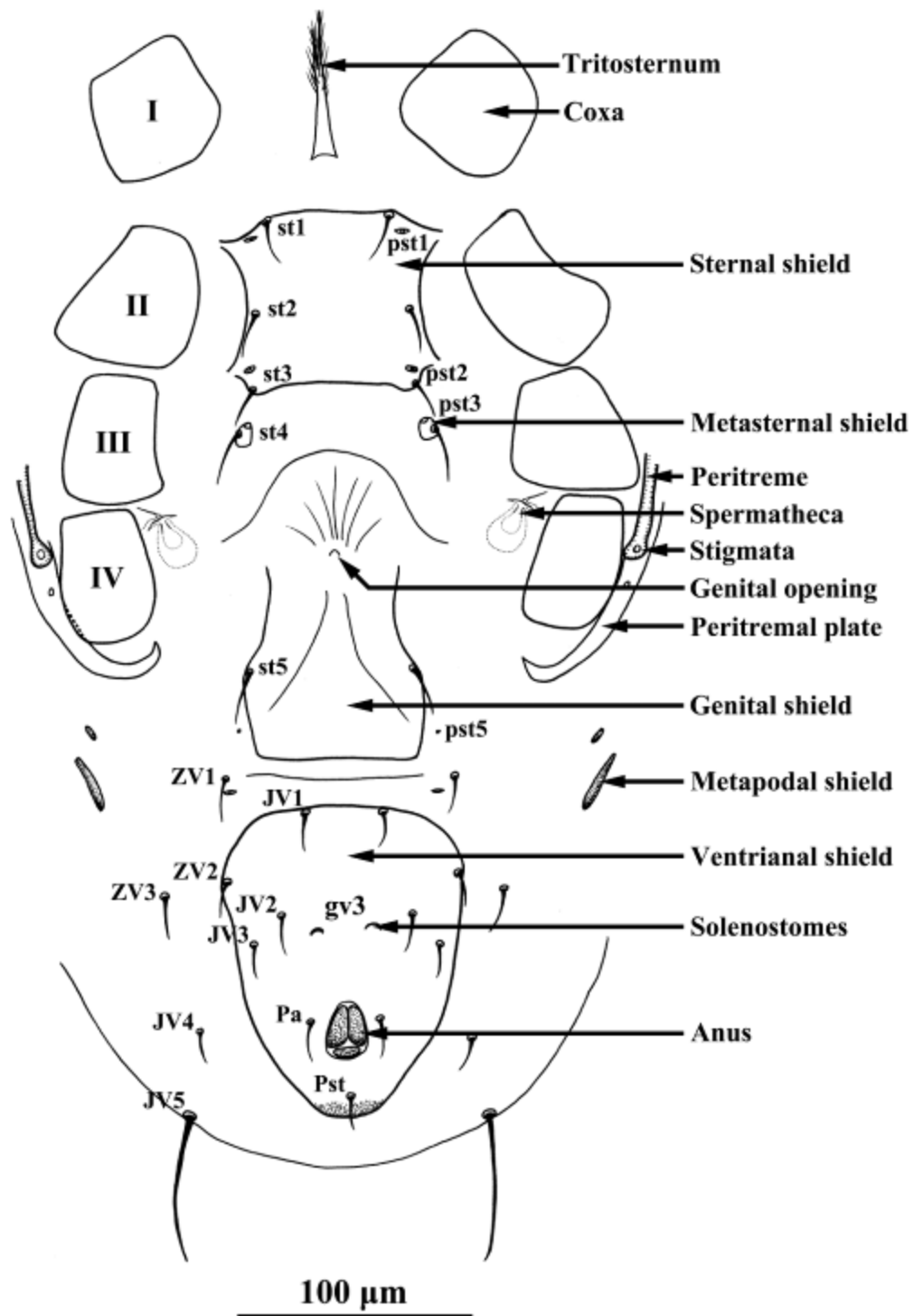


FIGURE 5. Ventral view of adult female phytoseiids.

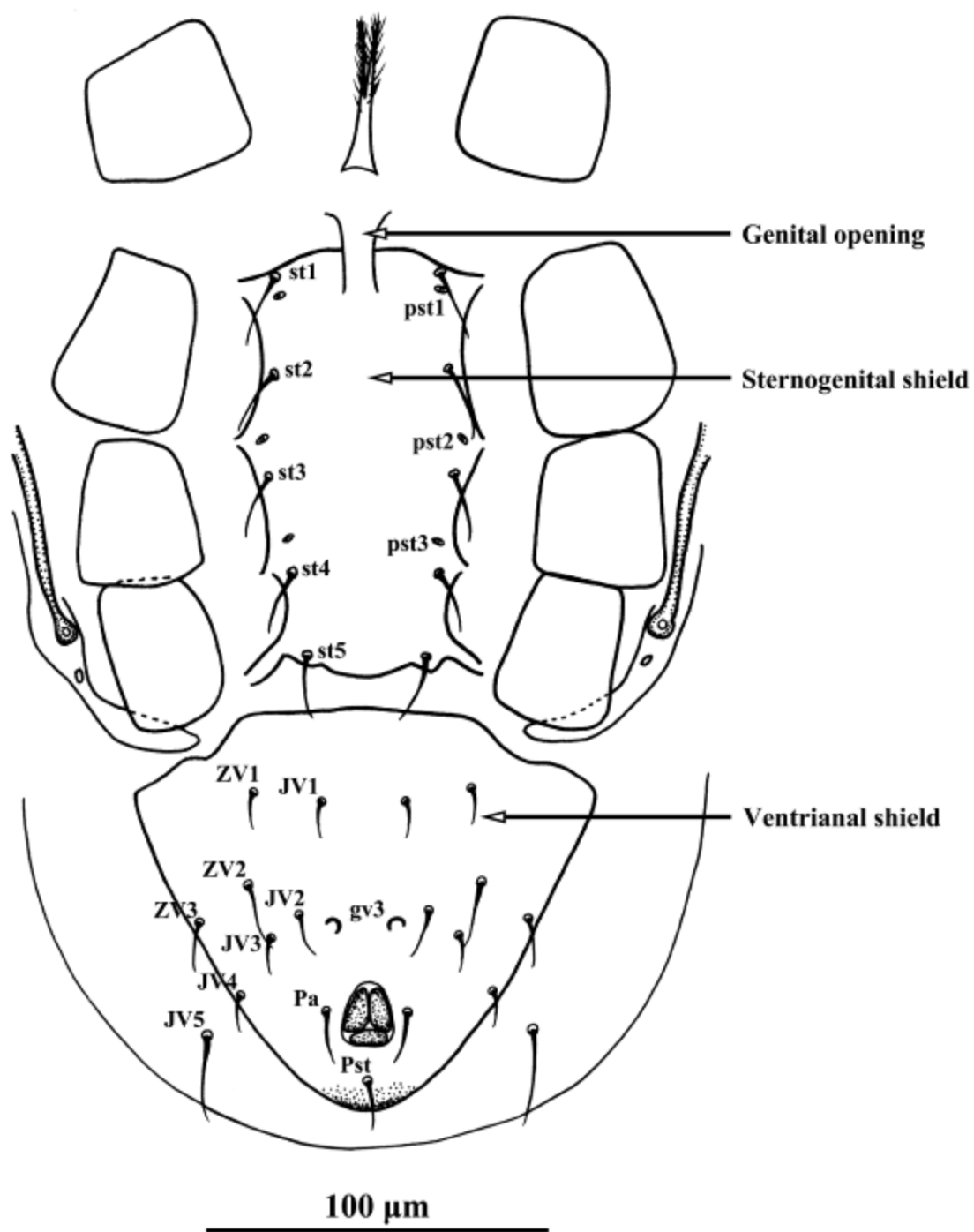


FIGURE 6. Ventral view of adult male phytoseiids.

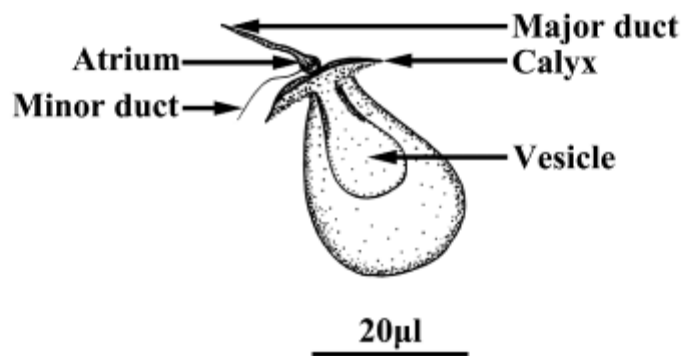


FIGURE 7. Spermatheca of phytoseiids.

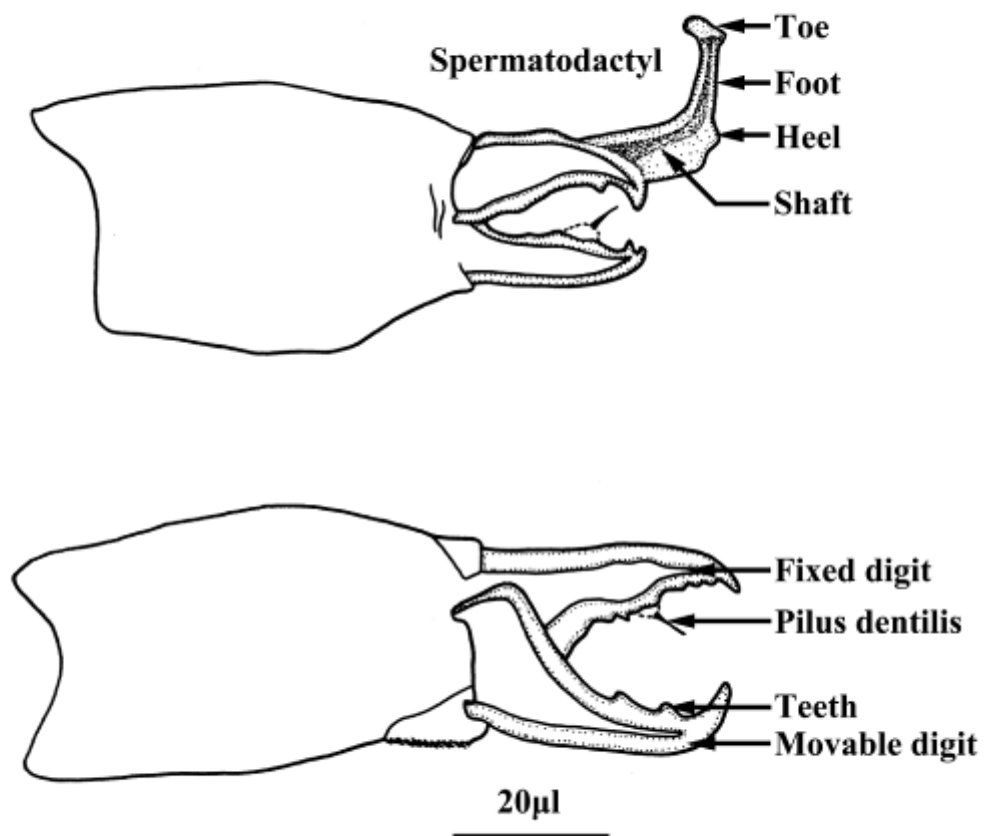


FIGURE 8. Chelicera and spermatodactyl of phytoseiids.

Chapter 4 Taxonomy

Family PHYTOSEIIDAE Berlese, 1916

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Phytoseiini Berlese, 1916: 3.

Phytoseiinae.—Vitzthum, 1941: 768.

Phytoseiidae.—Baker & Wharton, 1952: 87.

Diagnosis - Free living; dorsal shield entire (except *Macroseius biscutatus*), idiosomal setae 38 or fewer pairs; dorsal shield with 23 or fewer setae (including r-R series); ventral idiosoma with 10 or fewer pairs of setae; peritremal shield fused anteriorly with dorsal shield (except tribe Indoseiulini); *st5* always inserted on genital shield; genital shield truncate posteriorly; most female with ventrianl shield, few species with separate ventral and anal shield, or only anal shield; spermatheca variable, with calyx, atrium, major duct and minor duct; male with similar setal pattern with female, and with sternogenital shield and ventrianal shields separate.

Key to the subfamilies in the family Phytoseiidae

1. Setae *z3* and *s6* absent Amblyseiinae Muma
— Setae *z3* and *s6* never both absent 2
2. Setae *Z1*, *S2*, *S4* and *S5* absent Phytoseiinae Berlese
— Setae *Z1*, *S2*, *S4* or *S5* at least present one seta Typhlodrominae Wainstein

Subfamily AMBLYSEIINAE Muma, 1961

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Typhlodromus (Amblyseius) Chant, 1957b: 292.

Amblyseiinae Muma, 1961: 273.

Amblyseiini.—Schuster & Pritchard, 1963: 225.

Macroseiinae Chant *et al.*, 1959: 808.

Type genus - *Amblyseius* Berlese, 1914: 143

Amblyseiinae is distinguished from other 2 subfamilies (Phytoseiinae and Typhlodrominae) by the absence of setae *z3* and *s6*, and also the absence of ventral setae *JV3* (except *Macrocaudus multisetatus*). Chant & McMurtry (2006b) comprised them to 9 tribes, including Indoseiulini, Macroseiini, Afroseiulini, Euseiini, Kampimodromini, Phytoseiulini, Amblyseiini, Neoseiulini, Typhlodromipsini.

Key to the tribe in the subfamily Amblyseiinae

1. Peritremal shield not fused with anterior dorsal shield
.....tribe Indoseiulini Ehara & Amano
— Peritremal shield fused with anterior dorsal shield 2
2. Posterior margin of sternal shield with median projection, deutosternal groove wider (>5µm), most species with preanal setae migration
..... tribe Euseiini Chant & McMurtry
— Posterior margin of sternal shield usually not with median projection, deutosternal groove narrower (<5µm), most species with preanal setae migration 3

- 
3. Seta *S4* absent.....tribe Kampimodromini Kolodochka
 — Seta *S4* present 4
4. Ratio seta *s4:Z1* > 3.0:1.0.....tribe Amblyseiini Muma
 — Ratio seta *s4:Z1* < 3.0:1.0..... 5
5. Ge II and Ge III rarely with a macroseta; fixed digit usually with fewer than 6 teeth,
 rarely multidentate; never with these 2 character together
 tribe Neoseiulini Chant & McMurtry
 — Ge II and Ge III rarely without a macroseta; fixed digit usually with more than 6 teeth;
 most species with these 2 characters together
tribe Typhlodromipsini Chant & McMurtry

Tribe INDOSEIULINI Ehara & Amano, 1998

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Indoseiulini Ehara & Amano, 1998: 48.

Type genus - *Gynaeseius* Wainstein 1962 (= *Indoseiulus* Ehara, 1982: 42).

This tribe is characterized by the peritremal shield not fused with anterior dorsal shield. One genus belongs to this tribe.

Genus *Gynaeseius* Wainstein, 1962

寬腹綏蟎屬

Amblyseius (*Kampimodromus*) section *Gynaeseius* Wainstein, 1962b: 14.

Indoseius Ghai & Menon, 1969: 347. Type species - *Indoseius ricini* Ghai & Menon, 1969: 347. (Preoccupied by *Indoseius* Evans, 1955).

Amblyseius (*Indoseiulus*) Ehara, 1982: 42. Type species - *Indoseius ricini* Ghai & Menon, 1969: 347. (Synonymy according to Chant & McMurtry 2006a)

Indoseiulus —Denmark & Kolodochka, 1993: 249.

Macmurtryseius [sic] Kolodochka & Denmark, 1995: 20. Type species - *Amblyseius* (*Indoseiulus*) *hebridensis* McMurtry & Moraes, 1984: 29. (Synonymy according to Chant & McMurtry 2006a).

irregularis group Chant, 1959b: 70.

Type species - *Typhlodromus irregularis* Evans, 1953: 463.

There are 11 valid species in this genus. Chant & McMurtry (2006) reported that

the circumstance of presence/absence of setae S2 and S4. Eight species are seta S4 absent and seta S2 present. However, three species cannot make sure these 2 setae absent. It could be setae S4 absent and S2 occupied a position far behind its normal position, or setae S2 absent and S4 occupied a position far forward of its normal position.

Diagnosis – Idiosomal pattern uncertain. Dorsal shield weakly sclerotized, broad, posterior margin truncate. Dorsal setae usually smooth, short, Z5 never elongate, Sternal shield weakly sclerotized, posterior margin without medium projection. Genital shield truncate posteriorly, wider than ventrianal shield, never reticulated. Female ventrianal shield reduced, weakly sclerotized, vase-shaped, or ovoid, never triangular or pentagonal, with 3 pair of preanal setae, *gv3* conspicuous, *JV1* usually migrate from usual position. Peritreme variable, not fused with anterior dorsal shield. Spermatheca variable. Chelicera variable size and shaped, with variable dentition. Leg IV with 3 macrosetae, Ge II with 7 setae.

Key to species in the genus *Gynaeseius* from Taiwan

1. Movable digits of chelicera with one tooth; calyx of spermatheca cup-shaped
.....*santosoi* (Ehara 2005)
— Movable digits of chelicera with three teeth; calyx of spermatheca tubular.....
.....*liturivorus* (Ehara 1982)



***Gynaeseius liturivorus* (Ehara, 1982)**

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(Figures 9–10)

Amblyseius (Indoseiulus) liturivorus Ehara, 1982: 43.

Amblyseius (Amblyseius) liturivorus.—Tseng, 1983: 54.

Gynaeseius armellae (Schicha & Gutierrez, 1985) (Synonymy according to Denmark & Kolodochka 1993)

Female (n=4)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:8C/JV-3:ZV.

Dorsum. Dorsal shield smooth, **368** 371 (348–386) long (*j1–J5* level) and **226** 222 (195–251) wide at level of *j6*, **192** 190 (175–205) wide at level of *S4*; seven pairs of solenostomes on dorsal shield, (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), fifteen pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *id6*, *idm2*, *idm3*, *imd4*, *idm5*, *idm6*, *idx*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* **18** 19 (17–22), *j3* **14** 17 (14–21), *j4* **5** 9 (5–12), *j5* **4** 8 (4–10), *j6* **4** 9 (4–14), *J2* **6** 11 (6–13), *J5* **5** 6 (5–8), *z2* **6** 10 (6–14), *z4* **5** 12 (5–16), *z5* **5** 10 (5–14), *Z1* **12** 13 (11–19), *Z4* **9** 13 (9–16), *Z5* **15** 21 (15–28), *s4* 12 18 (12–23), *S2* **12** 15 (12–21), *S5* **11** 17 (11–21), *r3* **15** 14 (11–16), *R1* **10** 13 (10–15). All setae short, smooth, setae *Z4*, *Z5* never longer than other.

Peritreme. Peritreme extending beyond seta *z2*; peritremal shield not being fused with dorsal shield anteriorly, with one pair of solenostomes (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternal shield weakly sclerotized, smooth, posterior margin invisible, **89** 82 (71–89) long, **98** 102 (92–112) wide, with three pairs of setae *st1* **28** 34 (28–37), *st2* **29** 31 (29–36), *st3* **21** 29 (21–35), and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield

at coxae II–IV. Metasternal platelets tear-shaped, with one pair metasternal setae, *st4* **17** 29 (17–35), with one pair of lyrifissures (*pst3*). Genital shield smooth, broadly posteriorly truncated, with one pair of genital setae *st5* **24** 32 (24–37), **97** 92 (87–97) wide at level of genital setae. Distances between *st1-st1* **67** 68 (65–73), *st2-st2* **70** 70 (68–76), *st3-st3* **84** 82 (77–85), *st1-st3* **76** 74 (69–76), *st5-st5* **92** 87 (82–92). Ventrianal shield reduced, weakly sclerotized, anterior and lateral margin invisible, **63** 57 (53–63) wide at level of anus; with three pairs of pre-anal setae, *JV1* **20** 26 (20–33), *JV2* **22** 28 (22–33), *ZV2* **15** 23 (15–34), solenostomes *gv3* crescentic; *Pa* **16** 16 (13–19), *Pst* **14** 16 (14–18) on shield. Setae *JV4* **19** 20 (19–21), *JV5* **18** 20 (18–23), *ZV1* 21 22 (19–26), *ZV3* 14 19 (14–23) on interscutal membrane. All ventral setae smooth. Two pairs of metapodal plates ? 23 (22–25) long, ? 6 (5–6) wide, ? 10 (9–12) long, ? 2 (1–3) wide.

Chelicera. Movable digit **29** 30 (28–33) long, with three teeth; fixed digit **30** 29 (26–34) long, anterior half with two teeth, posterior half with nine teeth, with *pilus dentilis*.

Spermatheca. Calyx elongated, slender, flaring distally, ? 42 (38–50) long, ? 2 (2–4) wide, atrium swollen, incorporated without neck, with a thin major duct, minor duct prominent.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* III (ad2) ? 27 (24–31), *Sti* III (ad) ? 32 (30–32), *St* III (d) ? 29 (28–29), *Sge* IV (ad2) ? 41 (40–43), *Sti* IV (ad) ? 50 (45–56) and *St* IV (d) ? 47 (44–51).

Specimens examined. JAPAN: Green house, Kisigaiwa, Wakayama Pref, one holotype female and one paratype female (AC-13291) from *Glycine max* (Fabaceae),

5.x.1980, S. Yano (NSMT); Green house, Kisigaiwa, Wakayama Pref, three paratype females (ZIHU3654, 3655, 3656) from *Glycine max* (Fabaceae), 5.x.1980, S. Yano (HUM); Ienoko, Togane, Chiba Pref., one female (AC-13514) from *Pyrus* sp. (Rosaceae), 18.x.1989, H. Amano (NSMT).

TAWAN: Dashu Dist., Kaohsiung City, one female from *Carica papaya* (Caricaceae), 8.xii.1992, C. C. Ho (TARI); Hualien District Agricultural Research and Extension Station, Ji'an Township, Hualien County, three females (no. 2432-2, 3, 4) from *Manihot esculenta* (Euphorbiaceae), 21.xii.2018, J. R. Liao (NTU).

Distribution. Asia: Japan (Ehara 1982), Philippines (Corpuz-Raros 2005), Sri Lanka (Moraes *et al.* 2004b), Taiwan (Tseng 1983).

Remarks. Ehara (1982) reported this species have 3 teeth on movable digit, multidentate (10 on drawing) on fixed digit; Tseng (1983) reported 2 teeth on movable digit, 11 teeth on fixed digit; and present study reported 3 teeth on movable digit, 11 teeth on fixed digit. Other characters are congruent with previous studies.

This species was reported associated with *Tetranychus* spider mites on soybean in greenhouse. Although only few collection data from Taiwan, we still found this species associated with *Tetranychus* spp. Further observation is still needed for feeding habit and lifestyle of this species.

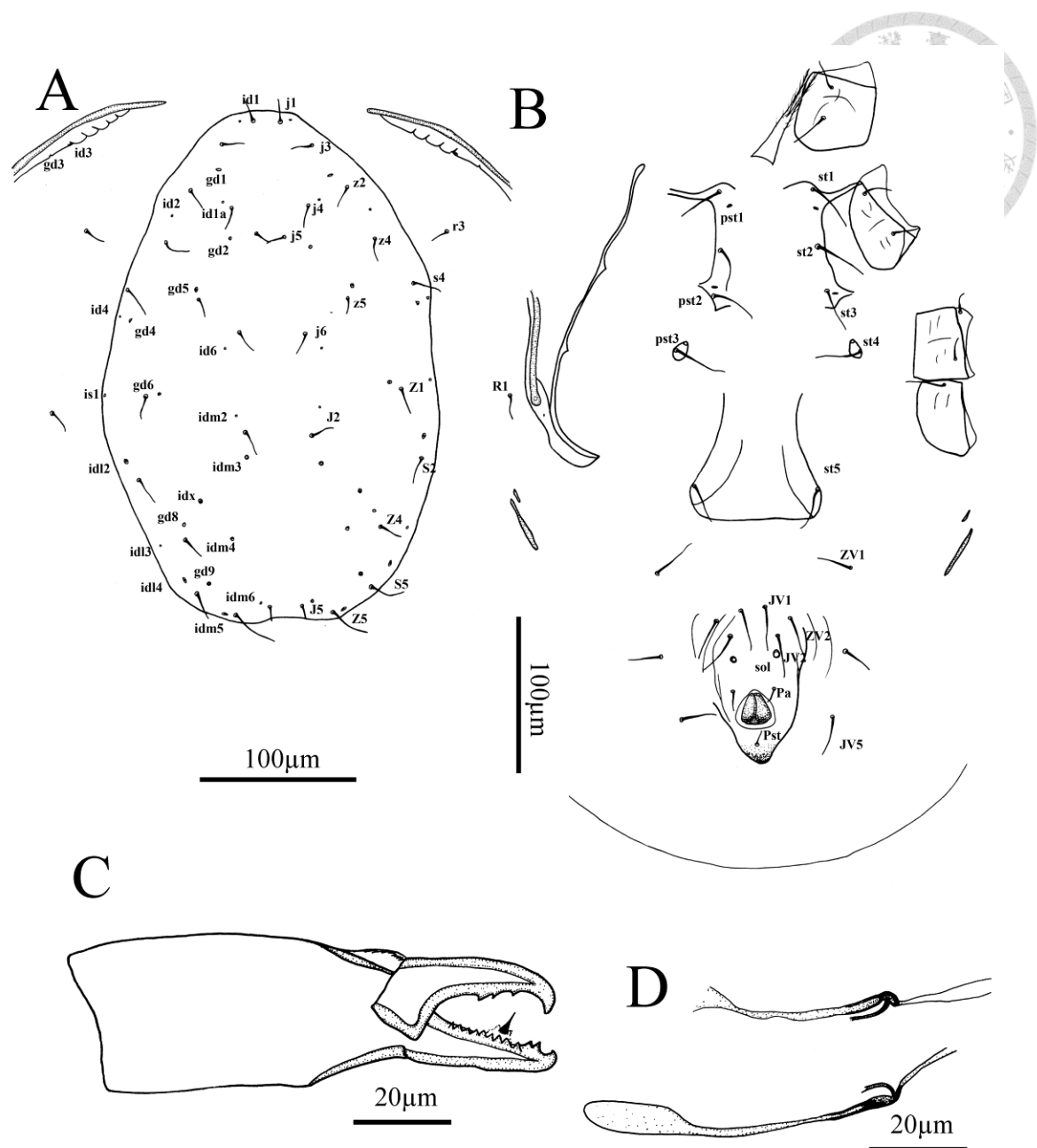


FIGURE 9. *Gynaseius liturivorus* (Ehara, 2005), Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

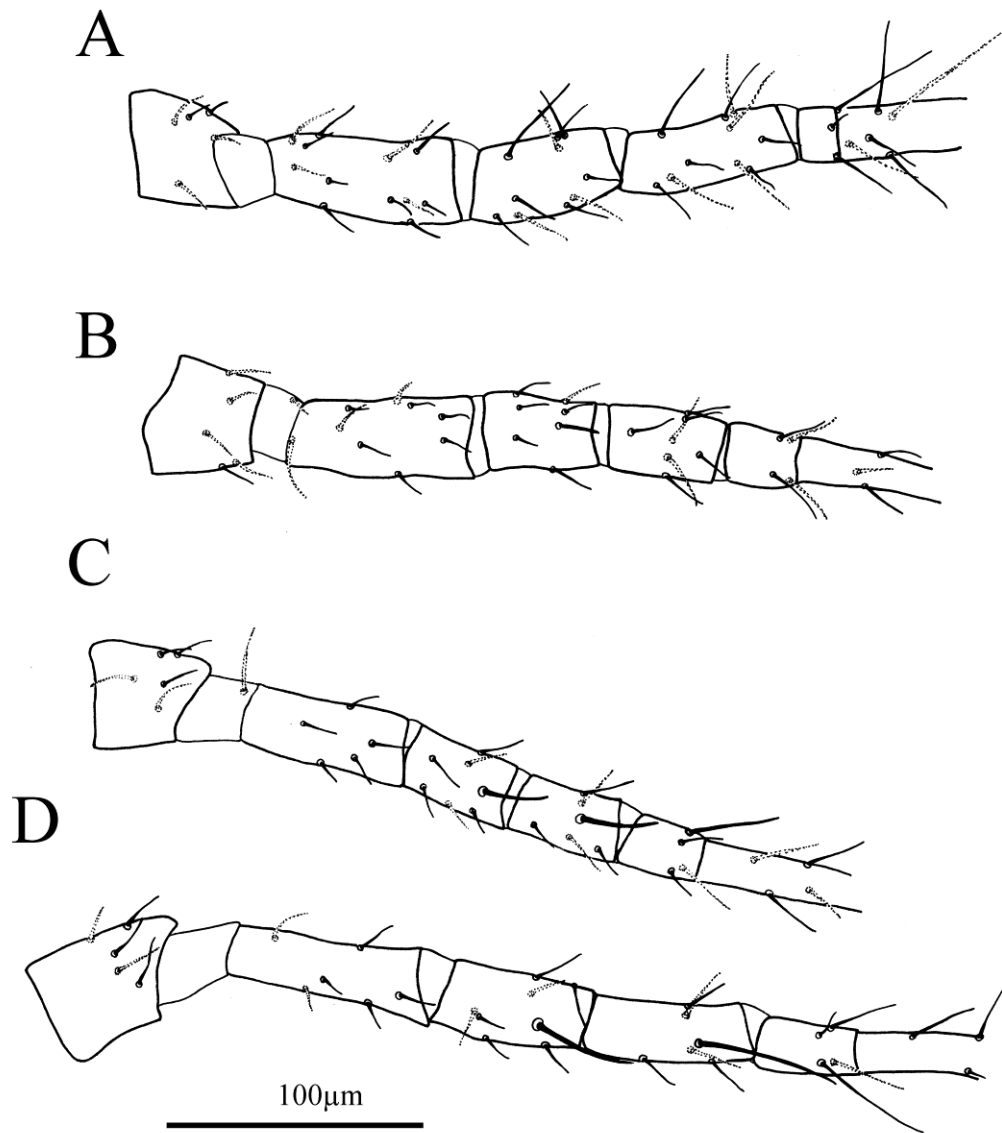


FIGURE 10. *Gynaseius liturivorus* (Ehara, 2005), Female, A. leg I anterior view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV anterior view.

***Gynaseius santosoi* (Ehara, 2005)**

桑氏寬腹綏蟎



(Figures 11–12)

Indoseiulus santosoi Ehara 2005: 36.

Female (n=3)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:8C/JV-3:ZV.

Dorsum. Dorsal shield smooth; 382 (358–406) long (*j1–J5* level) and 251 (247–255) wide at level of *j6*, 230 (230–231) wide at level of *S4*; seven pairs of solenostomes on dorsal shield, (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), thirteen pairs of lyrifissures (*id1*, *id2*, *id4*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *idx*, *is1*, *idl2*, *idl3*, *idl4*); muscle-marks (sigilla) visible on podosoma; length of setae: *j1* 28 (27–30), *j3* 15 (15–15), *j4* 7 (7–8), *j5* 7 (6–8), *j6* 7 (6–8), *J2* 9 (8–10), *J5* 6 (6–7), *z2* 10 (9–11), *z4* 8 (6–9), *z5* 7 (4–11), *Z1* 9 (7–11), *Z4* 15 (10–18), *Z5* 17 (16–19), *s4* 13 (13–14), *S2* 12 (11–13), *S5* 7 (5–9), *r3* 9 (6–11), *R1* 8 (7–9). All setae smooth.

Peritreme. Peritreme extending beyond seta *j3*; peritremal shield not being fused with dorsal shield anteriorly, with one pair of solenostomes (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, posterior margin slightly concave, much wider than long, 80 (75–86) long, 97 (90–106) wide, with three pairs of setae *st1* 34 (31–36), *st2* 31 (28–33), *st3* 28 (21–33), and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae II–IV. Metasternal platelets tear-shaped, with one pair metasternal setae, *st4* 26 (23–29), with one pair of lyrifissures (*pst3*). Genital shield smooth, with one pair of genital setae *st5* 33 (28–35), 98 (95–101) wide at level of genital setae. Distances between *st1–st1* 64 (56–72), *st2–st2* 67 (59–75), *st3–st3* 76 (66–82), *st1–st3* 70 (58–81), *st5–st5* 86 (77–90). Ventrianal shield margin invisible; with three pairs of pre-anal setae,

JV1 25 (22–28), *JV2* 24 (22–26), *ZV2* 21 (21–23), solenostomes *gv3* crescentic; *Pa* 12 (11–14), *Pst* 18 (17–20) on shield. Setae *JV4* 19 (16–20), *JV5* 44 (40–46), *ZV1* 24 (20–27), *ZV3* 19 (19–20) on interscutal membrane. All ventral setae smooth. One pair of metapodal plates 21 (20–22) long, 5 (4–6) wide.

Chelicera. Movable digit 31 (30–33) long, with one tooth; fixed digit 28 (25–30) long, anterior half with three teeth, with *pilus dentilis*.

Spermatheca. Calyx cup-shaped, 4 (3–5) long, 8 (7–10) wide, atrium incorporated without neck, with a thin major duct, minor duct visible.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-1/2-2, 2-2/1-2/2-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* I (pd1) 28 (27–31), *Sge* II (pd2) 32 (30–35), *Sge* III (ad2) 41 (40–43), *Sti* III (ad) 35 (33–37), *St* III (d) 23 (21–27), *Sge* IV (ad2) 59 (55–62), *Sti* IV (ad) 44 (42–49) and *St* IV (d) 54 (51–55).

Specimens examined. TAIWAN: Lanyu Island, Taitung County (22°00.881' N, 121°33.970' E, 39m), one female (no. 462–1) from *Morus alba* (Moraceae), 4.iv.2010, J. R. Liao & C. C. Ho (NTU); Lanyu Island, Taitung County (22°03.846' N, 121°30.655' E, 21m), one female (no. 1646–2) from *Morus alba* (Moraceae), 14.iv.2016, H. Y. Lin (NCHU); Cihou Fort, Qijin District, Kaohsiung City (22°36.933' N, 120°15.917' E, 13m), one female (no. 2016–2) from *Macaranga tanarius* (Euphorbiaceae), 22.i.2017, J. R. Liao & H. C. Lee (NMNS).

Distribution. Asia: Indonesia (Java (Ehara, 2005), Taiwan (Kaohsiung, Lanyu Island (present study)).

Remarks. *Gynaseius santosoi* (Ehara) is reported for the first time for Taiwanese fauna. Ehara (2005) described this species based on a single female specimen from a

fabaceous climbing plant from Indonesia. The present study found several differences with the original description: leg III with three macrosetae (two in Ehara (2005)), one macroseta on Ge I (two macrosetae in Ehara (2005)), posterior margin of sternal shield concave (indented in Ehara (2005)).

The Lanyu specimens were collected from the habitat plants when *Neoseiulus longispinosus* and *Eotetranychus suginamensis* occurred. However, further observation is still needed for feeding habit and lifestyle of this species.

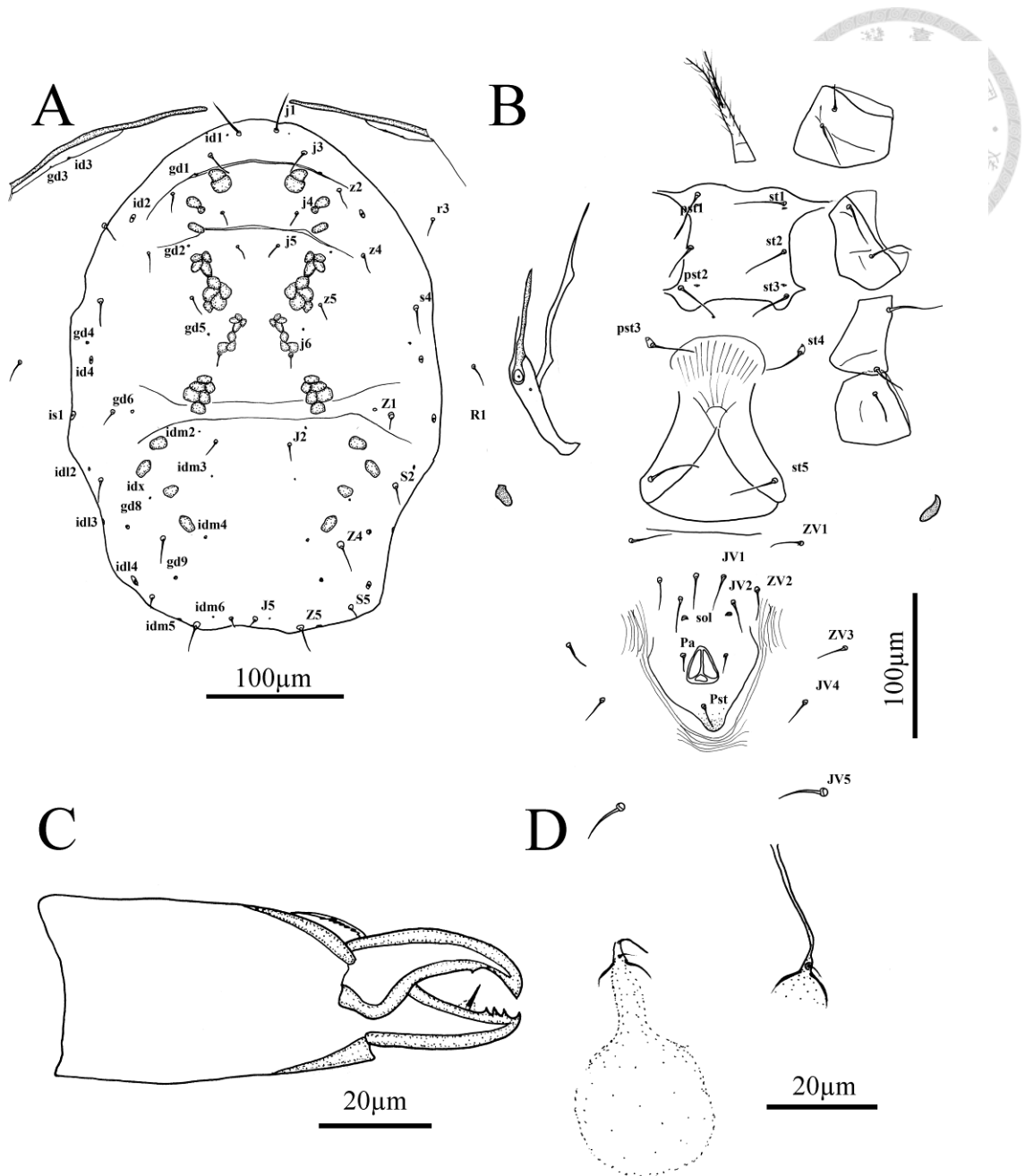


FIGURE 11. *Gynaseius santosoi* (Ehara, 2005), Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

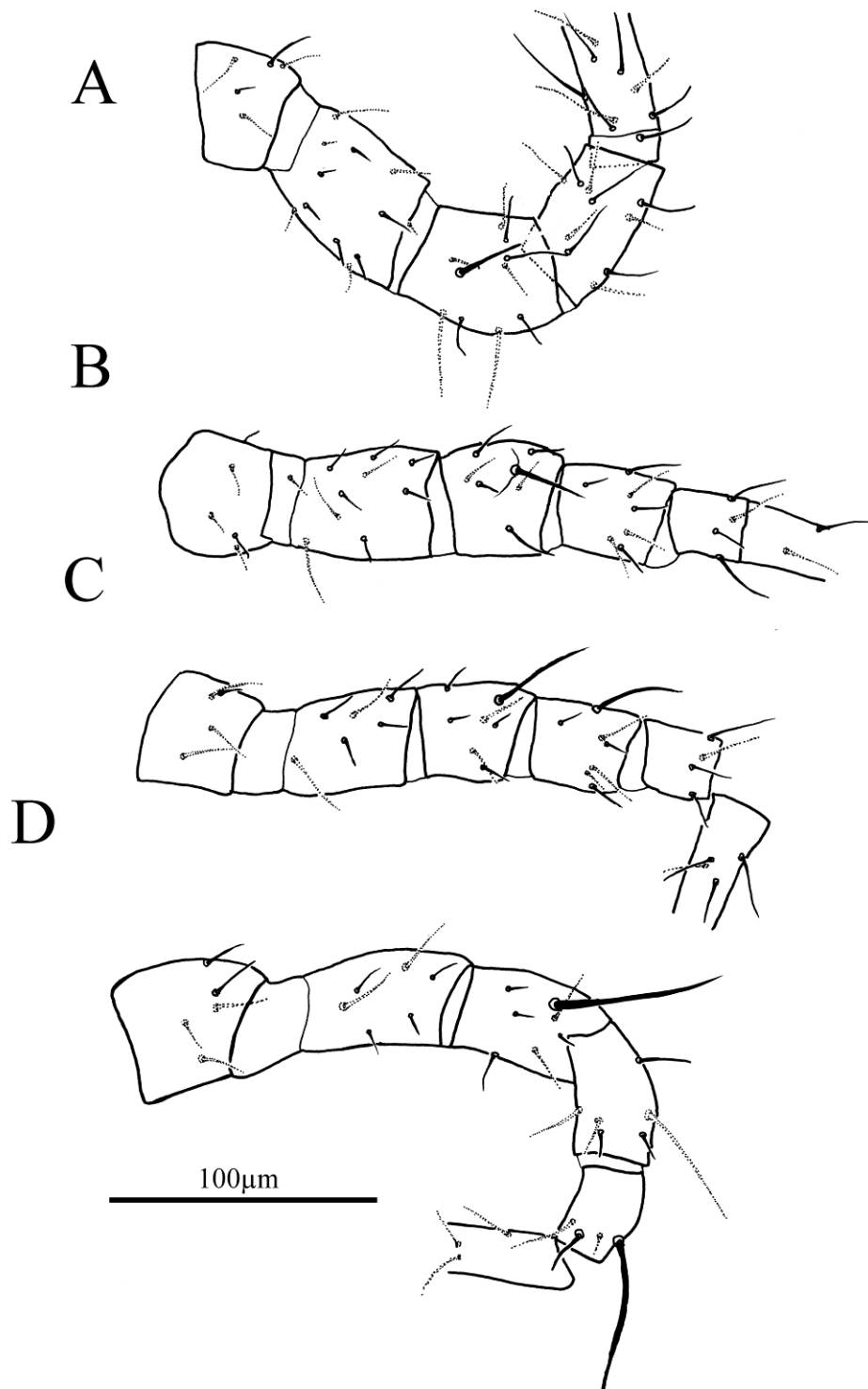


FIGURE 12. *Gynaseius santosoi* (Ehara, 2005), Female, A. leg I anterior view, B. leg II posterior view, C. leg III posterior view, D. leg IV posterior view.

Tribe EUSEIINI Chant & McMurtry, 2005b

真綏蟎族

Euseiini Chant & McMurtry, 2005b: 191.



Type genus - *Amblyseius* (*Amblyseius*) section *Euseius* Wainstein, 1962b: 15.

The tribe Euseiini is characterized by strong posterior projection of sternal shield. The tribe Euseiini comprised three subtribes, Euseiina, Ricoseiina, Typhlodromalina. Dos Santos & Tixier (2018) reported the evolutionary history of this tribe based on molecular data, and also the relationship of plant.

Subtribe Euseiina Chant & McMurtry, 2005b

真綏蟎亞族

Euseiina Chant & McMurtry, 2005b: 209.

Type genus - *Amblyseius* (*Amblyseius*) section *Euseius* Wainstein, 1962: 15.

This subtribe is characterized by seta *r*5 absent, chelicera reduced in size, peritreme not extend beyond to seta *j*3 level. All species have dorsal setal pattern 10A:9B, but *Moraeseius papayana* has 10A:8A (seta *Z*1 absent). This subtribe comprised 3 genera, *Iphiseius* Berlese, *Euseius* Wainstein, *Moraeseius* Chant & McMurtry. There is only the genus *Euseius* recorded in Taiwan.

Genus *Euseius* Wainstein, 1962

真綏蟎屬



finlandicus group Athias-Henriot, 1957: 23,

Amblyseius (*Amblyseius*) section *Euseius* Wainstein, 1962: 15.

Amblyseius (*Amblyseius*) section *Afrodromus* Wainstein, 1962: 17. Type species -
Typhlodromus africanus Evans, 1954: 527.

Amblyseius (*Euseius*).—De Leon, 1965: 121.

Euseius Wainstein.—De Leon, 1967: 86.

victoriensis group Schicha, 1987: 24.

Amblyseius (*Amblyseius*) *finlandicus* group Ueckermann & Loots, 1988: 61.

Type species - *Seius finlandicus* Oudemans, 1915: 183. (Senior synonym of
Typhlodromus pruni Oudemans, 1929).

Diagnosis – Idiosomal pattern 10A:9B/JV-3:ZV. Dorsal shield usually anterolateral reticulated, but sometimes strongly reticulated, posteriorly broader, posterior margin truncate, with strong waist. Dorsal setae usually short or medium, never elongate, Sternal shield posterior margin with medium projection, sometimes weakly sclertized Genital shield truncated posteriorly, wider than ventrianal shield, never reticulated. Female ventrianal shield reduced, vase-shaped, or ovoid, never triangular or rentagonal, with 3 pair of preanal setae, *gv3* conspicuous, *JV1* usually migrate from usual position Peritreme short, not extending over *j3* level. Spermatheca variable. Chelicera reduced, stubby, fixed digit usually with few small teeth, movable digit strongly recurved, with one tooth. Male ventrianal shield triangular, preanal setae migrate to a row.

Key to species in the genus *Euseius* from Taiwan

1. Dorsal shield length relatively smaller, c.a. 250 μm ; *JV1* and *JV2* on normal position;
only leg IV with macrosetae..... 2
- Dorsal shield length relatively larger, c.a. 350 μm ; *JV1* and *JV2* arranged in tangential
row; leg III and leg IV with macrosetae..... 3
2. Calyx of spermatheca long and narrow funnel-shaped, atrium sac-shaped with thick
walls *circellatus* (Wu & Li, 1983)
- Calyx of spermatheca horn-shaped, atrium c-shaped with a pair of petal-shaped
structure *macaranga* Liao & Ho, 2017a
3. Dorsal setae *j1* and *Z5* conspicuously longer, others minute; calyx of spermatheca
tubular..... 4
- Dorsal setae *j1* and *Z5* not conspicuously longer, remaining setae not minute; calyx
of spermatheca funnel or cup-shaped..... 5
4. Dorsal shield reticulated anterolaterally..... *ovalis* (Evans, 1953)
- Dorsal shield strongly reticulated except for central podosoma
..... *paraovalis* Liao & Ho, 2017a
5. Calyx of spermatheca short cup-shaped..... *oolong* Liao & Ho, 2018
- Calyx of spermatheca relative longer, funnel shaped, flaring distally 6
6. Dorsal shield most surface reticulated 7
- Dorsal shield mostly smooth except reticulated in anterolateral region 8
7. *St IV* longer than 60 μm *nicholsi* (Ehara & Lee, 1971)
- *St IV* c.a. 50 μm *sojaensis* (Ehara, 1964)
8. Dorsal shield with six pairs of solenostomes
..... *aizawai* (Ehara & Bhandhufalck, 1977)

— Dorsal shield with five pairs of solenostomes.....*daluensis* Liao & Ho, 2017a



Euseius aizawai (Ehara & Bhandhufalck, 1977)

愛澤真綏蟎



(Figures 13–16)

Amblyseius (Amblyseius) aizawai Ehara & Bhandhufalck, 1977: 59.

Amblyseius aizawai.—Liang & Ke, 1983: 163.

Amblyseius (Euseius) aizawai.—Ehara, 2002b: 36.

Euseius aizawai.—Moraes *et al.*, 1986: 36.

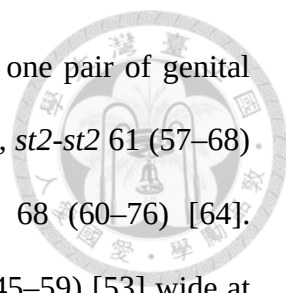
Female (n=10)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield smooth, with lateral reticulation, 334 (288–359) [325] long (*j1*–*J5* level) and 236 (206–265) [206] wide at level of *j6*, 214 (168–238) [211] wide at level of *S4*; with six pairs of solenostomes (*gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), ten pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of dorsal setae: setae *j1* 30 (27–34) [27], *j3* 29 (24–40) [23], *j4* 9 (6–10) [6], *j5* 8 (4–11) [4], *j6* 10 (7–12) [4], *J2* 11 (9–14) [6], *J5* 6 (5–7) [2], *z2* 18 (12–22) [12], *z4* 17 (12–22) [12], *z5* 9 (8–11) [6], *Z1* 12 (9–14) [8], *Z4* 12 (10–14) [8], *Z5* 52 (54–59) [53], *s4* 26 (22–31) [23], *S2* 17 (15–20) [13], *S4* 21 (18–20) [16], *S5* 21 (17–28) [14], *r3* 14 (10–17) [9], *R1* 13 (11–14) [10]. All setae smooth, except *Z5* slightly serrated.

Peritreme. Peritreme extending to *z2*, peritremal shield smooth, lightly sclerotized, with one pair of solenostomes (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, with projection of posterior margin, wider than long, 66 (57–77) [63] long, 87 (81–92) [82] wide at level of *st3*, with three pairs of setae *st1* 28 (20–32) [32], *st2* 24 (16–30) [23], *st3* 23 (18–27) [18], and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae I–IV. Metasternal platelets tear-shaped, with one pair metasternal setae, *st4* 20 (16–22) [18], and one pair of lyrifissures (*pst3*). Genital



shield smooth, 82 (75–89) [77] wide at level of genital setae, with one pair of genital setae *st5* 24 (20–29) [20]. Distances between *st1-st1* 52 (47–60) [51], *st2-st2* 61 (57–68) [58], *st3-st3* 66 (59–72) [67], *st1-st3* 54 (49–59) [49], *st5-st5* 68 (60–76) [64]. Ventrianal shield smooth, vase-shaped, 95 (88–102) [93] long, 51 (45–59) [53] wide at level of *ZV2*, 72 (64–79) [74] wide at level of anus; with three pairs of pre-anal setae, *JV1* migrate next to *JV2*, *JV1* 26 (21–30) [22], *JV2* 22 (18–28) [19], *ZV2* 17 (14–20) [12], solenostomes *gv3* crescentic; *Pa* 12 (10–15) [10], *Pst* 12 (8–15) [7] on shield. Setae *JV4* 9 (6–11) [4], *JV5* 32 (24–39) [30], *ZV1* 18 (12–20) [17], *ZV3* 9 (7–10) [5] on interscutal membrane. All ventral setae smooth. Two pairs of metapodal platelets 18 (15–21) [16] long, 6 (5–7) [4] wide, 11 (8–15) [9] long, 2 (2–3) [1] wide.

Chelicera. Movable digit 21 (19–23) [20] long, with one tooth; fixed digit 23 (21–24) [21] long, anterior half with three teeth, with *pilus dentilis*.

Spermatheca. Calyx funnel-shaped, 13 (10–16) [14] long, 8 (6–10) [8] wide, atrium with neck, indistinguishable embolus, with a thin major duct.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/2-1, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-0, 1-1/1-1. Macrosetae: *Sge* III (ad1) 30 (27–36) [22], *Sti* III (ad) 25 (23–28) [25], *St* III (d) 30 (27–37) [21]; *Sge* IV (ad2) 37 (32–40) [32], *Sti* IV (ad) 35 (31–38) [32] and *St* IV (d) 58 (48–66) [65].

Male (n=5)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3, 4:ZV-1, 3.

Dorsum. Dorsal shield lightly sclerotized, smooth, with lateral reticulation, 238 (230–248) long (*j1-J5* level) and 192 (181–197) wide at level of *j6*, 162 (157–167) wide at level of *S4*; with six pairs of solenostomes (*gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), ten pairs of

lyrifissures (*id1*, *id1a*, *id2*, *id4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of dorsal setae: setae *j1* 23 (21–24), *j3* 22 (20–23), *j4* 5 (4–6), *j5* 5 (4–6), *j6* 7 (5–10), *J2* 8 (6–11), *J5* 3 (3–4), *z2* 10 (7–15), *z4* 11 (9–14), *z5* 6 (5–6), *Z1* 7 (6–7), *Z4* 8 (6–10), *Z5* 43 (40–44), *s4* 20 (19–23), *S2* 13 (12–15), *S4* 17 (15–21), *S5* 19 (17–21), *r3* 10 (9–10), *R1* 10 (8–12). All setae smooth, except *Z5* slightly serrated. Setae *r3* and *R1* inserted on dorsal shield.

Peritreme. Peritreme extending beyond to *r3*, peritremal shield smooth, lightly sclerotized.

Venter. Sternogenital shield smooth, posterior margin almost straight, longer than wide, 115 (104–122) long, 67 (60–74) wide at level of *st5*, with five pairs of setae *st1* 21 (19–23), *st2* 17 (14–20), *st3* 18 (15–21), *st4* 14 (12–17), *st5* 15 (13–18) and three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Exopodal shield at coxae I–IV. Distances between *st1*–*st1* 47 (44–53), *st2*–*st2* 53 (48–56), *st3*–*st3* 49 (46–51), *st4*–*st4* 44 (39–47), *st5*–*st5* 34 (30–39), *st1*–*st5* 99 (95–101). Ventrianal shield subtriangular, slightly reticulated, 95 (91–100) long and 143 (140–147) wide at level of anterior corner, 48 (44–53) wide at level of anus, fused with peritremal shield cingulum; with three pairs of pre-anal setae, arranged in tangential row, *JV1* 15 (14–18), *JV2* 15 (12–17), *ZV2* 10 (6–13), solenostomes *gv3* crescentic; *Pa* 7 (7–7), *Pst* 12 (9–15) on shield. Setae *JV5* 19 (16–23) on interscutal membrane. All ventral setae smooth.

Chelicera. Movable digit 18 (17–20) long, with one tooth; fixed digit 22 (20–24) long, anterior half with two teeth, with *pilus dentilis*. Spermatodactyl U-shaped, shaft 22 (21–23) long, heel rounded, foot 10 (8–13) long, with expanded toe and lateral thorn-like projection.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/2-1, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1,

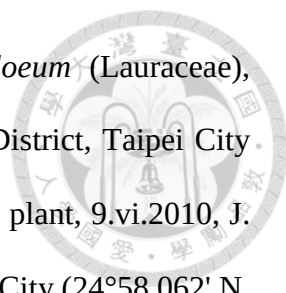
1-1/1-2/1-0, 1-1/1-1. Macrosetae: *Sge* III (ad2) 19 (15–23), *Sti* III (ad) 18 (15–19), *St* III (d) 20 (17–23), *Sge* IV (ad2) 29 (27–31), *Sti* IV (ad) 28 (25–31), *St* IV (d) 44 (43–44).

Specimens examined. CHINA: Bawangling National Forest Park, Changjiang Li Autonomous County, Hainan Province, one female from fern, ?.v.1987, W. N. Wu (GIABR).

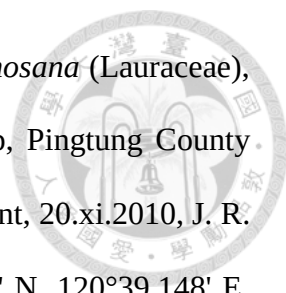
TAIWAN: Wuling Farm, Heping District, Taichung City (24°22.667' N, 121°18.494' E, 1774m), eight females from *Prunus campanulata* (Rosaceae), 19.x.2009, J. R. Liao & C. C. Ho (NTU); Zhiliang, Heping District, Taichung City (24°20.144' N, 121°18.756' E, 1924m), two females two males from *Prunus campanulata* (Rosaceae), 19.x.2009, J. R. Liao & C. C. Ho (NTU); Zhiliang, Heping District, Taichung City (24°20.539' N, 121°18.486' E, 2334m), one female one male from *Prunus campanulata* (Rosaceae), 19.x.2009, J. R. Liao & C. C. Ho (NTU); Lishan, Heping District, Taichung City (24°15.263' N, 121°15.057' E, 1989m), two females one male from *Morus alba* (Moraceae), 20.x.2009, J. R. Liao & C. C. Ho (NTU); Huanshan, Heping District, Taichung City (24°18.493' N, 121°17.422' E, 1704m), one female from *Solanum nigrum* (Solanaceae), 20.x.2009, J. R. Liao & C. C. Ho (NTU); Huanshan, Heping District, Taichung City (24°19.119' N, 121°17.151' E, 1583m), four females one male from *Tetradium glabrifolium* (Rutaceae), 20.x.2009, J. R. Liao & C. C. Ho (NTU); Huanshan, Heping District, Taichung City (24°19.119' N, 121°17.151' E, 1583m), one female from *Tabebuia chrysantha* (Bignoniaceae), 21.x.2009, J. R. Liao & C. C. Ho (NTU); Dalu Forest Road, Wufeng Township, Hsinchu County (24°32.470' N, 121°06.733' E, 1279m), five females two male from *Morus alba* (Moraceae), 20.i.2010, Y. H. Chiang & J. R. Liao (NTU); Dalu Forest Road, Wufeng Township, Hsinchu County (24°32.061' N, 121°07.110' E, 1570m), three females from *Debregeasia orientalis* (Urticaceae), 20.i.2010, Y. H. Chiang & J. R. Liao (NTU); Daoxiang Rd., Beitou District, Taipei City



(25°08.818' N, 121°28.960' E, 213m), two females one male from *Michelia compressa* (Magnoliaceae), 9.ii.2010, J. R. Liao & S. W. Kong (NPUST); Taizhi Temple Park, Xinying District, Tainan City (23°17.652' N, 120°16.432' E, 9m), one female from *Bischofia javanica* (Euphorbiaceae), 20.ii.2010, J. R. Liao (NTU); Chaishan, Gushan District, Kaohsiung City (22°39.034' N, 120°16.481' E, 101m), one female from unknown plant, 11.iii.2010, J. R. Liao & S. W. Kong (NTU); Chaishan, Gushan District, Kaohsiung City (22°39.034' N, 120°16.481' E, 101m), one female from *Macaranga tanarius* (Euphorbiaceae), 11.iii.2010, J. R. Liao & S. W. Kong (NTU); Shitou Mountain, Xindian District, New Taipei City (24°57.671' N, 121°32.481' E, 123m), one female from unknown plant, 17.iv.2010, J. R. Liao (NCHU); Shitou Mountain, Xindian District, New Taipei City (24°57.568' N, 121°32.564' E, 155m), nine females one male from *Prunus campanulata* (Rosaceae), 17.iv.2010, J. R. Liao (NMNS); Nanzhuang Township, Miaoli County (24°38.365' N, 120°57.342' E, 94m), one male from *Dimocarpus longan* (Sapindaceae), 19.iv.2010, J. R. Liao (NCHU); Nanzhuang Township, Miaoli County (24°32.212' N, 120°57.190' E, 772m), one female from *Debregeasia edulis* (Urticaceae), 19.iv.2010, J. R. Liao (NTU); Qingshi Road, Wufeng Township, Hsinchu County (24°33.789' N, 121°06.772' E, 924m), one female from *Morus alba* (Moraceae), 3.v.2010, J. R. Liao & Y. H. Chiang (NTU); Qingshi Road, Wufeng Township, Hsinchu County (24°33.789' N, 121°06.774' E, 926m), one female from *Turpinia formosana* (Staphyleaceae), 3.v.2010, J. R. Liao & Y. H. Chiang (NTU); Jinping Road, Jianshi Township, Hsinchu County (24°41.164' N, 121°13.581' E, 447m), three females from *Cinnamomum osmophloeum* (Lauraceae), 17.v.2010, J. R. Liao & Y. H. Chiang (NTU); Maokong, Wenshan District, Taipei City (24°20.539' N, 121°18.486' E, 2334m), one female three males from *Ficus* sp. (Moraceae), 9.vi.2010, J. R. Liao & A. K. Dubey (NTU); Maokong, Wenshan District, Taipei City (24°58.062' N,



121°35.332' E, 313m), one female from *Cinnamomum osmophloeum* (Lauraceae), 9.vi.2010, J. R. Liao & A. K. Dubey (NTU); Maokong, Wenshan District, Taipei City (24°58.062' N, 121°35.332' E, 313m), seven females from unknown plant, 9.vi.2010, J. R. Liao & A. K. Dubey (NTU); Maokong, Wenshan District, Taipei City (24°58.062' N, 121°35.332' E, 313m), two females from *Cocos nucifera* (Arecaceae), 9.vi.2010, J. R. Liao & A. K. Dubey (NTU); Dalu Forest Road, Wufeng Township, Hsinchu County (24°32.165' N, 121°06.852' E, 1334m), four females one male from *Morus alba* (Moraceae), 13.viii.2010, C. T. Chen & J. R. Liao (TARL); Dalu Forest Road, Wufeng Township, Hsinchu County (24°32.165' N, 121°06.852' E, 1334m), one female from *Debregeasia orientalis* (Urticaceae), 13.viii.2010, C. T. Chen & J. R. Liao (NTU); Jiaoban Mountain, Fuxing District, Taoyuan City (24°49.138' N, 121°21.195' E, 441m), one female from *Quercus glauca* (Fagaceae), 24.viii.2010, Y. J. Tsao & J. R. Liao (NTU); Baling, Fuxing District, Taoyuan City (24°40.515' N, 121°24.001' E, 881m), one female from *Morus alba* (Moraceae), 28.viii.2010, J. R. Liao & C. T. Chen (NTU); Baling, Fuxing District, Taoyuan City (24°40.515' N, 121°24.001' E, 881m), one female from *Quercus glauca* (Fagaceae), 28.viii.2010, J. R. Liao & C. T. Chen (NTU); LaLa mountain, Fuxing District, Taoyuan City (24°41.463' N, 121°34.717' E, 1207m), one female from *Debregeasia orientalis* (Urticaceae), 28.viii.2010, J. R. Liao & C. T. Chen (NTU); Jiali Mountain, Nanzhuang Township, Miaoli County (24°31.651' N, 121°01.599' E, 1326m), two females from *Diospyros* sp. (Ebenaceae), 13.x.2010, J. R. Liao (NTU); Jiali Mountain, Nanzhuang Township, Miaoli County (24°31.651' N, 121°01.599' E, 1326m), three females three males (MZLQ 7598 to MZLQ 7603) from *Litsea* sp. (Lauraceae), 13.x.2010, J. R. Liao (ESALQ-USP); Lunbei Township, Yunlin County (23°46.480' N, 120°21.713' E, 15m), one female from *Morus alba* (Moraceae), 24.x.2010, J. F. Hsieh & C. T. Chen (NTU); Simaxian, Tai'an Township, Miaoli County



(24°24.679' N, 120°56.725' E, 852m), one female from *Phoebe formosana* (Lauraceae), 31.x.2010, J. R. Liao & W. C. Yang (NTU); Sandimen Township, Pingtung County (22°43.866' N, 120°40.059' E, 487m), one female from unknown plant, 20.xi.2010, J. R. Liao (NTU); Laonong, Liugui District, Kaohsiung City (22°55.785' N, 120°39.148' E, 224m), one female from *Bauhinia variegata* (Fabaceae), 20.xi.2010, J. R. Liao (NTU); Guanziling, Baihe District, Tainan City (23°19.301' N, 120°29.014' E, 451m), three females from *Bauhinia blakeana* (Fabaceae), 11.i.2011, J. R. Liao (NTU); Guanziling, Baihe District, Tainan City (23°19.301' N, 120°29.014' E, 451m), one female from *Colocasia esculenta* (Araceae), 11.i.2011, J. R. Liao (NTU); Guanziling, Baihe District, Tainan City (23°19.301' N, 120°29.014' E, 451m), three females from *Mangifera indica* (Anacardiaceae), 11.i.2011, J. R. Liao (NTU); Jinfeng Township, Taitung County (22°35.779' N, 120°57.244' E, 132m), one male from *Macaranga tanarius* (Euphorbiaceae), 23.i.2011, J. R. Liao & J. F. Hsieh (NTU); Paomagudao, Jiaoxi Township, Yilan County (24°50.276' N, 121°46.346' E, 147m), one female from *Carica papaya* (Caricaceae), 9.ii.2011, J. R. Liao (NTU); Caopingtou, Xinyi Township, Nantou County (23°33.447' N, 120°52.575' E, 1119m), two females from *Prunus campanulata* (Rosaceae), 24.iv.2011, J. R. Liao (NTU); Caopingtou, Xinyi Township, Nantou County (23°33.447' N, 120°52.575' E, 1119m), one female from *Machilus zuihensis* (Lauraceae), 24.iv.2011, J. R. Liao (NTU); Nanqing Highway, Zhudong Township, Hsinchu County (24°40.634' N, 121°05.987' E, 203m), two females one male from *Dendrocalamus latiforus* (Poaceae), 30.vi.2014, J. R. Liao (NTU); Jinshuiying Historic Trail, Chunri Township, Pingtung County (22°24.766' N, 120°43.628' E, 1078m), one female from *Turpinia formosana* (Staphyleaceae), 24.vi.2014, J. R. Liao (NTU); Shenshan, Wutai Township, Pingtung County (22°44.986' N, 120°43.640' E, 740m), one female from *Pachira aquatica* (Malvaceae), 25.vi.2014, J. R. Liao (NTU); Shimen

Reservoir, Longtan District, Taoyuan City (24°49.221' N, 121°12.473' E, 286m), two females from *Morus alba* (Moraceae), 30.v.2010, J. R. Liao (NTU); Shimen Reservoir, Longtan District, Taoyuan City (24°49.221' N, 121°12.473' E, 286m), one female from *Schefflera octophylla* (Araliaceae), 30.v.2010, J. R. Liao (NTU).

THAILAND: Chiang Dao, one paratype female (ZIHU-3608) from *Carica papaya* (Caricaceae), 4.xi.1970, S. Ehara (HUM).

Distribution. Asia: China (Guangdong (Liang & Ke, 1983), Guangxi (Moreas *et al.*, 1989), Hainan (Chen *et al.*, 1980), Yunnan (Liang & Ke, 1983)), Malaysia (Ehara, 2002b), Taiwan (present study), Thailand (Ehara & Bhandhufalck, 1977).

Remarks. The females of this species resemble those of *E. ovalis* (Evans, 1953), but differ from the reticulation of the anterolateral margin on dorsal shield, seta *j1* is slightly longer than *j3* (*j1* is apparently longer than *j3* in *E. ovalis*), and calyx of spermatheca funnel-shaped (tubular in *E. ovalis*). Furthermore, the females of this species are also similar to those of *E. nicholsi* (Ehara & Lee, 1971) but differ in the dorsal shield being lightly sclerotized (strongly sclerotized in *E. nicholsi*). Taiwanese female specimens that differed with other Taiwanese specimens (dorsal shield with lateral reticulation) only in dorsal shield with strong reticulation except for central part of podosoma, with no other observable differences between them. Liao *et al.* (2017a) reported these situation probably is an intraspecific variation, but Liao *et al.* (2017) identified three different species among these specimens, including *E. aizawai*, *E. nicholsi*, and *E. sojaensis*. We also observed one undetermined male specimen in the paratype slide (ZIHU-3608), that belong to the genus *Amblyseius*.

Li *et al.* (2006) reported that *E. aizawai* is a natural enemy can control citrus red mite (*Panonychus citri*) on citrus leaves in central Guizhou. They fed *E. aizawai* with 19 different pollens to rear in the laboratory. They considered the pollens could be

alternative foods for mass-rearing in the laboratory; also can help the *E. aizawai* live in the field when spider mite numbers are too low.

In Taiwan, *E. aizawai* and closely species were observed in from flat ground to high mountain areas (approximately 2400 m) (e.g., Wuling Farm, an organic farm located in a high altitude mountain area), but *E. ovalis* was primarily located in developed flat ground areas. Additionally, in some cases (e.g., Maokong, Taipei City), these *Euseius* species were found in the same collection site, but on different host plant; however, in one case in Guanziling, Tainan City, these species were simultaneously collected from the same habitat plant, *Mangifera indica*. These species may provided similar ecological nichese (i.e. type IV pollen feeding generalist predators). *E. aizawai* was observed to occur with other phytoseiid mites such as *Amblyseius eharai*, *A. herbicolus*, *E. ovalis*. We suspect that they are competitors in field. Additionally, we observed that this species feeds on spider mites such as *Panonychus citri* and *Tetranychus kanwawai*. Therefore, this species may have biocontrol potential in the field, need further study to confirm.

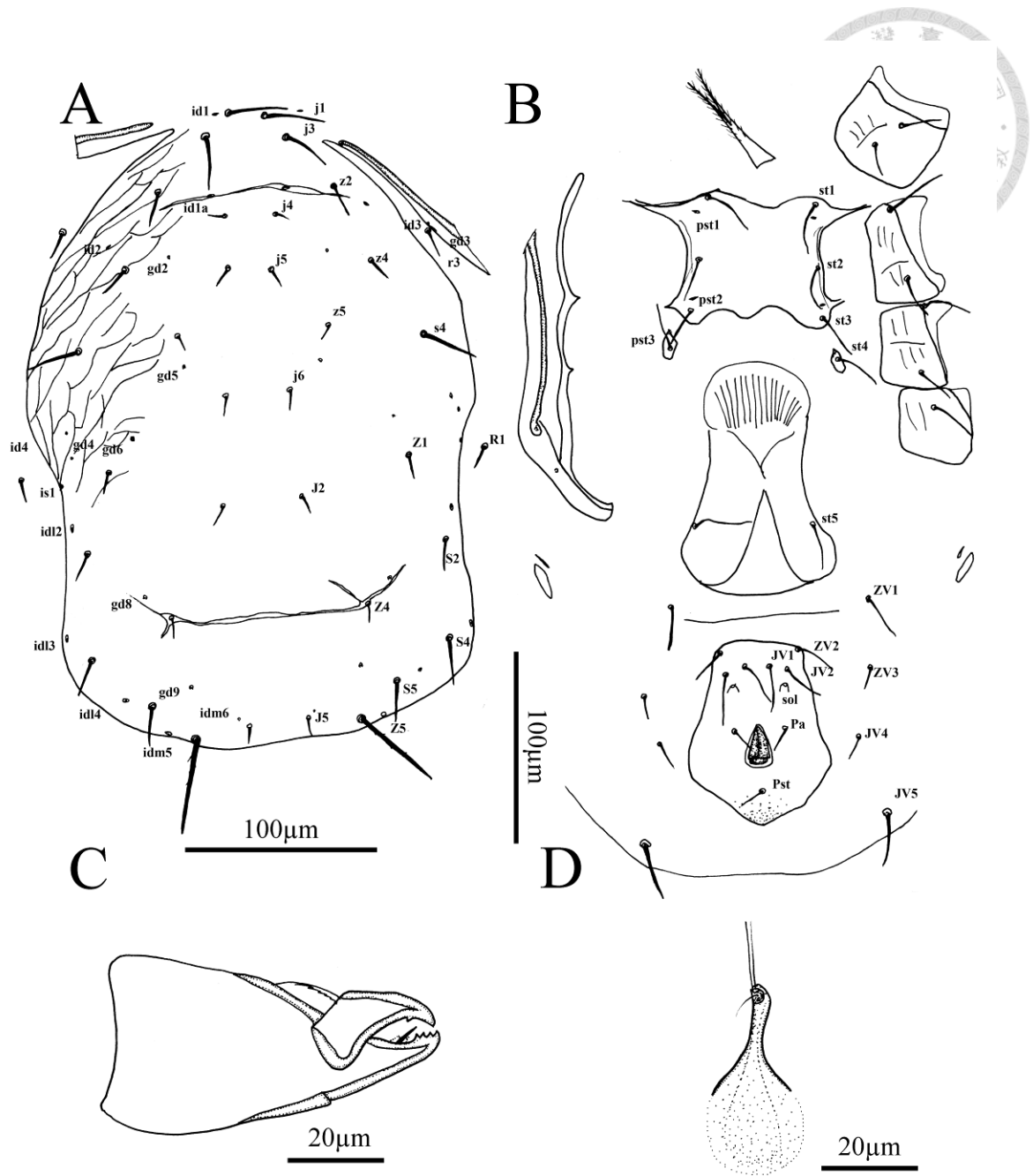


FIGURE 13. *Euseius aizawai* (Ehara & Bhandhufalck, 1977), Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

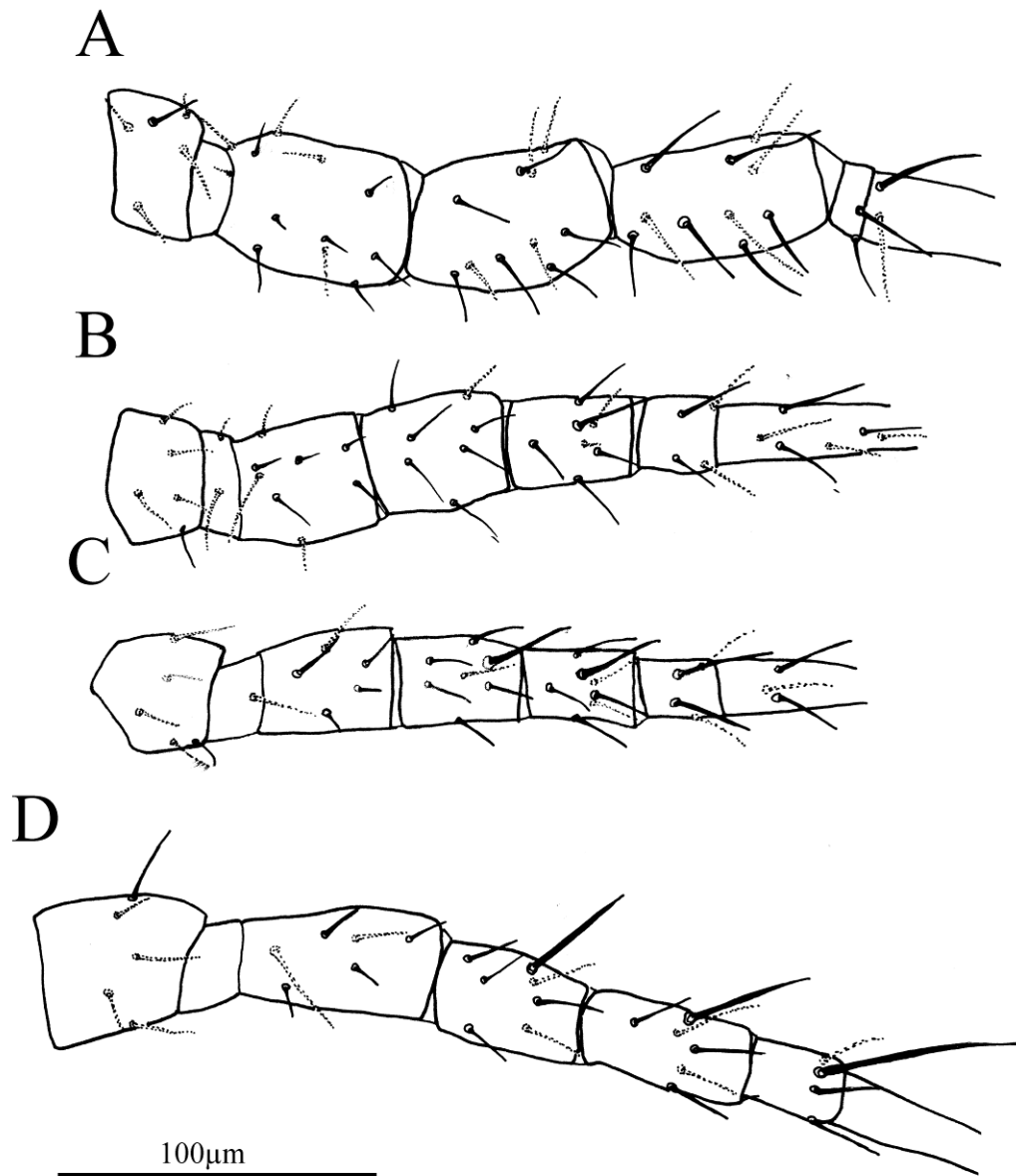


FIGURE 14. *Euseius aizawai* (Ehara & Bhandhufalck, 1977), Female, leg I anterior view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV posterior view.

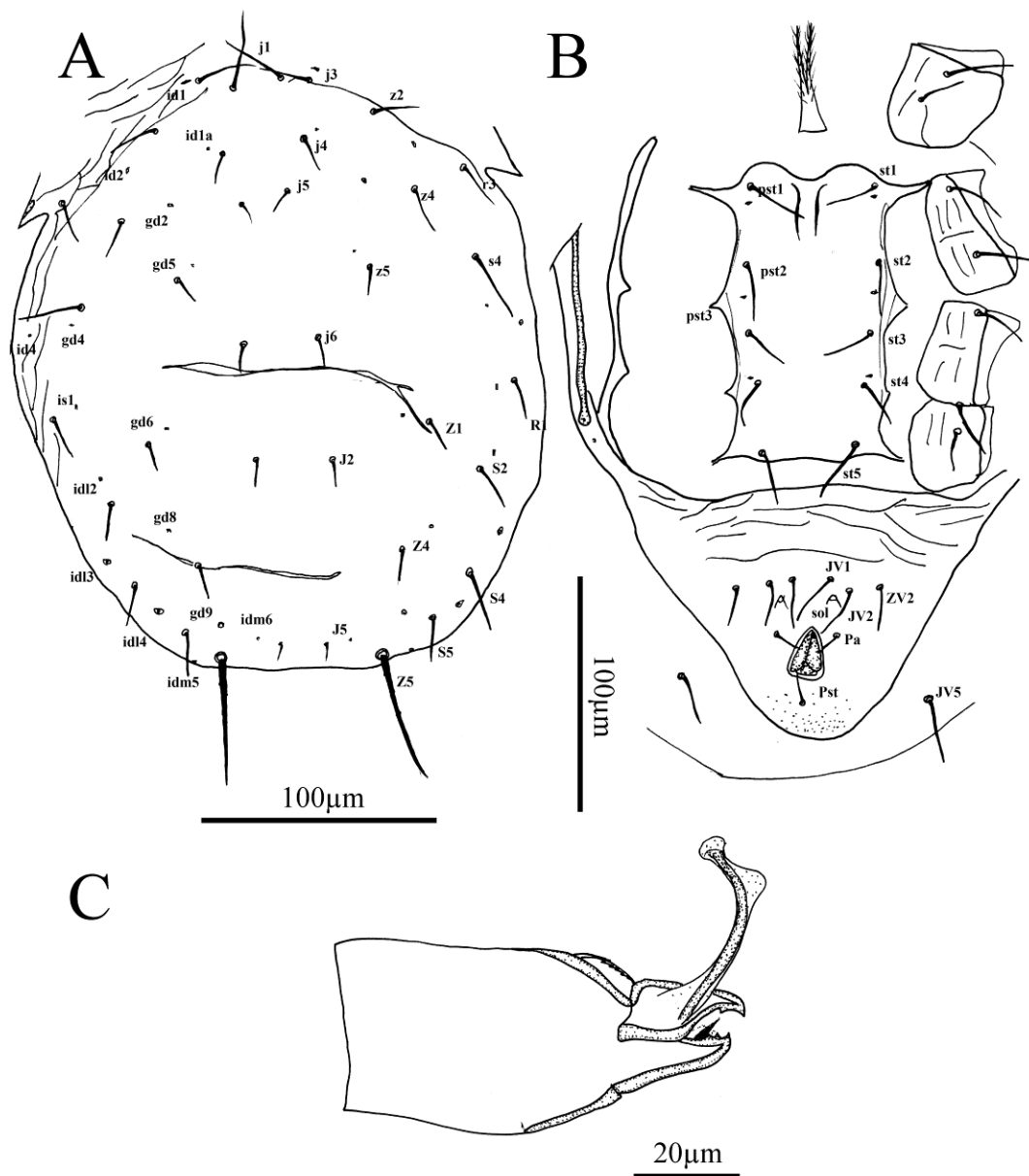


FIGURE 15. *Euseius aizawai* (Ehara & Bhandhufalck, 1977), Male, A. dorsal shield; B. ventral idiosoma; C. chelicera and spermatodactyl.

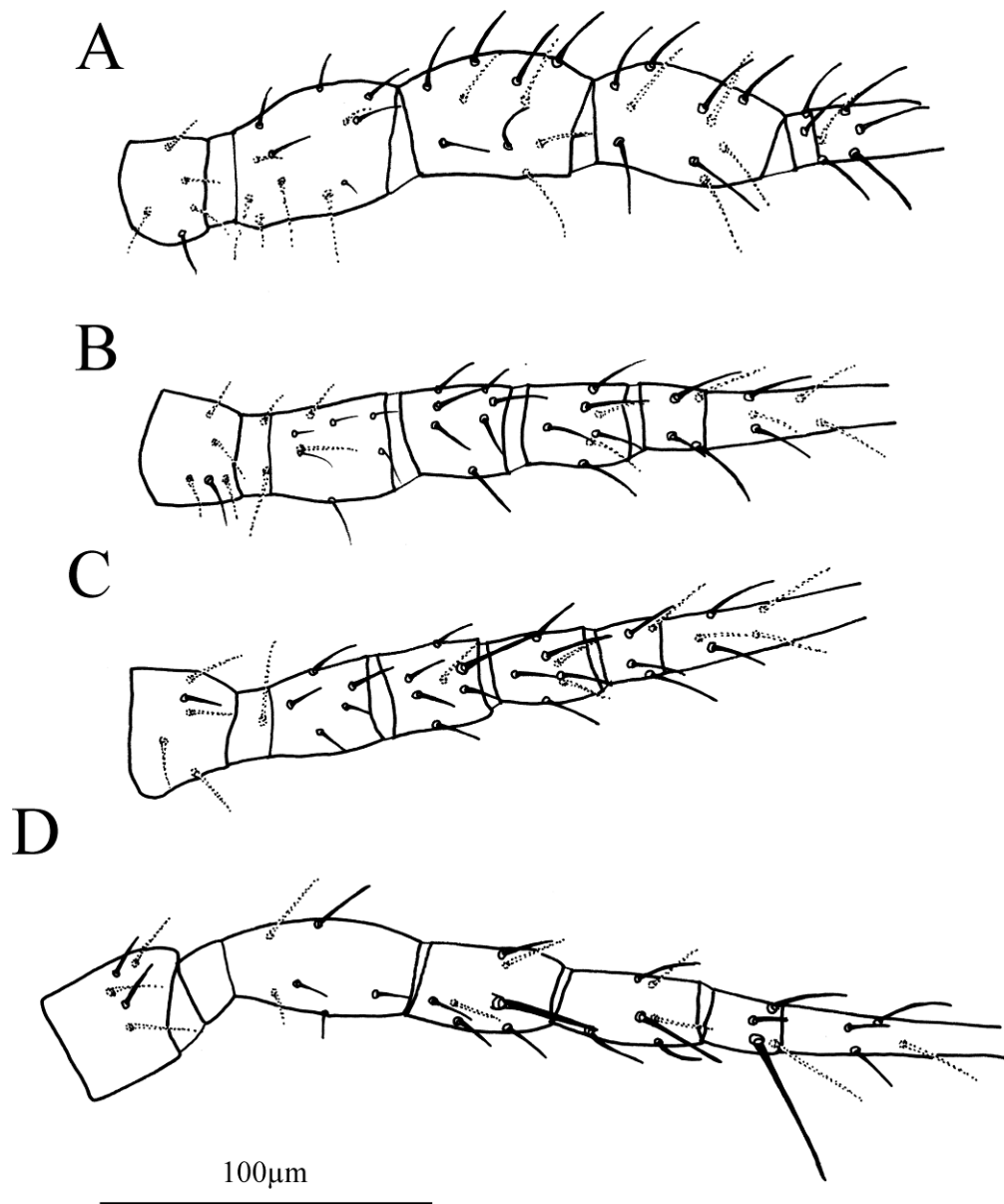


FIGURE 16. *Euseius aizawai* (Ehara & Bhandhufalck, 1977), Male, A. leg I posterior view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV anterior view.

Euseius circellatus (Wu & Li, 1983)

環形真綫蟎



(Figures 17–20)

Amblyseius (*Amblyseius*) *circellatus* Wu & Li, 1983: 173.

Typhlodromalus circellatus.—Moraes *et al.*, 1986: 128.

Amblyseius circellatus.—Wu *et al.*, 1997: 77.

Amblyseius (*Neoseiulus*) *circellatus*.—Ehara, 2002a: 125.

Amblyseius (*Neoseiulus*) *circillatus* [sic].—Wu *et al.*, 2009: 80.

Euseius circellatus.—Chant & McMurtry, 2005b: 215.

Female (n=6)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield with lateral reticulation, 268 (251–278) long (*j1*–*J5* level) and 160 (150–170) wide at level of *j6*, 148 (143–155) wide at level of *S4*; with six pairs of solenostomes (*gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), nine pairs of lyrifissures (*id1*, *id2*, *id4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 21 (19–24), *j3* 21 (19–24), *j4* 16 (15–17), *j5* 17 (15–20), *j6* 15 (14–18), *J2* 15 (13–17), *J5* 5 (4–6), *z2* 22 (19–26), *z4* 23 (21–25), *z5* 17 (14–18), *Z1* 16 (14–17), *Z4* 16 (14–18), *Z5* 39 (37–43), *s4* 32 (25–35), *S2* 19 (16–21), *S4* 16 (11–18), *S5* 17 (14–19), *r3* 21 (17–24), *R1* 13 (8–15); All setae smooth, except *Z5* slightly serrated.

Peritreme. Peritreme extending to *r3* level, peritremal shield smooth, lightly sclerotized, with one pair of solenostomes (*gd3*), one pair of lyrifissures (*id3*)

Venter. Sternal shield smooth, with projection of posterior margin, wider than long, 58 (51–64) long, 81 (76–86) wide at *st3* level, with three pairs of setae *st1* 24 (22–26), *st2* 22 (16–27), *st3* 20 (15–22), and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae II–IV. Metasternal platelets tear-shaped, with one pair metasternal setae,

st4 18 (12–22), and one pair of lyrifissures (*pst3*). Genital shield smooth, 69 (63–75) wide at level of genital setae, with one pair of genital setae *st5* 20 (17–22). Distances between *st1-st1* 49 (47–51), *st2-st2* 53 (51–56), *st3-st3* 62 (60–64), *st1-st3* 50 (48–51), *st5-st5* 56 (53–59). Ventrianal shield smooth, vase-shaped, 84 (81–87) long, 41 (39–43) wide at level of *ZV2*, 53 (47–56) wide at level of anus; with three pairs of pre-anal setae, arranged in triangular pattern, *JV1* 18 (14–23), *JV2* 17 (11–19), *ZV2* 18 (13–24), solenostomes *gv3* crescentic; *Pa* 12 (11–17), *Pst* 12 (10–14) on shield. Setae *JV4* 10 (7–12), *JV5* 23 (17–25), *ZV1* 19 (14–21), *ZV3* 11 (5–13) on interscutal membrane. All ventral setae smooth. Two pairs of metapodal platelets 20 (17–25) long, 2 (1–2) wide, 13 (10–15) long, 3 (2–3) wide.

Chelicera. Movable digit 19 (17–23) long, with one tooth; fixed digit 21 (20–24) long, anterior half with five teeth, with *pilus dentilis*.

Spermatheca. Calyx funnel-shaped, 14 (13–15) long, 1 (1–2) wide, atrium sac-shaped with thick walls.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/2-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-1/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *St IV* 48 (42–50).

Male (n=6)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3, 4:ZV-1, 3.

Dorsal shield with lateral reticulation, 207 (196–213) long (*j1-J5* level) and 141 (130–147) wide at level of *j6*, 99 (94–107) wide at level of *S4*; with six pairs of solenostomes (*gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), nine pairs of lyrifissures (*id1*, *id2*, *id4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 17 (16–19), *j3* 21 (17–27), *j4* 17 (15–18), *j5* 17 (15–20), *j6* 16 (12–20), *J2* 14 (12–16), *J5* 4 (3–6), *z2* 22 (21–22), *z4* 22

(21–25), *z5* 16 (14–17), *Z1* 15 (12–19), *Z4* 16 (14–18), *Z5* 32 (30–34), *s4* 28 (25–29), *S2* 17 (12–19), *S4* 14 (11–17), *S5* 17 (14–21), *r3* 18 (15–20), *R1* 12 (10–15); All setae smooth, except *Z5* slightly serrated. Setae *r3* and *R1* inserted on dorsal shield.

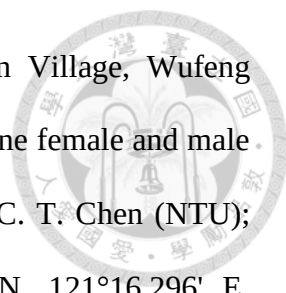
Peritreme. Peritreme extending to *r3* level, peritremal shield smooth, lightly sclerotized, with one pair of solenostomes (*gd3*).

Venter. Sternogenital shield smooth, slightly lateral reticulated, posterior margin almost straight, longer than wide, 109 (105–114) long, 59 (53–64) wide at level of *st5*, with five pairs of setae *st1* 19 (17–23), *st2* 19 (17–228), *st3* 17 (14–20), *st4* 15 (11–18), *st5* 15 (13–17), and three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Exopodal shield at coxae III–IV. Distances between *st1-st1* 37 (32–41), *st2-st2* 44 (37–48), *st3-st3* 43 (37–46), *st4-st4* 37 (33–39), *st5-st5* 24 (19–26), *st1-st5* 87 (78–96). Ventrianal shield subtriangular, slightly reticulated, 81 (75–93) long and 118 (109–133) wide at level of anterior corner, 41 (38–50) wide at level of anus, fused with peritremal shield cingulum, with three pairs of pre-anal setae, arranged in triangular pattern, solenostome *gv3* crscentic, *JV1* 12 (9–15), *JV2* 12 (9–16), *ZV2* 14 (12–17); *Pa* 8 (5–10), *Pst* 9 (7–12) on shield. Setae *JV5* 20 (18–21) on interscutal membrane. All ventral setae smooth.

Chelicera. Movable digit 17 (15–23) long, with one tooth; fixed digit 19 (16–20) long, anterior half with one tooth, posterior half with four teeth, with *pilus dentilis*. Spermatodactyl U-shaped, shaft 17 (15–22) long, heel rounded, foot 19 (16–20) long, with narrow toe and lateral thorn-like projection.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/2-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-1/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *St IV* 41 (37–45).

Specimens examined. Dongpu, Xinyi Township, Nantou County, two females



from Leguminosae plant, 18.x.1985, C. C. Ho (TARL), Taoshan Village, Wufeng township, Hsinchu County (24°32.165' N, 121°06.852' E, 1337m), one female and male from *Conyza sumatrensis* (Asteraceae), 13.viii.2010, J. R. Liao & C. T. Chen (NTU); Jinping Road, Jianshi Township, Hsinchu County (24°40.185' N, 121°16.296' E, 1057m), one female from *Mallotus japonicus* (Euphorbiaceae), 17.iv.2014, J. R. Liao (NTU); Simaxian, Tai'an Township, Miaoli County (24°24.466' N, 120°56.309' E, 818m), five male from *Pueraria lobata* (Fabaceae), 2.v.2016, J. R. Liao (NTU); Simaxian, Tai'an Township, Miaoli County (24°24.466' N, 120°56.309' E, 818m), one female from *Broussonetia papyrifera* (Moraceae), 2.v.2016, J. R. Liao (NTU); Simaxian, Tai'an Township, Miaoli County (24°24.333' N, 120°58.561' E, 1267m), one female from *Pueraria lobata* (Fabaceae), 2.v.2016, J. R. Liao (NMNS).

Distribution. Asia: China, Fujian (Wu & Li 1983), Guangdong (Wu *et al.* 2009), Hainan (Wu *et al.* 2009), Yunnan (Wu *et al.* 2009), Indonesia (Sumatra) (Ehara 2002a)), Taiwan (Liao *et al.* 2017a).

Remarks. The Taiwanese female specimens observed mostly agreed with the descriptions of Chinese and Sumatran specimens by Wu & Li (1983) and Ehara (2002a). However, we observed slight differences among them: 1. Chinese specimens have anterolateral reticulation on the dorsal shield but Taiwanese and Sumatran specimens have lateral reticulation. 2. Taiwanese specimens have a *St* IV length of 48 (43–50) μm but Chinese specimens have one of 30 μm , and Sumatran specimens have one of $29.0 \pm 0.6 \mu\text{m}$. 3. Ehara (2002a) mentioned that the Sumatran specimens' *st4* is located on metasternal platelets, which is in agreement with Taiwanese specimens but not with Chinese specimens (on interscutal membrane). Wu & Li (1983) described the Chinese specimens' *st4* is located on metasternal platelets, but without illustration. Wu *et al.* (1997) redescribed Chinese specimens' *st4* is located on metasternal platelets in the text,

but on interscutal membrane in the illustration. Wu et al. (2009) redescribed Chinese specimens' *st4* is located on interscutal membrane in both of text and illustration. In addition, the Taiwanese female specimen resembles with *E. dowdi* (Schicha, 1993) in the special spermatheca calyx and the length of *St IV* being 47–50 μm , but differs in lateral reticulation on the dorsal shield (smooth in *E. dowdi*).

Ehara (2002a) mentioned that the species might be a junior synonym of the Indian species *E. kalimpongensis* Gupta (1969); however, we observed differences between them: *E. kalimpongensis* has a smooth dorsal shield and a concave posterior margin of the sternal shield.

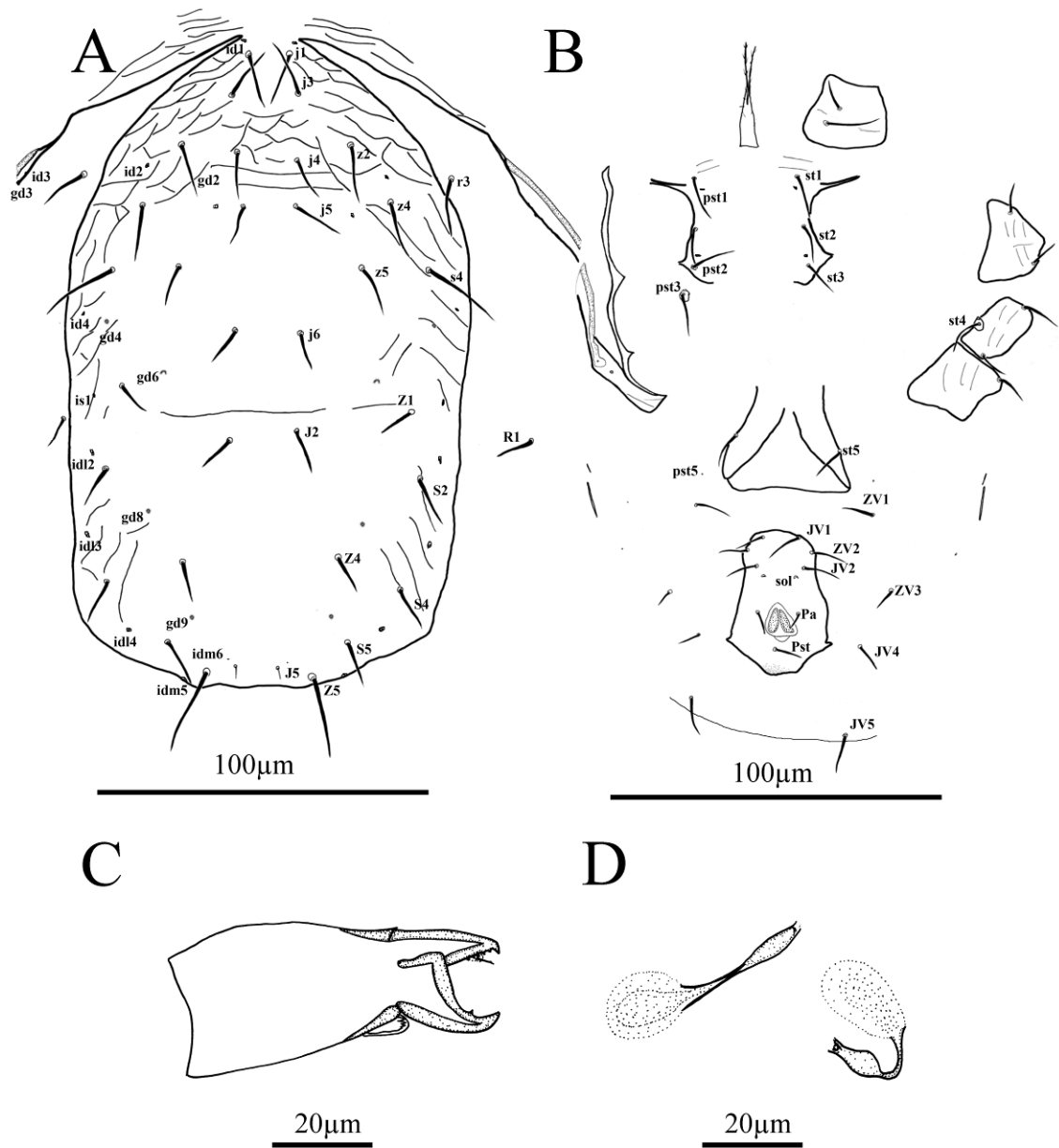


FIGURE 17. *Euseius circellatus* (Wu & Li, 1983), Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

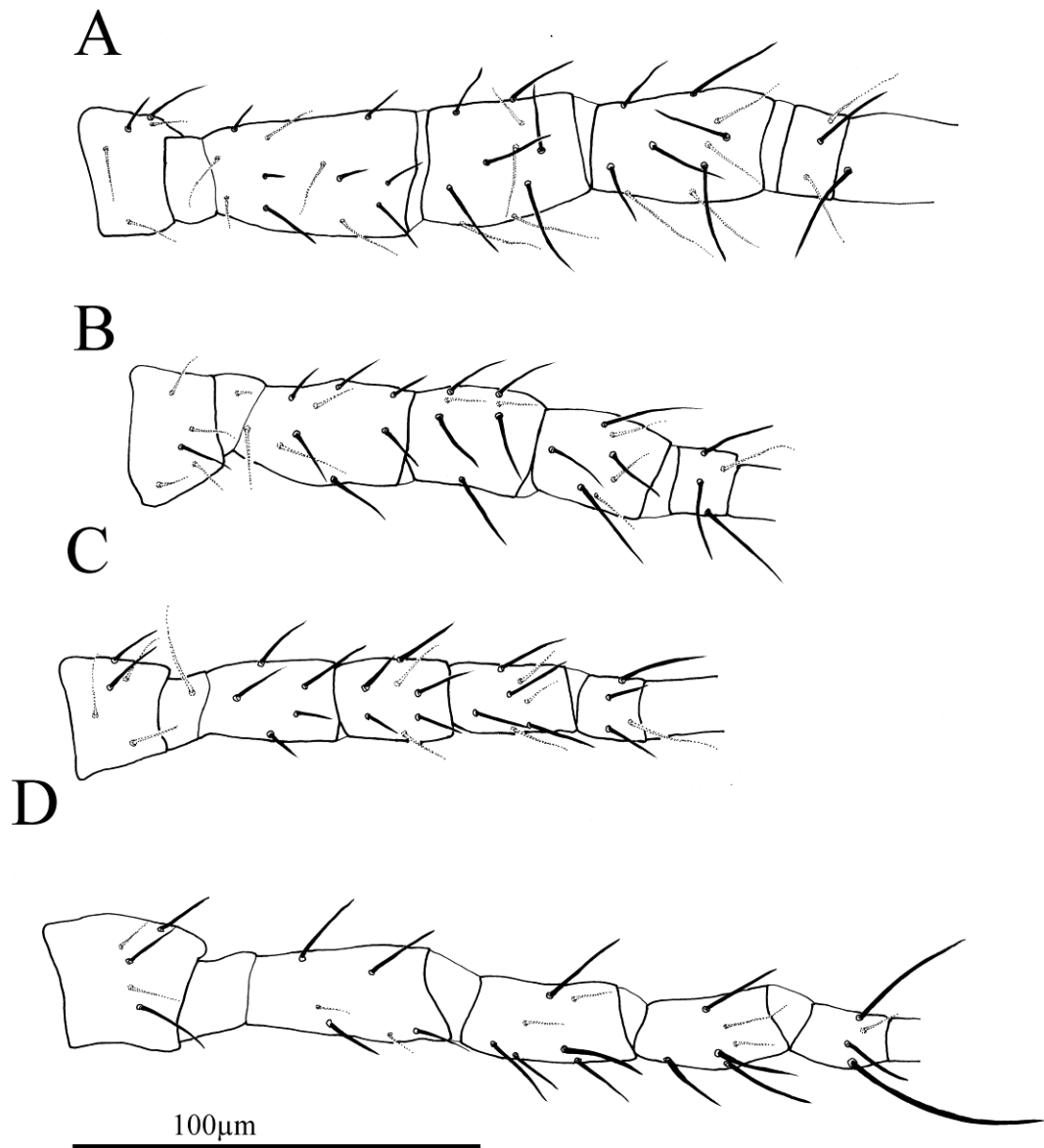


FIGURE 18. *Euseius circellatus* (Wu & Li, 1983), Female, A. leg I anterodorsal view, B. leg II posterior view, C. leg III dorsal view, D. leg IV anterior view.

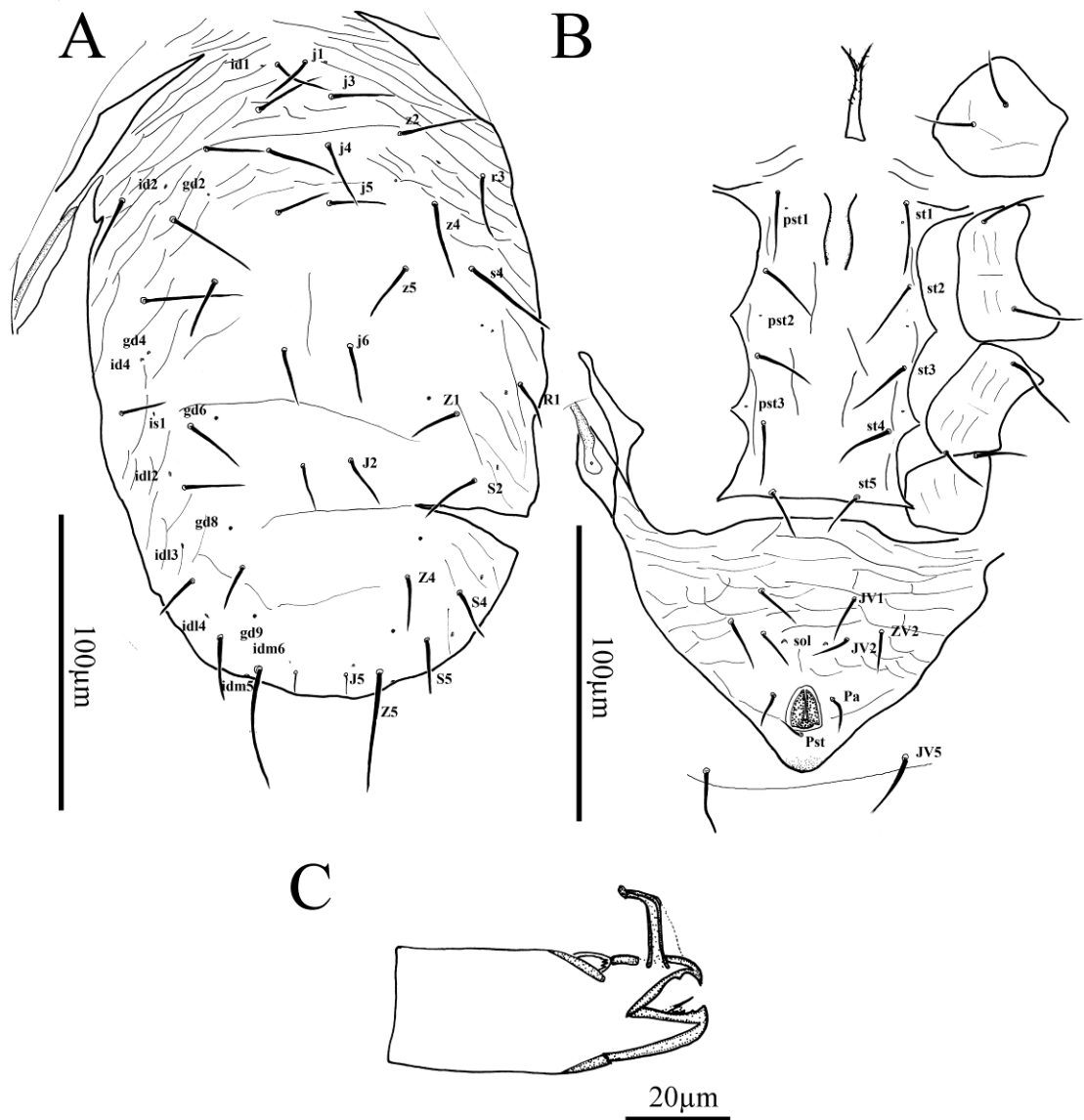


FIGURE 19. *Euseius circellatus* (Wu & Li, 1983), Male, A. dorsal shield, B. ventral idiosoma; C. chelicera and spermatodactyl.

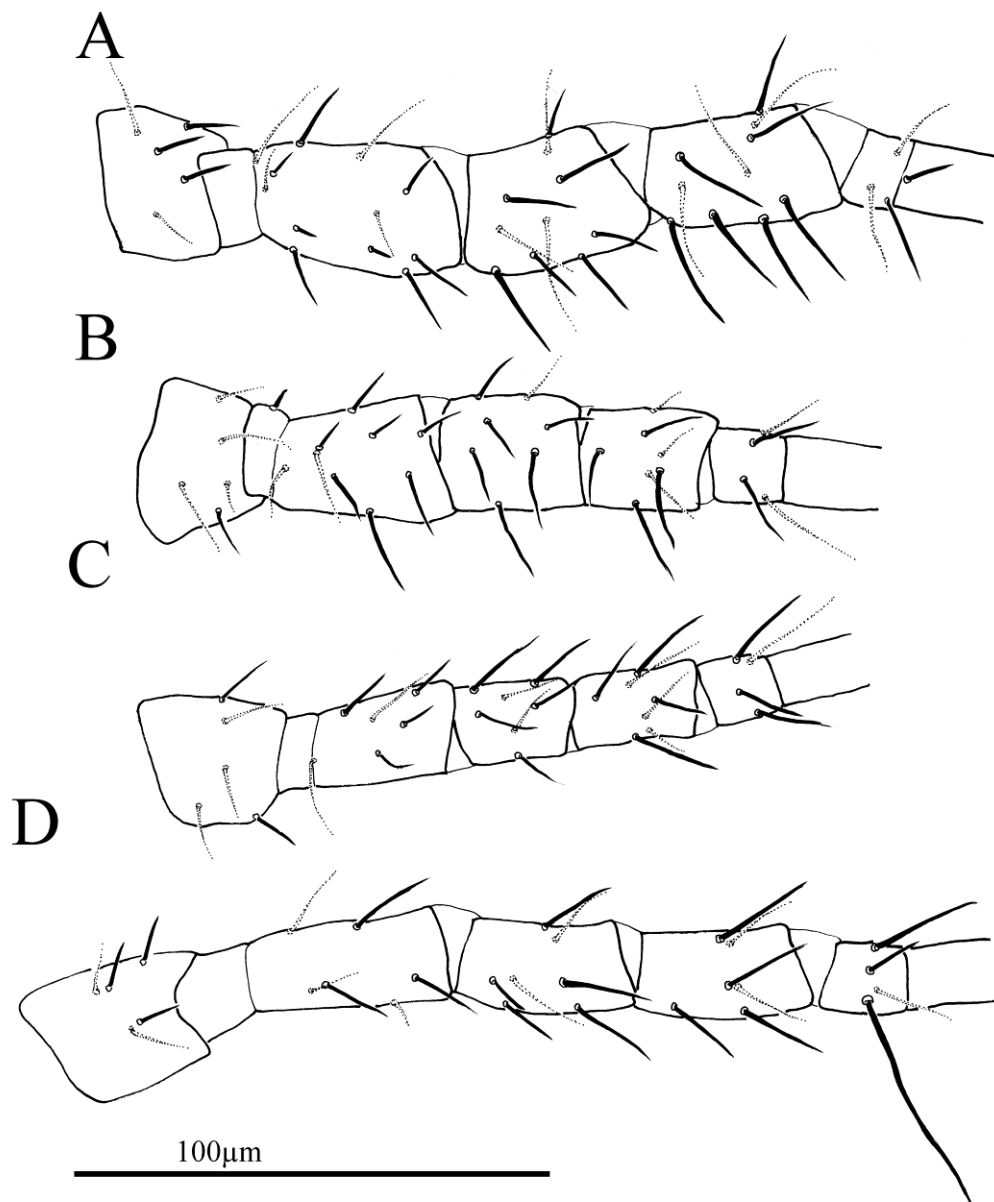


FIGURE 20 *Euseius circellatus* (Wu & Li, 1983), Male, A. leg I anterior view, B. leg II dorsal view, C. leg III posterior view, D. leg IV anterior view.

Euseius daluensis Liao & Ho, 2017a

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(Figures 21–24)

Euseius daluensis Liao & Ho, in Liao *et al.*, 2017a: 211.

Female (n=6)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield laterally reticulated; **293** 312 (285–335) long (*j1*–*J5* level) and **208** 217 (204–234) wide at level of *j6*, **199** 207 (183–220) wide at level of *S4*; five pairs of solenostomes on dorsal shield, (*gd2*, *gd4*, *gd6*, *gd8*, *gd9*), ten pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* **23** 27 (23–32), *j3* **19** 21 (15–27), *j4* **6** 6 (4–5), *j5* **3** 5 (3–6), *j6* **6** 6 (5–9), *J2* **8** 8 (6–10), *J5* **3** 3 (2–5), *z2* **9** 10 (7–13), *z4* **8** 9 (6–12), *z5* **6** 6 (4–7), *Z1* **6** 8 (6–11), *Z4* **9** 9 (8–11), *Z5* **46** 51 (46–56), *s4* **14** 16 (7–24), *S2* **10** 11 (8–14), *S4* **9** 11 (9–14), *S5* **12** 12 (9–14), *r3* **8** 9 (8–1), *R1* **7** 8 (6–10). All setae smooth, except *Z5* slightly serrated.

Peritreme. Peritreme extending to *z2* level, peritremal shield smooth, lightly sclerotized, with one pair of solenostomes (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, posterior margin with medium projection, much wider than long, **60** 63 (51–71) long, **82** 85 (75–95) wide, with three pairs of setae *st1* **25** 26 (23–28), *st2* **26** 26 (23–28), *st3* **23** 23 (22–24), and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae I–IV, almost reach coxa I. Metasternal platelets tear-shaped, with one pair metasternal setae, *st4* **19** 21 (19–23), with one pair of lyrifissures (*pst3*). Genital shield smooth, with one pair of genital setae *st5* **23** 25 (21–30), **76** 81 (74–86) wide at level of genital setae. Distances between *st1*–*st1* **53** 53 (49–55), *st2*–*st2* **62** 63 (58–67), *st3*–*st3* **62** 63 (58–67), *st1*–*st3* **51** 54 (51–56), *st5*–*st5* **62** 66 (57–78). Ventrianal shield vase-shaped **91** 92 (83–99) long, **49** 52 (48 60) wide at

level of ZV2, **69** 71 (69–76) wide at level of anus; with three pairs of pre-anal setae, *JV1* migrate next to *JV2*, *JV1* **24** 25 (20–27), *JV2* **22** 22 (18–26), *ZV2* **16** 17 (13–21), solenostomes *gv3* crescentic; *Pa* **7** 10 (7–12), *Pst* **10** 12 (9–16) on shield. Setae *JV4* **7** 9 (5–12), *JV5* **22** 24 (17–29), *ZV1* **19** 19 (16–21), *ZV3* **7** 8 (5–11) on interscutal membrane. All ventral setae smooth. Two pairs of metapodal plates **21** 22(21–23) long, **4** 4 (1–10) wide, **11** 13 (10–17) long, **1** 3 (2–4) wide.

Spermatheca. Calyx funnel-shaped, **8** 7 (5–9) long, **6** 6 (4–8) wide, atrium with contracted neck, indistinguishable embolus, with a thin major duct.

Chelicera. Movable digit **20** 21 (20–24) long, with one tooth; fixed digit **25** 24 (22–27) long, anterior half with five teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/1-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-2/1-1/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* III (ad2) **28** 30 (26–37), *Sge* IV (ad2) **35** 38 (33–46), *Sti* IV (ad1) **35** 34 (30–36) and *St* IV (pd1) **55** 59 (50–67).

Male (n=1)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3, 4:ZV-1, 3.

Dorsum. Dorsal shield laterally reticulated; 230 long (*j1*-*J5* level) and 156 wide at level of *j6*, 137 wide at level of *S4*, f five pairs of solenostomes on dorsal shield, (*gd2*, *gd4*, *gd6*, *gd8*, *gd9*), ten pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 23, *j3* 19, *j4* 4.59, *j5* 5, *j6* 5, *J2* 6, *J5* 2, *z2* 8, *z4* 9, *z5* 5, *Z1* 6, *Z4* 7, *Z5* 38, *s4* 27, *S2* 10, *S4* 9, *S5* 9, *r3* 9, *R1* 8. All setae smooth, except *Z5* slightly serrated. Setae *r3* and *R1* inserted on dorsal shield.

Peritreme. Peritreme extending to level of *z2*, did not to dorsal view, peritremal shield smooth, lightly sclerotized, with one pair of solenostomes (*gd3*).

Venter. Sternogenital shield smooth, lateral slightly reticulated, posterior margin straight, longer than wide 104 long, 63 wide at level of *st5*, with five pairs of setae *st1* 22, *st2* 16, *st3* 19, *st4* 15, *st5* 15, three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Distances between *st1-st1* 44, *st2-st2* 52, *st3-st3* 49, *st4-st4* 41, *st5-st5* 33, *st1-st5* 94. Exopodal shield at coxae I-IV. Ventrianal shield subtriangular, strongly reticulated, 79 long, 123 wide at level of anterior corner, 47 wide at level of anus, anterolateral fused with peritremal shield; with three pairs of pre-anal setae, arranged in tangential row, *JV1* 18, *JV2* 17, *ZV2* 14, solenostomes *gv3* crescentic; *Pa* 8, *Pst* 8 on shield. Setae *JV5* 21 on interscutal membrane. All ventral setae smooth.

Chelicera. Movable digit 17 long, with one tooth; fixed digit 20 long, anterior half with five teeth, with *pilus dentilis*. Spermatodactyl T-shaped, shaft 21 long, heel elongate, foot 7 long, with elongate toe and lateral thorn-like projection..

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/1-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-2/1-1/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* III (ad2) 22, *Sge* IV (ad1) 28, *Sti* IV (ad1) 25 and *St* IV (pd1) 40.

Specimens examined. Dalu Forest Road, Wufeng Township, Hsinchu County (24°33.924' N, 121°05.433' E, 771m), one holotype female (no. 770–1) from *Bambusa oldhamii* (Poaceae), 13.viii.2010, C. T. Chen & J. R. Liao (NTU); Dongpu, Xinyi Township, Nantou County, two paratype females (TAL074C10-1, 2) from *Dendrocalamus latiflorus* (Poaceae), 18.xi.1985, C. C. Ho (TARL); three females one male paratype (no. 770–2, 4, 5) data same with holotype (NTU); one paratype female (no. 770–3) data same with holotype (TARL); Nanqing Highway, Zhudong Township, Hsinchu County (24°40.634' N, 121°05.987' E, 203m), one paratype female (no. 1326–1)

from *Dendrocalamus latiforus* (Poaceae), 30.vi.2014, J. R. Liao (NMNS); Nanqing Highway, Zhudong Township, Hsinchu County (24°40.634' N, 121°05.987' E, 203m), one female one male paratype (no. 1326–2, 3) (T-MZLQ 3277 and T-MZLQ 3278) from *Dendrocalamus latiforus* (Poaceae), 30.vi.2014, J. R. Liao (ESALQ-USP); Liouyi Mountain, Jiashian District, Kaohsiung City (23°04.703' N, 120°34.727' E, 314m), one paratype female (no. 1616–3) from *Bambusa oldhamii* (Poaceae), 12.iii.2016, J. R. Liao (NTU).

Distribution. Asia: Taiwan (Liao *et al.* 2017a).

Remarks. The females of this species resemble *E. finlandicus* (Oudemans, 1915) and *E. ovalis* (Evans, 1953), but differ from *E. finlandicus* in z_2 , z_4 being minute, and $St\ IV > Sge\ IV > Sti\ IV$ ($St\ IV > Sge\ IV = Sti\ IV$ in *E. finlandicus*); from *E. ovalis* in calyx of the spermatheca funnel-shaped (tubular in *E. ovalis*), j_1 slightly longer than j_3 (j_1 apparently longer than j_3 in *E. ovalis*), and the chelicera lacking *pilus dentilis*.

We often collected *Euseius daluensis* in together with *E. aizawai* in the same place but from different adjacent plants. We suspect these two species may have similar ecological niches and food habit, but need more evidences for approval.

Additionally, the specimens (770–2 and 770–5) were broken when remounting the slides.

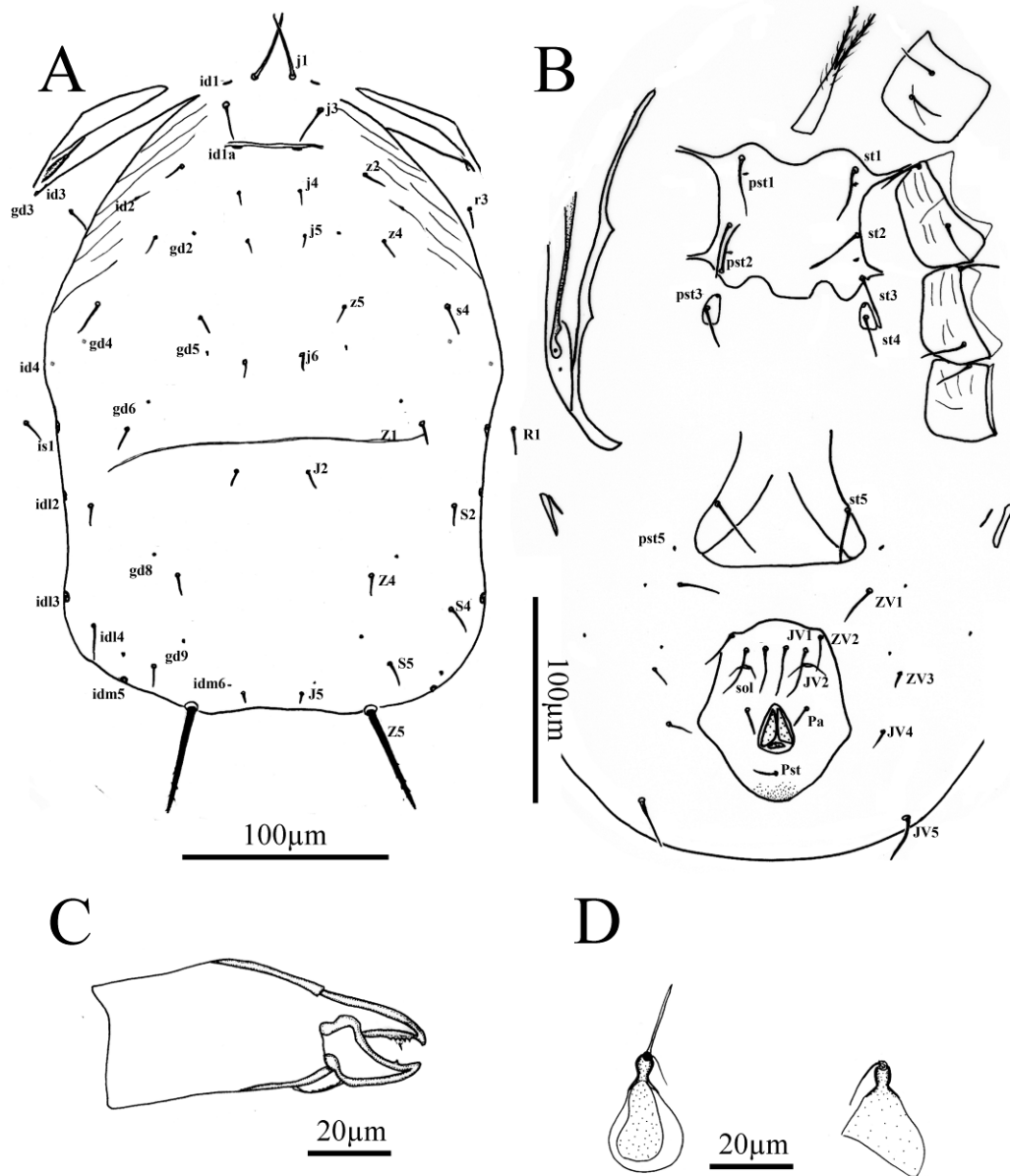


FIGURE 21. *Euseius daluensis* Liao & Ho, 2017a, Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

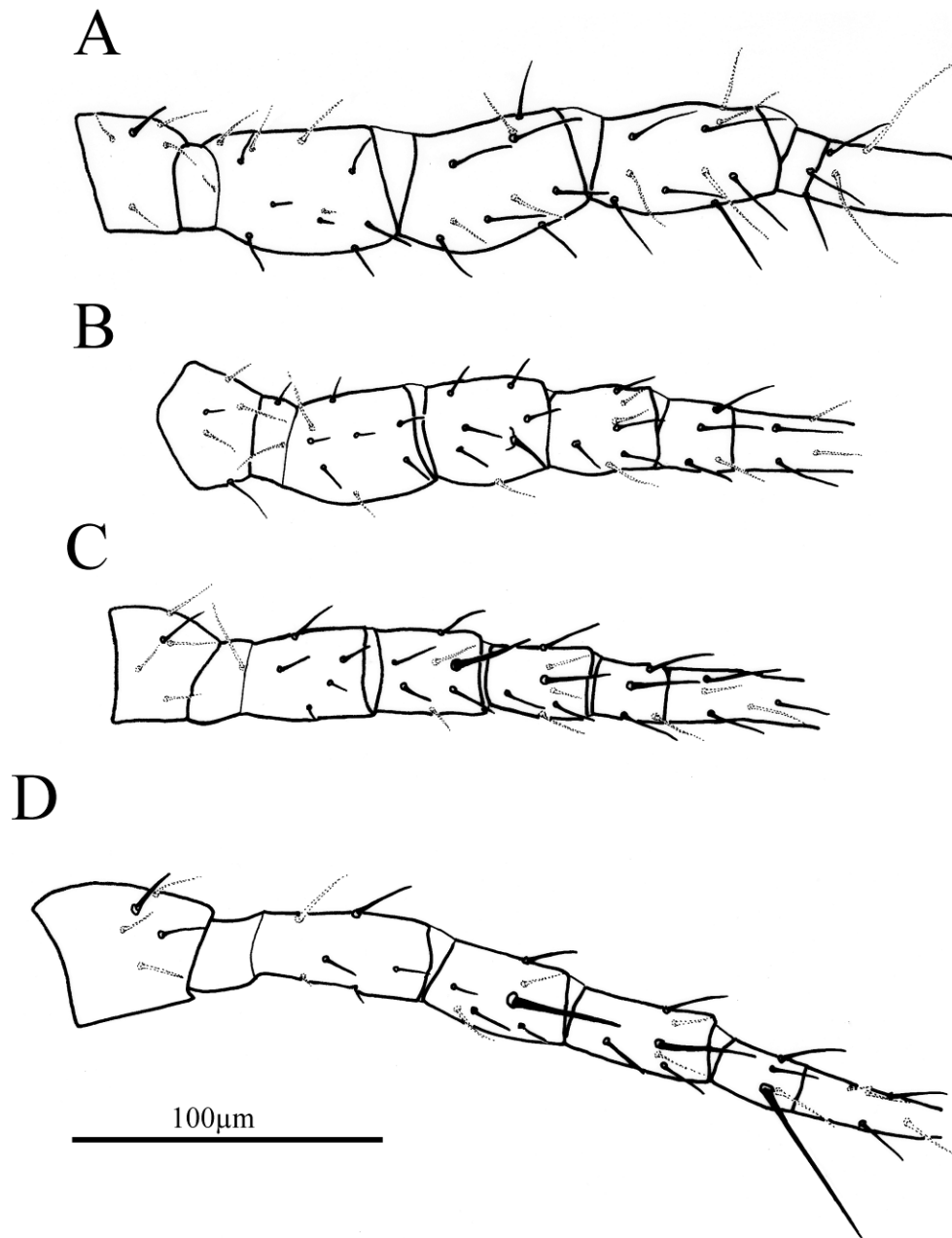


FIGURE 22. *Euseius daluensis* Liao & Ho, 2017a, Female, A. leg I anterior view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV dorsal view.

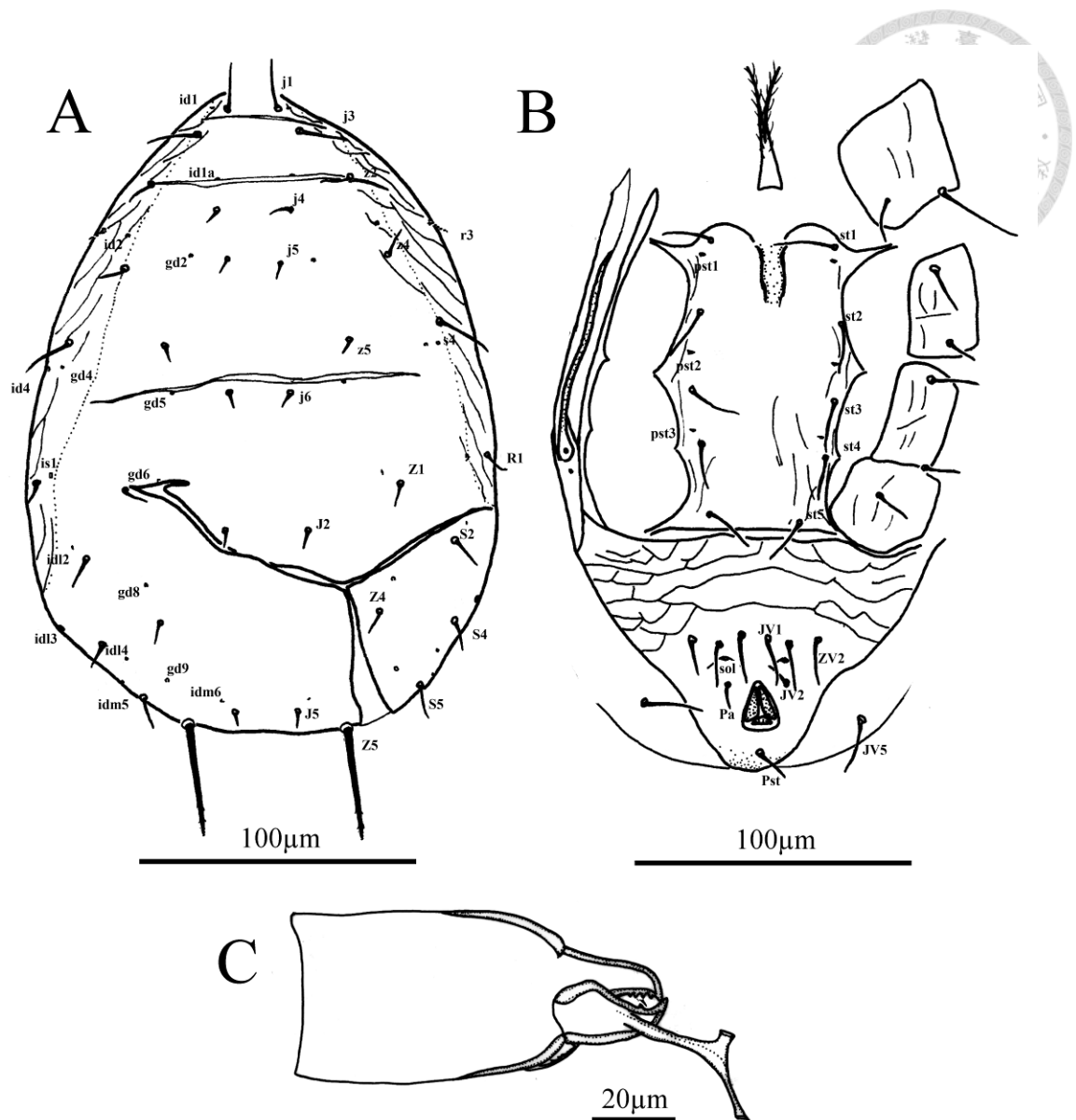


FIGURE 23. *Euseius daluensis* Liao & Ho, 2017a, Male, A. dorsal shield, B. ventral idiosoma; C. chelicera and spermatodactyl.

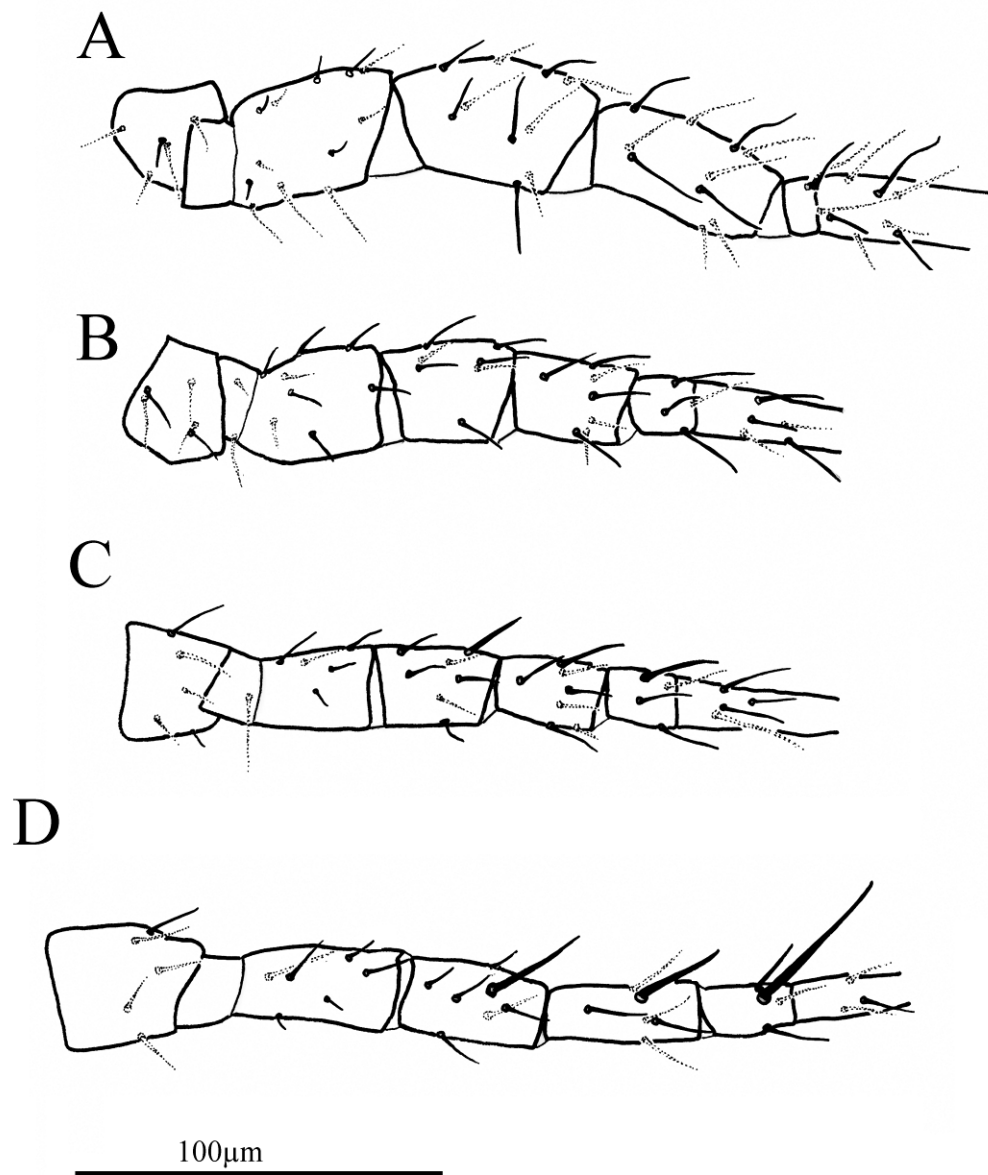


FIGURE 24. *Euseius daluensis* Liao & Ho, 2017a, Male, A. leg I posterior view, B. leg II posterior view, C. leg III posterior view, D. leg IV dorsal view.

Euseius macaranga Liao & Ho, 2017a

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(Figures 25–28)

Euseius macaranga Liao & Ho, in Liao *et al.*, 2017a: 215.

Female (n=10)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield much smaller than idiosoma, lateral margin condense or curved at level of *R1*; dorsal shield reticulated except central part; **240** 259 (240–279) long (*j1-J5* level) and **147** 151 (137–160) wide at level of *j6*, **145** 141 (130–150) wide at level of *S4*; six pairs of solenostomes on dorsal shield, (*gd1*, *gd2*, *gd4*, *gd6*, *gd8*, *gd9*), twelve pairs of lyrifissures, (*id1*, *id1a*, *id2*, *id4*, *idm2*, *idm3*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* **20** 20 (18–23), *j3* **27** 21 (18–27), *j4* **17** 16 (13–17), *j5* **19** 17 (13–20), *j6* **14** 13 (8–15), *J2* **13** 12 (9–15), *J5* **5** 4 (3–6), *z2* **24** 22 (18–28), *z4* **28** 25 (18–30), *z5* **15** 15 (11–21), *Z1* **14** 13 (10–19), *Z4* **13** 12 (7–15), *Z5* **38** 42 (38–46), *s4* **33** 32 (27–36), *S2* **21** 18 (14–23), *S4* **14** 13 (10–16), *S5* **12** 12 (9–16), *r3* **29** 26 (22–29), *R1* **15** 14 (10–18). All setae smooth, except *Z5* slightly serrated.

Peritreme. Peritreme extend to level of *z4*; peritremal shield lightly sclerotized, with reticulation, with one pair of solenostomes (*gd3*).

Venter. Sternal shield smooth, posterior margin concave, much wider than long, **59** 63 (59–67) long, **74** 77 (72–83) wide, with three pairs of setae, *st1* **24** 24 (17–29), *st2* **22** 21 (18–24), *st3* **22** 20 (15–24), and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae II–IV. Metasternal platelets tear-shaped, with one pair metasternal setae, *st4* **18** 17 (12–19), with one pair of lyrifissures (*pst3*). Genital shield smooth, with one pair of genital setae *st5* **21** 22 (18–25), **55** 57 (52–65) wide at level of genital setae. Distances between *st1-st1* **45** 44 (42–47), *st2-st2* **50** 52 (48–54), *st3-st3* **58** 58 (54–63), *st1-st3* **46**

49 (46–51), *st5-st5* **49** 44 (39–51). Ventrianal shield vase-shaped, smooth, **78** 81 (74–90) long, **35** 36 (28–39) wide at level of ZV2, **46** 49 (44–59) wide at level of anus; with three pairs of pre-anal setae, arranged in triangular pattern, *JV1* **18** 15 (10–18), *JV2* **13** 1 (9–17), *ZV2* **14** 12 (9–16), solenostomes *gv3* crescentic; *Pa* **9** 10 (5–13), *Pst* **10** 11 (9–14) on shield. Setae *JV4* **8** 7 (6–9), *JV5* **24** 23 (18–25), *ZV1* **16** 15 (11–18), *ZV3* **8** 7 (3–9) on interscutal membrane. All ventral setae smooth. One pair of metapodal plates **21** 18 (15–22) long, **3** 2 (1–3) wide.

Chelicera. Movable digit **23** 20 (18–23) long, with one tooth; fixed digit **22** 21 (19–22) long, anterior half with three teeth, with *pilus dentilis*.

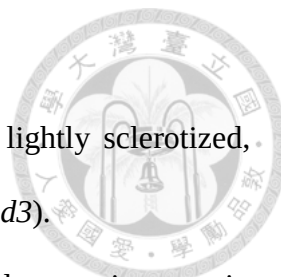
Spermatheca. Calyx horn-shaped, **21** 20 (14–22) long, **9** 7 (5–9) wide, atrium c-shaped with one pair of petal structure.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/1-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *St IV* (pd1) **41** 36 (31–41).

Male (n=5)

A lightly sclerotized mite. Idiosomal setal pattern: 10A: 9B/JV-3, 4: ZV-1, 3.

Dorsum. Dorsal shield with reticulation except central part; **192** (186–196) long (*j1-J5* level) and **140** (133–146) wide at level of *j6*, **118** (115–121) wide at level of *S4*, six pairs of solenostomes on dorsal shield, (*gd1*, *gd2*, *gd4*, *gd6*, *gd8*, *gd9*), twelve pairs of lyrifissures, (*id1*, *id1a*, *id2*, *id4*, *idm2*, *idm3*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 17 (16–18), *j3* 18 (16–21), *j4* 16 (14–17), *j5* 16 (14–18), *j6* 12 (10–14), *J2* 13 (12–14), *J5* 4 (2–55), *z2* 19 (16–21), *z4* 21 (16–24), *z5* 12 (12–13), *Z1* 12 (10–13), *Z4* 13 (9–15), *Z5* 33 (30–36), *s4* 26 (24–27), *S2* 15 (13–17), *S4* 14 (12–17), *S5* 13 (12–14), *r3* 24 (21–27), *R1* 11 (10–12). All setae smooth, except *Z5* slightly serrated.



Setae *r3* and *R1* inserted on dorsal shield.

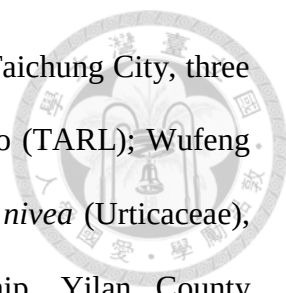
Peritreme. Peritreme extending to *r3* level; peritremal shield lightly sclerotized, with reticulation, anteriorly narrow, with one pair of solenostomes (*gd3*).

Venter. Sternogenital shield smooth, lateral slightly reticulated, posterior margin with little medium projection, longer than wide, 99 (92–109) long, 56 (50–62) wide at level of *st5*, with five pairs of setae *st1* 19 (18–19), *st2* 16 (15–17), *st3* 16 (15–17), *st4* 16 (13–19), *st5* 12 (11–14), three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Distances between *st1-st1* 36 (33–38), *st2-st2* 41 (40–44), *st3-st3* 39 (38–41), *st4-st4* 33 (32–34), *st5-st5* 20 (19–21), *st1-st5* 84 (80–87). Exopodal shield at coxae II–IV. Ventrianal shield subtriangular, with strongly reticulated, 77 (69–83) long, 105 (92–112) wide at anterior corner, 42 (39–45) at level of anus, fused with peritremal shield cingulum; with three pairs of pre-anal setae, arranged in triangular pattern,, *JV1* 11 (10–12), *JV2* 10 (10–11), *ZV2* 11 (9–12), solenostomes *gv3* crescentic; *Pa* 6 (4–8), *Pst* 8 (7–10) on shield. Setae *JV5* 15 (13–18) on interscutal membrane. All ventral setae smooth.

Chelicera. Movable digit 15 (15–16) long, with one tooth; fixed digit 17 (16–19) long, anterior half with three teeth, with *pilus dentilis*. Spermatodactyl L-shaped, shaft 16 (13–18) long, heel reduced, foot 5 (4–7) long, with expanded toe and lateral thorn-like projection.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/1-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1 Macrosetae: *St IV* (*pd1*) 29 (26–32).

Specimens examined. Zhiben, Taitung County, 18 females from *Macaranga tanarius* (Euphorbiaceae), 15.v.1991, C. C. Ho (TARL); Beikeng, Wufeng District, Taichung City, two females and one male from *Vernicia fordii* (Euphorbiaceae),



16.iii.2007, C. C. Ho (TARL); Zhanggong Lane, Wufeng District, Taichung City, three females from *Vernicia fordii* (Euphorbiaceae), 20.iii.2007, C. C. Ho (TARL); Wufeng District, Taichung City, one female and one male from *Boehmeria nivea* (Urticaceae), 10.xii.2008, C. C. Ho (TARL); Paomagudao, Jiaoxi Township, Yilan County (24°49.656' N, 121°45.928' E, 36m), two females from *Bidens pilosa* (Asteraceae), 16.vii.2010, M. J. Chiu & J. R. Liao (NTU); Xiziwan, Gushan District, Kaohsiung City (22°38.539' N, 120°15.275' E, 58m), one holotype female (no. 390–2) from *Macaranga tanarius* (Euphorbiaceae), 11.iii.2010, J. R. Liao & S. W. Kong (NTU). Paratype: Kaohsiung City, two females (no. 85–1159) from unknown plant, 4.xii.1985, C. C. Ho (TARI); Beiyi Road, Xindian District, New Taipei City (24°57.173' N, 121°32.514' E, 43m), one female one male (no. 310–8, 9) from *Macaranga tanarius* (Euphorbiaceae), 28.i.2010, J. R. Liao (NTU); nine female one male, (no. 390–1, 3, 4, 5, 6, 7, 8, 9, 10,) data same as holotype (NTU); Xiziwan, Gushan District, Kaohsiung City (22°38.539' N, 120°15.275' E, 58m), 13 females 3 males (no. 389–3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 17, 18, 19, 20,) from *Millettia pinnata* (Papilionaceae), 11.iii.2010, J. R. Liao & S. W. Kong (TARL); Nanren Mountain, Manzhou Township, Pingtung County (22°05.087' N, 120°49.810' E, 140m), two females two males (no. 609–1, 2, 3, 4) from *Callicarpa formosana* (Lamiaceae), 14.vi.2010, J. R. Liao (NMNS); Hutoushan, Ruisui Township, Hualien County (23°30.377' N, 121°20.793' E, 631m), one female two males (no. 737–2, 3, 4) from *Macaranga tanarius* (Euphorbiaceae), 2.viii.2010, J. R. Liao & S. F. Lin (NCHU); Sandimen Township, Pingtung County (22°43.866' N, 120°40.059' E, 487m), one male (no. 939–6) (T-MZLQ 3279) from unknown plant, 20.xi.2010, J. R. Liao (ESALQ-USP); Laonong River, Liugui District, Kaohsiung City (22°55.785' N, 120°39.148' E, 224m), one female (no. 940–3) (T-MZLQ 3281) from *Morus* sp. (Moraceae), 20.xi.2010, J. R. Liao (ESALQ-USP); Laonong River, Liugui District,

Kaohsiung City (22°55.785' N, 120°39.148' E, 224m), five females from *Macaranga tanarius* (Euphorbiaceae), 20.xi.2010, J. R. Liao (NTU); Fudekeng Recovery Park, Wenshan District, Taipei City (25°00.505' N, 121°35.388' E, 112m), four females from *Macaranga tanarius* (Euphorbiaceae), 1.xii.2010, J. R. Liao (NTU);

Jinfeng Township, Taitung County (22°35.779' N, 120°57.244' E, 132m), three females from *Macaranga tanarius* (Euphorbiaceae), 23.i.2011, J. R. Liao (NTU); Jinfeng Township, Taitung County (22°35.779' N, 120°57.244' E, 132m), one female from *Ageratum conyzoides* (Asteraceae), 23.i.2011, J. R. Liao (NTU); Paomagudao, Jiaoxi Township, Yilan County (24°50.276' N, 121°46.346' E, 147m), two females from *Mallotus japonicus* (Euphorbiaceae), 9.ii.2011, J. R. Liao (NTU); Ung ku, Nan'ao Township, Yilan County (24°30.302" N, 121°45.762" E, 109m), two females from *Trema orientalis* (Ulmaceae), 9.ii.2011, J. R. Liao (NTU); Lupishanuncai Road, Nan'ao Township, Yilan County (24°27.950' N, 121°45.317' E, 209m), five females from *Trema oreintalis* (Ulmaceae), 9.ii.2011, J. R. Liao (NTU); Agricultural Insect Building, Da'an District, Taipei City (25°00.747' N, 121°32.831' E, 13m), two females from *Macaranga tanarius* (Euphorbiaceae), 17.iii.2011, J. R. Liao (NTU); National Pingtung University of Science and Technology, Pingtung County, one female from *Macaranga tanarius* (Euphorbiaceae), 22.i.2015, P. C. Ma (NPUST); Wutai Township, Pintung County (24°44.795' N, 120°42.595' E, 370m), three females (no. 1479–1, 2, 3) from *Macaranga tanarius* (Euphorbiaceae), 25.iv.2015, J. R. Liao (NPUST); Nan'ao Township, Yilan County (24°25.208' N, 121°44.200' E, 205m), six female one male (no. 1820–1, 2, 3, 4, 5, 7, 8) from *Macaranga tanarius* (Euphorbiaceae), 2.viii.2016, J. R. Liao (NMNS); Baihe District, Tainan City (23°20.035' N, 120°28.930' E, 319m), five females one male (no.1826–2, 3, 4, 6, 7, 9, 10) from *Macaranga tanarius* (Euphorbiaceae), 10.viii.2016, J. R. Liao (NPUST).

Distribution. Asia: Taiwan (Liao *et al.*, 2017a).

Remarks. We observed similarities to seven *Euseius* species, namely *E. circellatus*, *E. dowdi* (Schicha, 1993), *E. kalimpongensis* (Gupta, 1969), *E. macaranga* Liao & Ho, 2017, *E. ploreraformis* (Schicha & Corpuz-Raros, 1992), *E. ruiliensis* (Wu & Li, 1985), *E. vaseformis* (Wu & Ou, 2009), regarding the following these characteristics: 1. a relatively small dorsal shield (approximately 250 μm); 2. anterior reticulation on the dorsal shield; 3. ventrianal shield vase-shaped, with *JV1* and *JV2* at a normal position; 4. peritremes extending to the *r3* to *z4* level, but never to *j1* level; and 5. leg IV with one macroseta on the basitarsus.

Many specimens in this study were collected from leaves of *Macaranga tanarius*, which are mildly hairy and pubescent. We postulate that the species may have strong relationship with *M. tanarius* and possibly has a subtype III lifestyle as a generalist predator living on pubescent leaves. However, the species with short and smooth dorsal setae had differences with other species in this subtype (e.g., *Paraphytoseius* spp. and *Phytoseius* spp.). These species are considered to have strong dorsal setae for passing through leaf hairs. Walter (1999) reported that *E. dowdi* shows preferences for leaves with tomentum. By comparing the specimen records, we observed that *E. circellatus* was located on *Conyza sumatrensis* (present study), *E. vaseformis* on *Boehmeria longispica* (Wu *et al.*, 2009), *E. dowdi* on *Cissus antacrtica* (Schicha & Odowd, 1993) and *Lantana camara* (Walter, 1999), and *E. ploreraformis* on *M. tanarius* (Schicha & Corpuz-Raros, 1992). We suggest that because these species typically have a smaller body, they can move between the leaf hairs without impediment. This situation needs more evidences for approval.

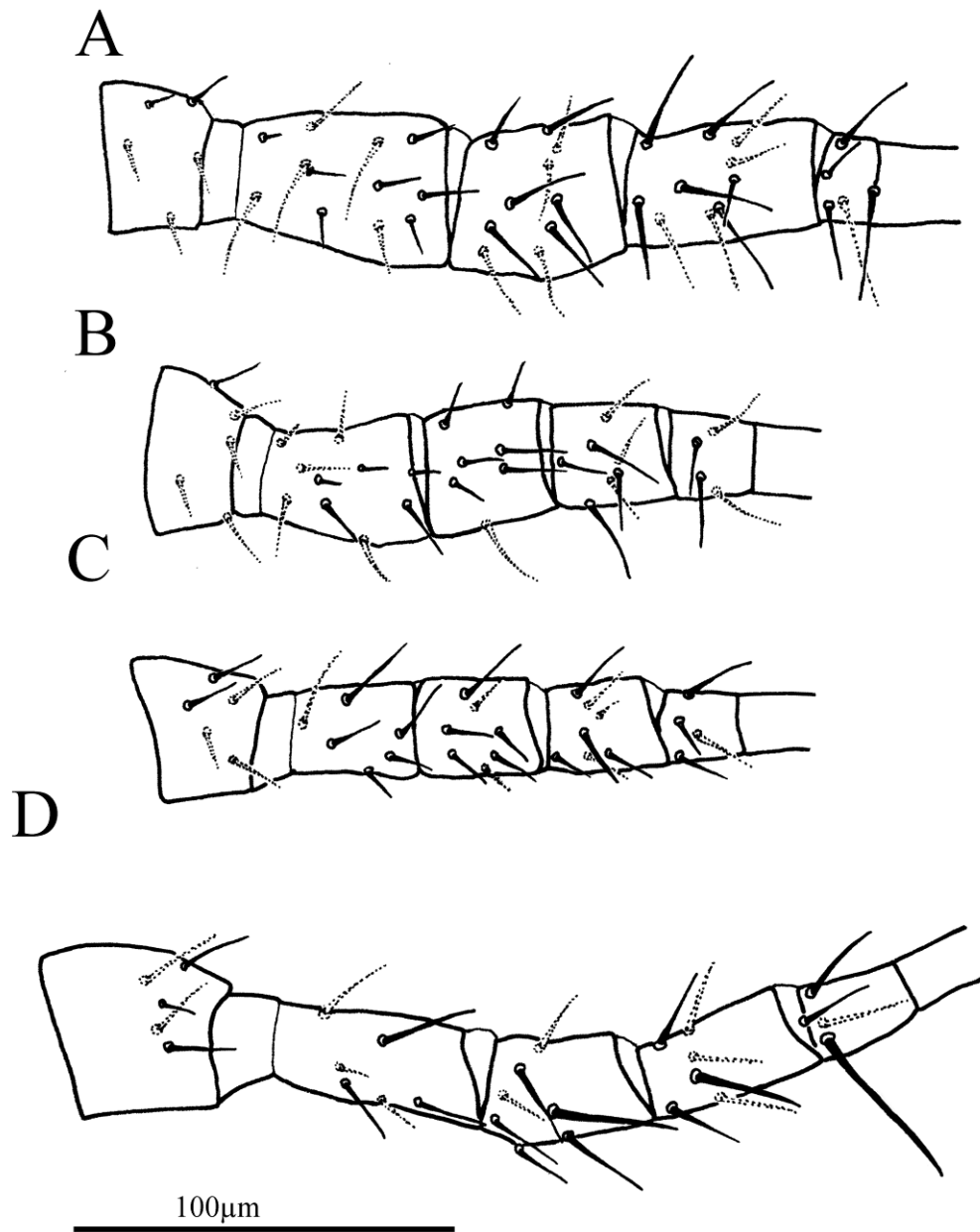


FIGURE 26. *Euseius macaranga* Liao & Ho, 2017a, Female, A. leg I dorsal view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV anterior view.

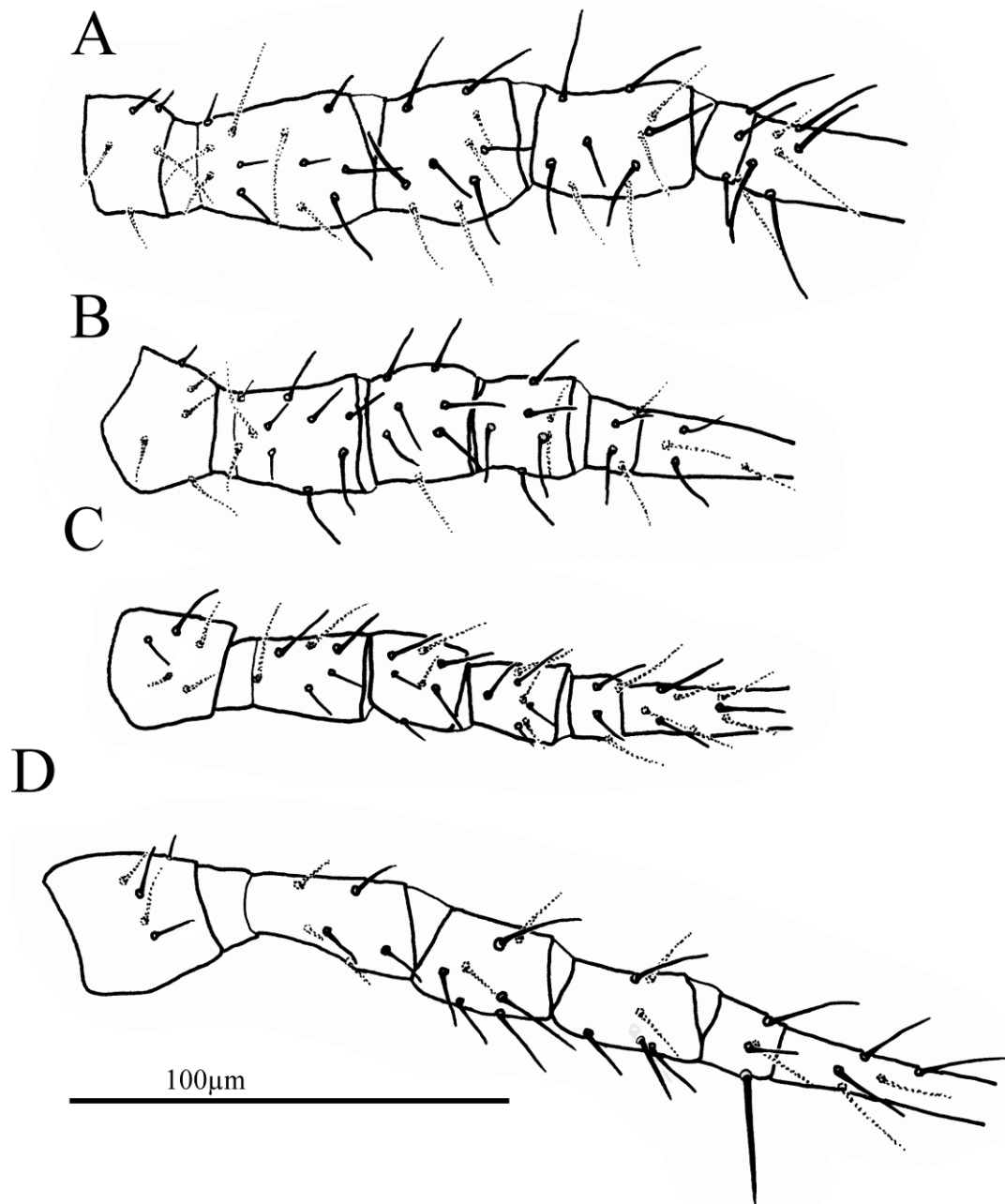


FIGURE 28. *Euseius macaranga* Liao & Ho, 2017a, Male, A. leg I anterodorsal view, B. leg II dorsal view, C. leg III posterodorsal view, D. leg IV anterior view.

Euseius nicholsi (Ehara & Lee, 1971)

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(Figures 29–30)

Amblyseius (Amblyseius) nicholsi Ehara & Lee 1971: 67.

Euseius nicholsi.—Wu *et al.*, 1997: 115.

Female (n=3)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield most surface strongly reticulated, **360** 353 (350–360) long (*j1-J5* level) and **256** 250 (243–256) wide at level of *j6*, **236** 237 (231–243) wide at level of *S4*; with seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), nine pairs of lyrifissures (*id1*, *id1a*, *id2*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); muscle-marks (sigilla) visible on podosoma; length of dorsal setae: setae *j1* **34** 32 (29–34), *j3* **28** 27 (26–28), *j4* **11** 9 (7–11), *j5* ? 7 (5–10), *j6* ? 7 (5–10) *J2* **14** 10 (7–14), *J5* **6** 5 (4–6), *z2* **17** 15 (14–17), *z4* **17** 18 (17–19), *z5* **11** 8 (7–11), *Z1* **13** 10 (8–13), *Z4* **15** 13 (10–15), *Z5* **60** 60 (60–60), *s4* **29** 27 (24–29), *S2* **18** 15 (12–18), *S4* **25** 21 (18–25), *S5* **26** 22 (19–26), *r3* **14** 17 (14–19), *R1* ? 12 (11–13). All setae smooth, except *Z5* slightly serrated.

Peritreme. Peritreme extending over *z2* level, peritremal shield smooth, lightly sclerotized, with one pair of solenostomes (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, projection of posterior margin invisible, wider than long, **54** 61 (54–65) long, **88** 89 (88–89) wide at level of *st3*, with three pairs of setae *st1* 27 27 (26–27), *st2* 28 24 (20–28), *st3* **24** 20 (15–24), and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae II–IV. Metasternal platelets tear-shaped, with one pair metasternal setae, *st4* **21** 18 (16–21), and one pair of lyrifissures (*pst3*). Genital shield smooth, **85** 87 (82–93) wide at level of genital setae, with one pair of genital setae *st5* **27** 22 (16–27). Distances between *st1-st1* **52** 56 (52–60), *st2-st2* **60** 63 (60–65),

st3-st3 **71** 73 (71–75), *st1-st3* **56** 59 (56–62), *st5-st5* **76** 76 (76–77). Ventrianal shield smooth, vase-shaped, **95** 90 (87–95) long, **45** 48 (45–51) wide at level of ZV2, **75** 72 (65–77) wide at level of anus; with three pairs of pre-anal setae, *JV1* migrate next to *JV2*, *JV1* **28** 24 (21–28), *JV2* **26** 23 (20–26), *ZV2* **18** 15 (13–18), solenostomes *gv3* crescentic; *Pa* **15** 13 (12–15), *Pst* **16** 14 (11–16) on shield. Setae *JV4* **10** 10 (10–10), *JV5* **29** 32 (29–35), *ZV1* **23** 19 (16–23), *ZV3* **13** 13 (13–13) on interscutal membrane. All ventral setae smooth. Two pairs of metapodal platelets **22** 22 (22–22) long, **5** 4 (4–5) wide, **8** 11 (8–13) long, **1** 2 (1–2) wide.

Chelicera. Movable digit **21** 24 (21–27) long, with one tooth; fixed digit **24** 24 (24–24) long, anterior half with four teeth, with *pilus dentilis*.

Spermatheca. Calyx funnel-shaped, **7** 7 (7–8) long, **4** 4 (3–4) wide, atrium with indistinguishable embolus, connect with a major duct, minor duct visible.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/1-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* II (pd2) **21** 20 (19–21) [25]; *Sge* III (ad2) **31** 28 (25–31), *Sti* III (ad) **25** 26 (25–27), *St* III (d) **24** 25 (24–27); *Sge* IV (ad2) **48** 50 (48–53), *Sti* IV (ad) **38** 38 (38–39) and *St* IV (d) **60** 68 (60–73).

Specimens examined. CHINA: Chai Wan, Hong Kong, one holotype female (NSMT-Ac-13078) from grass, 18.x.1970, S. Ehara (NSMT).

TAIWAN: Shoushan National Nature Park, Gushan Dist., Kaohsiung City (22°38.952'N, 120°16.128' E, 156m), one female (no. 388–1) from *Macaranga tanarius* (Euphorbiaceae), 11.iii.2010, J. R. Liao & S. W. Kong (NTU); Liugui Dist., Kaohsiung City (22°55.785'N, 120°39.148' E, 224m), one female (no. 942–6) from *Bauhinia variegata* (Fabaceae), 20.xi.2010, J. R. Liao (NTU).

Distribution. Asia: China (Fujian (Wu 1982), Guangdong (Chen *et al.* 1980; Wu 1982; Liang & Ke 1983), Guangxi (Wu 1982; Liang & Ke 1983), Hainan (Wu *et al.* 1997), Hong Kong (Ehara & Lee 1971), Hunan (Wu 1982), Jiangsu (Wu 1982; Liang & Ke 1983), Jiangxi (Wu 1982), Sichuan (Wu 1982; Liang & Ke 1983)), Taiwan (present study), Thailand (Ehara & Bhandhufalck 1977; Oliveira *et al.* 2012).

Remarks. *Euseius nicholsi* (Ehara & Lee) is widely distributed in Southern China, and also dominated biological control agent for spider mites (e.g. *Panonychus citri* McGregor, *Eotetranychus kankitus* Ehara) in citrus orchard (Wu *et al.* 2009). However, only two specimens have been found in Southern Taiwan, the biological control potential of this species need further investigations.

Liao *et al.* (2017a) reported Taiwanese *E. aizawai* specimens had been found two morphological types on dorsal shield (e.g. anterolateral dorsal shield reticulated and entire dorsal shield reticulated). After comparing holotypes of *E. aizawai* (from HUM), *E. nicholsi* (from NSMT), Chinese specimens of *E. nicholsi* (from GIABR), and discussing with Dr. Toyoshima (Pers. Comm., January 28, 2018), these Taiwanese specimens should belong to three different species, including *E. aizawai*, *E. nicholsi*, and *E. sojaensis*. *E. aizawai* differ in the anterolateral reticulated on dorsal shield, but remaining two species strongly reticulated on dorsal shield. *E. nicholsi* and *E. sojaensis* could be separated by lengths of macrosetae. Additionally, Ehara & Lee (1971) reported *E. nicholsi* is characterized in hook-shaped metapodal platelets. However, we found two slender metapodal platelets are overlapping on left side, but separating on right side of the holotype of *E. nicholsi* (NSMT AC13078).

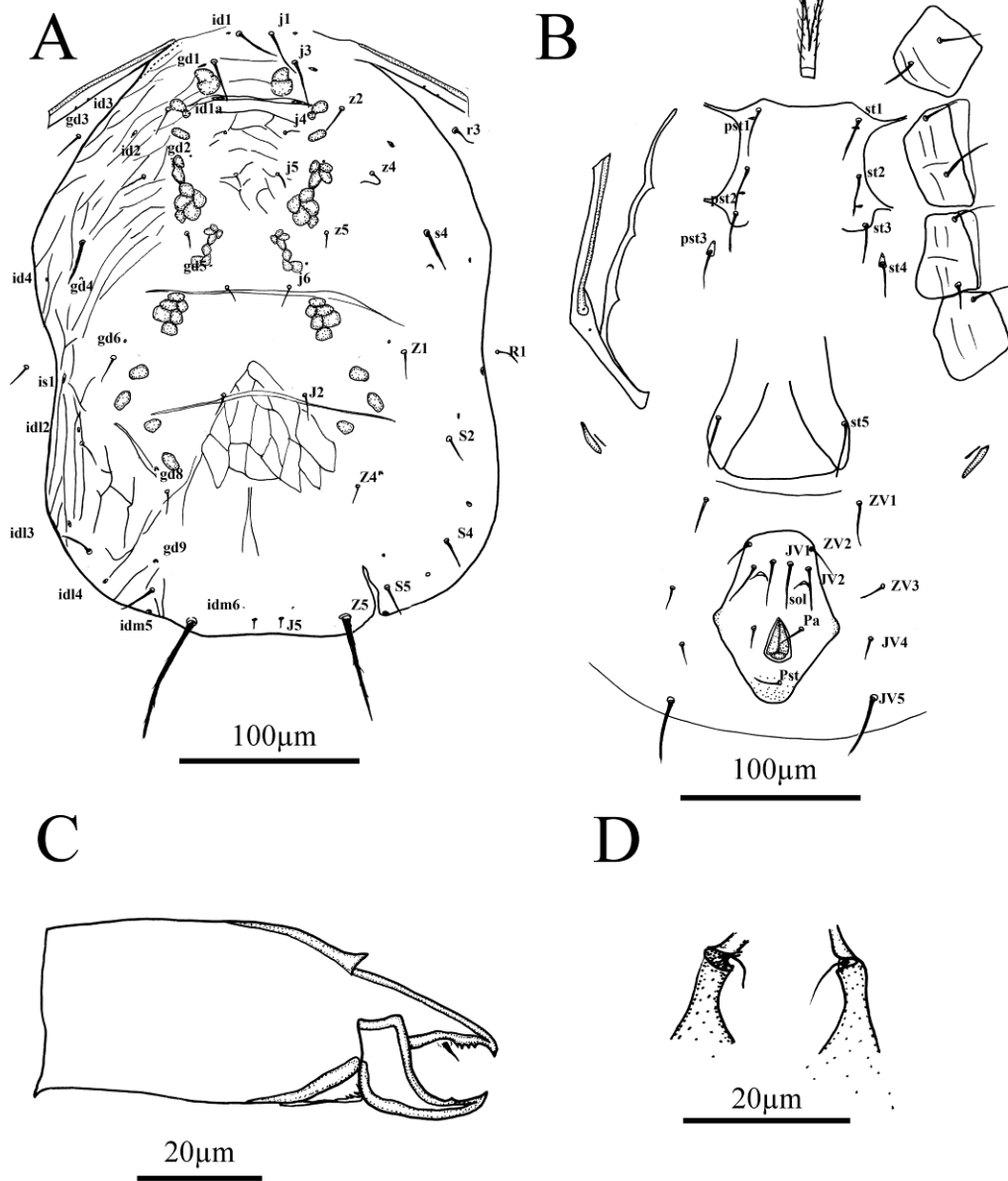


FIGURE 29. *Euseius nicholsi* (Ehara & Lee, 1971), Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

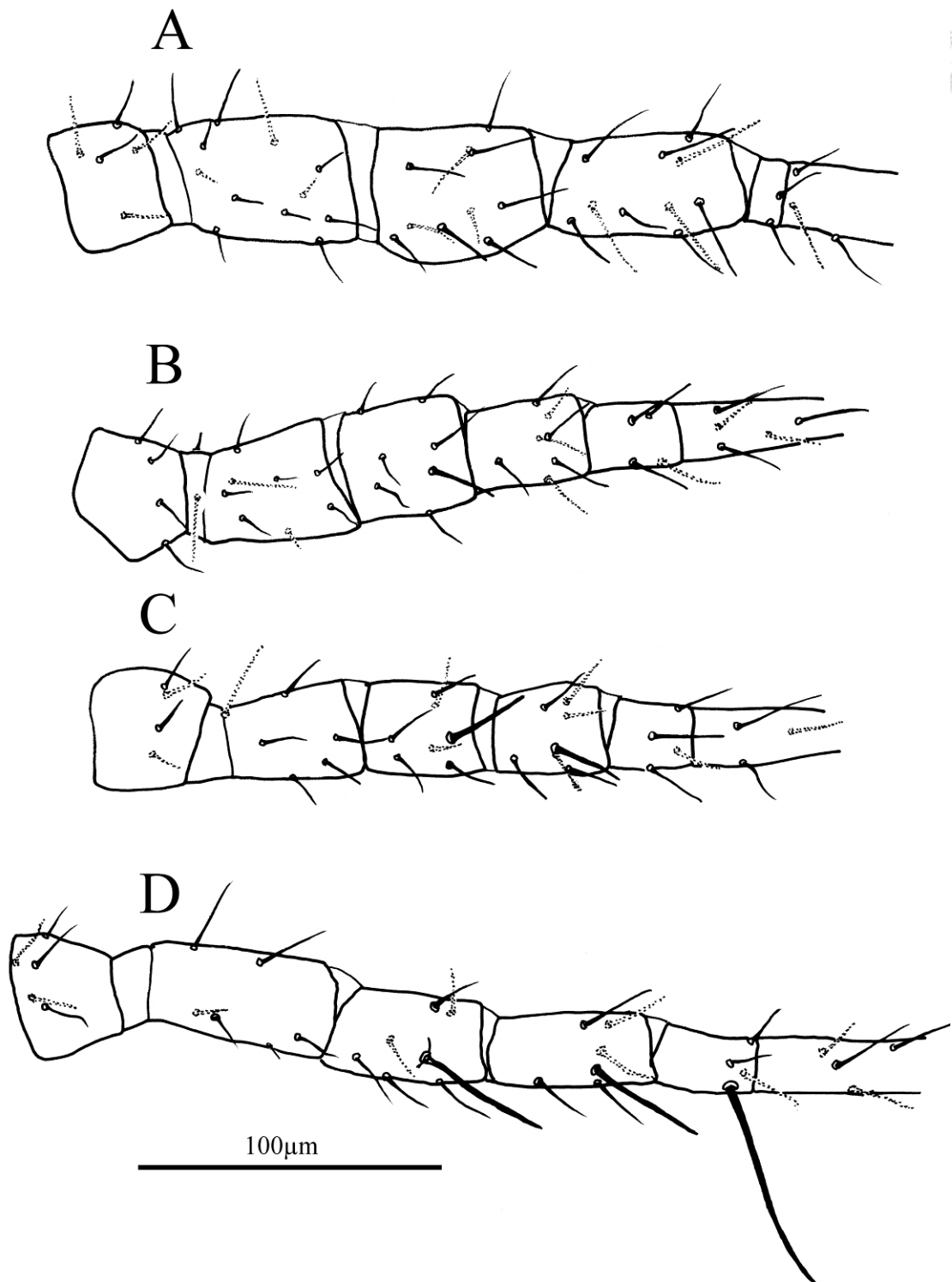


FIGURE 30. *Euseius nicholsi* (Ehara & Lee, 1971), Female, legs A. leg I anterior view, B. leg II dorsal view, C. leg III anterodorsal view, D. leg IV anterior view.

Euseius oolong Liao & Ho, 2018

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(Figures 31–32)

Euseius oolong Liao & Ho, in Liao *et al.*, 2018: 2193.

Female (n=6)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield laterally reticulated; **328** 341 (324–361) long (*j1*–*J5* level) and **237** 246 (236–266) wide at level of *j6*, **221** 237 (221–260) wide at level of *S4*; five pairs of solenostomes on dorsal shield, (*gd2*, *gd4*, *gd6*, *gd8*, *gd9*), ten pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); muscle-marks (sigilla) visible on podosoma; length of setae: *j1* **32** 28 (24–32), *j3* **20** 22 (20–25), *j4* **7** 8 (7–10), *j5* **7** 8 (7–11), *j6* **9** 9 (6–11), *J2* **8** 10 (8–12), *J5* **6** 5 (3–6), *z2* **12** 15 (12–18), *z4* **11** 13 (11–19), *z5* **6** 8 (6–10), *Z1* **8** 10 (7–15), *Z4* **8** 11 (8–16), *Z5* **53** 58 (53–63), *s4* **18** 25 (18–36), *S2* **13** 16 (13–18), *S4* **17** 22 (17–27), *S5* **22** 25 (22–29), *r3* **9** 12 (9–15), *R1* **9** 10 (9–13). All setae smooth, except *Z5* slightly serrated.

Peritreme. Peritreme extending beyond *z2* level, peritremal shield smooth, lightly sclerotized, with one pair of solenostomes (*gd3*).

Venter. Sternal shield smooth, posterior margin with medium projection, much wider than long, **61** 61 (51–70) long, **94** 93 (86–96) wide, with three pairs of setae *st1* **26** 27 (26–31), *st2* **23** 25 (23–28), *st3* **26** 24 (22–26), and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae I–IV. Metasternal platelets tear-shaped, with one pair metasternal setae, *st4* **21** 21 (19–23), with one pair of lyrifissures (*pst3*). Genital shield smooth, with one pair of genital setae *st5* **20** 23 (15–28), **75** 87 (75–92) wide at level of genital setae. Distances between *st1*–*st1* **49** 54 (45–61), *st2*–*st2* **63** 62 (48–69), *st3*–*st3* **75** 74 (65–79), *st1*–*st3* **56** 58 (52–63), *st5*–*st5* **68** 76 (68–82). Ventrianal shield vase-shaped

96 102 (96–108) long, **49** 49 (45–56) wide at level of ZV2, **82** 81 (77–85) wide at level of anus; with three pairs of pre-anal setae, *JV1* migrate next to *JV2*, *JV1* **26** 24 (19–26), *JV2* **18** 19 (15–24), *ZV2* **15** 17 (13–20), solenostomes *gv3* crescentic; *Pa* **17** 13 (9–17), *Pst* **14** 12 (9–15) on shield. Setae *JV4* **11** 10 (8–11), *JV5* **24** 29 (24–34), *ZV1* **20** 18 (16–20), *ZV3* **8** 8 (8–8) on interscutal membrane. All ventral setae smooth. Two pairs of metapodal plates **23** 22 (20–26) long, **4** 6 (4–9) wide, **10** 10 (9–11) long, **1** 2 (1–3) wide.

Chelicera. Movable digit **23** 24 (22–26) long, with one tooth; fixed digit **23** 24 (23–25) long, anterior half with five teeth, with *pilus dentilis*.

Spermatheca. Calyx cup-shaped with distal half only lightly sclerotized, **7** 6 (5–8) long, **4** 3 (3–4) wide, atrium incorporated within the calyx, without neck, with a thin major duct, minor duct visible.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-0, 1-1/1-1. Macrosetae: *Sge* II (pd2) **23** 23 (20–24), *Sge* III (ad2) **26** 30 (26–35), *Sti* III (ad) **23** 23 (19–26), *St* III (d) **26** 26 (24–30), *Sge* IV (ad2) **44** 44 (37–50), *Sti* IV (ad) **32** 34 (27–37) and *St* IV (d) **50** 58 (50–61).

Specimens examined. CHINA: Sun Yat-sen University, Guangzhou City, Guangdong Province, one female (no. 2028–2) from *Macaranga tanarius* (Euphorbiaceae), 23.ii.2017, J. R. Liao (NMNS); Guangdong Institute of Applied Biological Resources, Guangzhou City, Guangdong Province, two females (no. 2029–1, 2) from *Bauhinia purpurea* (Fabaceae), 23.ii.2017, J. R. Liao (GIABR).

TAIWAN: Tea Research and Extension Station, Yangmei Dist., Taoyuan City (24°54.354' N, 121°11.143' E, 230m), one holotype two paratype females (no. 1688–3) from *Camellia sinensis* (L.) O.Kuntze var. *oolong* (Theaceae), 11.v.2016, J. R. Liao

(NTU).

Distribution. Asia: China (Guangdong (present study)), Taiwan (present study).

Remarks. This new species is similar to *E. aizawai* (Ehara & Bhandhufalck), *E. australis* (Wu & Li), *E. daluensis* (Liao & Ho), *E. finlandicus* (Oudemans), *E. jiangxiensis* Wu & Ou, *E. nicholsi* (Ehara & Lee), *E. sojaensis* (Ehara), *E. utilis* (Liang & Ke), *E. wyebo* (Schicha & Corpuz-Raros). This species is also different based on its short and cup-shaped calyx of spermatheca which is funnel-shaped and/or longer in above mentioned closely related species.

This species is recorded in Taiwan and Southern China. However, few specimens have been found, the biological control potential of this species need further study in future.

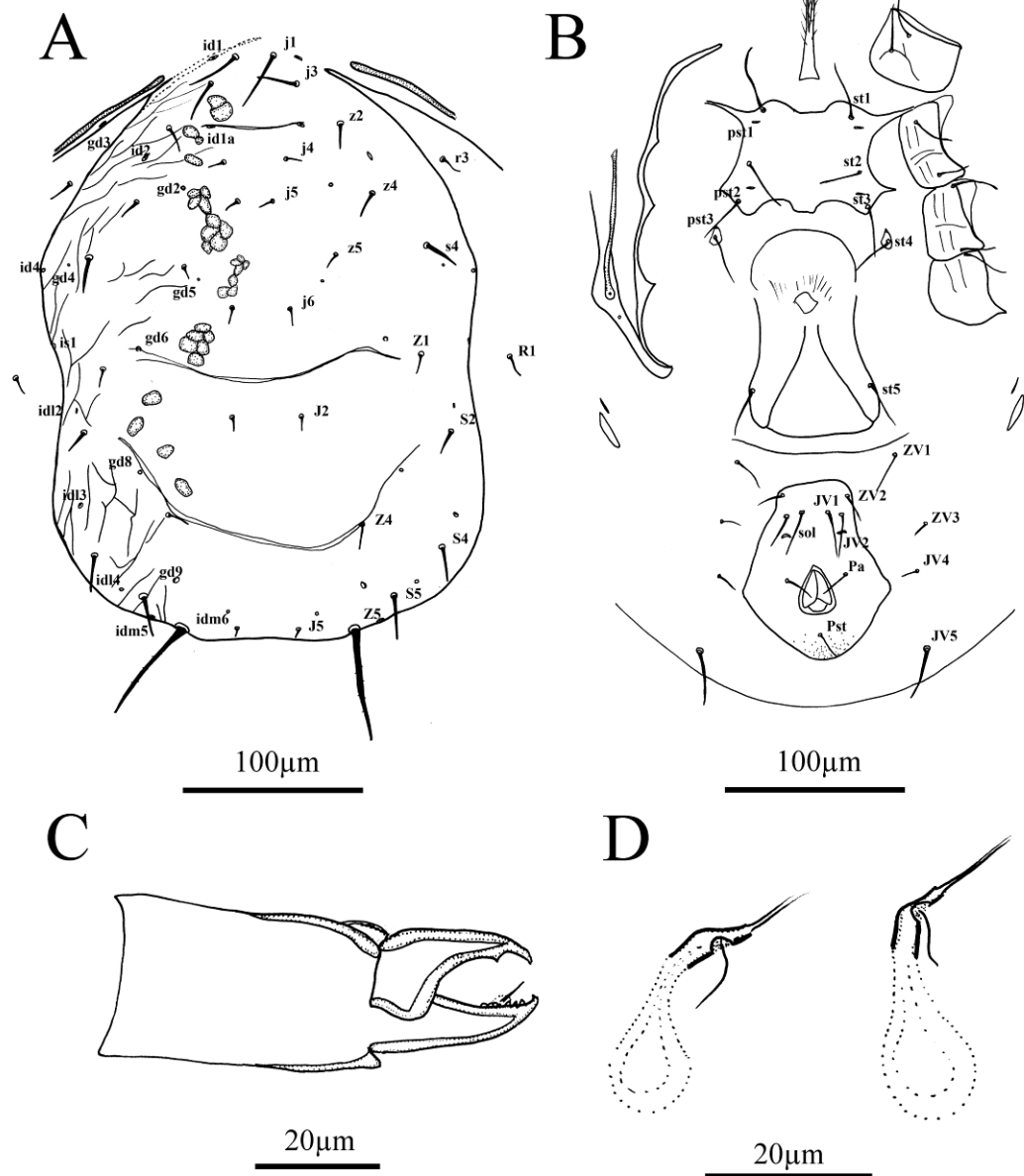


FIGURE 31. *Euseius oolong* Liao & Ho, 2018, Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

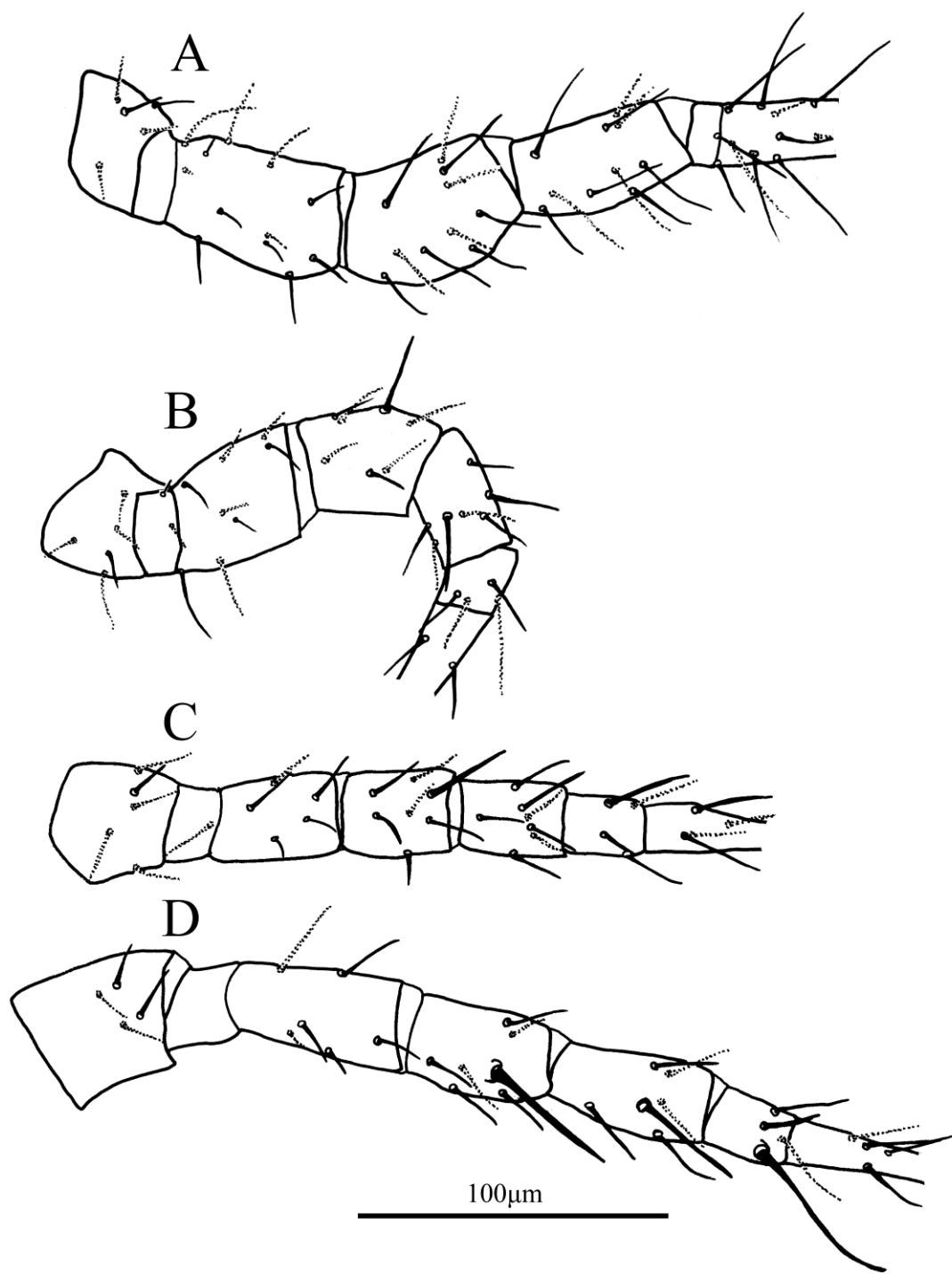


FIGURE 32. *Euseius oolong* Liao & Ho, 2018, Female, legs A. leg I anterior view, B. leg II posterior view, C. leg III dorsal view, D. leg IV anterior view.

***Euseius ovalis* (Evans, 1953)**

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(Figures 33–36)

Typhlodromus ovalis.—Evans, 1953: 458.

Typhlodromus (*Amblyseius*) *ovalis*.—Chant, 1959b: 68.

Amblyseius (*Typhlodromalus*) *ovalis*.—Muma, 1961: 288.

Amblyseius ovalis.—Collyer, 1964b: 634.

Amblyseius (*Amblyseius*) *ovalis*.—Ehara, 1966a: 24.

Amblyseius (*Euseius*) *ovalis*.—Gupta, 1985: 348.

Female (n=10)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield laterally reticulated; 376 (358–401) long (*j1-J5* level) and 265 (242–283) wide at level of *j6*, 251 (231–281) wide at level of *S4*; six pairs of solenostomes on dorsal shield, (*gd1*, *gd2*, *gd4*, *gd6*, *gd8*, *gd9*), ten pairs of lyrifissures, (*id1*, *id1a*, *id2*, *id4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: setae *j1* 34 (31–37), *j3* 10 (8–12), *j4* 4 (2–6), *j5* 5 (4–7), *j6* 6 (3–8), *J2* 8 (6–9), *J5* 4 (3–6), *z2* 7 (4–11), *z4* 7 (6–8), *z5* 6 (4–8), *Z1* 7 (5–10), *Z4* 8 (6–8), *Z5* 53 (49–58), *s4* 13 (10–15), *S2* 3 (9–16), *S4* 14 (10–17), *S5* 11 (8–15), *r3* 12 (11–14), *R1* 8 (6–11). All setae smooth, except *Z5* slightly serrated.

Peritreme. Peritreme extending to *z2* level, peritremal shield smooth, lightly sclerotized, with one pair of solenostomes (*gd3*).

Venter. Sternal shield smooth, posterior margin with medium projection, much wider than long, **75** (63–85) long, **95** (87–102) wide, with three pairs of setae *st1* 27 (24–31), *st2* 24 (20–29), *st3* 20 (14–29), and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae II–IV. Metasternal platelets tear-shaped, with one pair

metasternal setae, *st4* 17 (11–20), with one pair of lyrifissures (*pst3*). Genital shield smooth, with one pair of genital setae *st5* 21 (17–26), 96 (84–119) wide at level of genital setae. Distances between *st1-st1* 56 (50–60), *st2-st2* 62 (59–6), *st3-st3* 74 (67–79), *st1-st3* 59 (56–62), *st5-st5* 78 (72–87). Ventrianal shield vase-shaped 114 (106–121) long, 53 (48–58) wide at level of ZV2, 83 (73–90) wide at level of anus; with three pairs of pre-anal setae, *JV1* migrate next to *JV2*, *JV1* 24 (20–27), *JV2* 16 (14–18), *ZV2* 16 (13–21), solenostomes *gv3* crescentic; *Pa* 11 (9–14), *Pst* 14 (10–18) on shield. Setae *JV4* 7 (4–10), *JV5* 27 (21–30), *ZV1* 16 (10–21), *ZV3* 7 (5–9) on interscutal membrane. All ventral setae smooth. Two pairs of metapodal plates 24 (20–27) long, 6 (4–8) wide, 10 (6–15) long, 2 (1–3) wide.

Chelicera. Movable digit 23 (20–25) long, with one tooth; fixed digit 26 (22–31) long, anterior half with three teeth, with *pilus dentilis*.

Spermatheca. Calyx tubular, elongated, 18 (15–21) long, 2 (2–4) wide, with atrium at the basis, minor duct and major duct visible

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/1-0, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* II (ad1) 20 (17–23), *Sti* II (ad1) 19 (16–21), *St* II (ad) 25 (24–26), *Sge* III (ad1) 27 (24–28), *Sti* III (ad1) 23 (20–30), *St* III (ad1) 26 (23–28), *Sge* IV (ad1) 36 (31–41), *Sti* IV (ad1) 33 (24–41), *St* IV (d) 57 (50–64).

Male (n=5)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3, 4:ZV-1, 3.

Dorsum. Dorsal shield most surface strongly reticulated, 268 (249–284) long (*j1-J5* level) and 207 (189–229) wide at level of *j6*, 144 (123–157) wide at level of *S4*; six pairs of solenostomes on dorsal shield, (*gd1*, *gd2*, *gd4*, *gd6*, *gd8*, *gd9*), ten pairs of

lyrifissures, (*id1*, *id1a*, *id2*, *id4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 28 (20–31), *j3* 11 (8–15), *j4* 5 (4–5), *j5* 4 (3–5), *j6* 7 (5–8), *J2* 7 (5–8), *J5* 4 (3–5), *z2* 6 (3–9), *z4* 9 (6–9), *z5* 5 (4–6), *Z1* 7 (4–9), *Z4* 8 (7–9), *Z5* 47 (44–50), *s4* 13 (11–16), *S2* 13 (11–15), *S4* 14 (13–15), *S5* 12 (10–16), *r3* 12 (10–14), *R1* 9 (8–10); All setae smooth, except *Z5* slightly serrated. Setae *r3* and *R1* inserted on dorsal shield.

Peritreme. Peritreme extending to *z4* level, peritremal shield smooth, lightly sclerotized, with one pair of solenostomes (*gd3*).

Venter. Sternogenital shield smooth, slightly lateral reticulated, posterior margin almost straight, longer than wide, 126 (107–137) long, 76 (66–82) wide at level of *st5*, with five pairs of setae *st1* 22 (19–27), *st2* 22 (18–24), *st3* 21 (17–23), *st4* 17 (14–21), *st5* 18 (15–20), and three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Exopodal shield at coxae II–IV. Distances between *st1-st1* 45 (37–50), *st2-st2* 54 (46–59), *st3-st3* 54 (51–58), *st4-st4* 50 (46–54), *st5-st5* 36 (30–42), *st1-st5* 107 (95–115). Ventrianal shield subtriangular, slightly reticulated, 110 (98–121) long and 161 (132–179) wide at anterior corner, 63 (57–69) wide at level of anus, fused with peritremal shield cingulum, with three pairs of pre-anal setae, arranged in triangular pattern, solenostome *gv3* crscentic, *JV1* 21 (20–22), *JV2* 19 (17–22), *ZV2* 13 (11–16); *Pa* 9 (7–10), *Pst* 12 (9–13) on shield. Setae *JV5* 23 (20–25) on interscutal membrane. All ventral setae smooth.

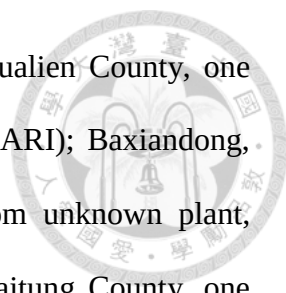
Chelicera. Movable digit 18 (14–22) long, with one tooth; fixed digit 20 (15–22) long, anterior half with two teeth, with *pilus dentilis*. Spermatodactyl L-shaped, shaft 23 (19–27) long, heel reduce, foot 7 (6–9) long, with expanded toe and lateral thorn-like projection.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/1-0,

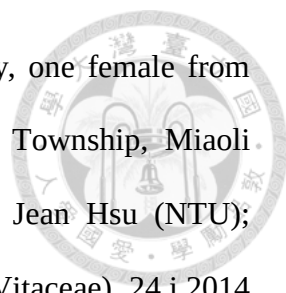
1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* II 17 (15–19), *Sge* III 24 (21–25), *Sti* III 21 (20–23), *St* III 21 (21–21), *Sge* IV 34 (29–36), *Sti* IV 29 (24–34), *St* IV 50 (41–57).

Specimens examined. CHINA: Jianfengling National Forest Park, Ledong Li Autonomous County, Hainan Province, one female from unknown plant, unknown time, W. N. Wu (GIABR); Nyingchi City (1950m), Tibet Autonomous Region, one female from shrub, 8.viii.1986, W. N. Wu (GIABR); Fuzhou City, Fujian Province, one female one male from *Canarium album* (Burseraceae), 13.ii.1998, W. N. Wu (GIABR).

TAIWAN: Taipei City, one female (0025) from *Vitis vinifera* (Vitaceae), 9.xi.1966, P. K. C. Lo (TARI); Taipei City, one female (0131) from *Brassica rapa pekinensis* (Brassicaceae), 24.i.1967, P. K. C. Lo (TARI); Taichung City, one male (0910) from *Pyrus* sp. (Rosaceae), 5.x.1967, P. K. C. Lo (TARI); Taipei City, three males (0918) from *Salix chaenomeloides* (Salicaceae), 1.xi.1967, P. K. C. Lo (TARI); Taipei City, one female (1021) from *Pyrus* sp. (Rosaceae), 28.i.1968, P. K. C. Lo (TARI); Taipei City, one male (1067) from *Bryophyllum pinnatum* (Crassulaceae), 31.x.1968, P. K. C. Lo (TARI); Taipei City, five females three males (1080) from *Lycium chinense* (Solanaceae), 9.i.1969, P. K. C. Lo (TARI); TARI, Wufeng District, Taichung City, three females from *Morus alba* (Moraceae), 23.x.1980, P. K. C. Lo (TARI); Wufeng District, Taichung City, one female from *Cinnamomum camphora* (Lauraceae), 25.x.1980, P. K. C. Lo (TARI); Wufeng District, Taichung City, three females from *Passiflora edulis* (Passifloraceae), 28.x.1980, P. K. C. Lo (TARI); TARI, Wufeng District, Taichung City, one female from *Bauhinia variegata* (Fabaceae), 28.x.1980, P. K. C. Lo (TARI); Ruisui Township, Hualien County, one female from *Morus alba* (Moraceae), 22.ii.1988, Y. J. Wang (TARI); TARI, Wufeng District, Taichung City, three females from *Lagerstroemia speciose* (Lythraceae), 17.x.1988, S. M. Yu (TARI); TARI (31), Wufeng District, Taichung City, two females from unknown plant,



18.x.1988, S. M. Yu (TARI); Wuhe Village, Ruisui Township, Hualien County, one female from *Citrus sinensis* (Rutaceae), 20.ii.1989, Y. J. Wang (TARI); Baxiandong, Changbin Township, Taitung County, six females two males from unknown plant, 4.iv.1989, C. C. Ho (TARI); Baxiandong, Changbin Township, Taitung County, one female from *Lygodium japonicum* (Lygodiaceae), 4.iv.1989, C. C. Ho (TARI); Zhongpu Township, Chiayi County, one female from *Phaseolus lunatus* (Leguminosae), 4.xi.1992, C. C. Ho (TARI); Jiaoxi Township, Yilan County, one female from vine, 27.i.2011, Y. T. Shih (NTU); Dongshanhe, Dongshan Township, Yilan County, two females from *Turpinia formosana* (Staphyleaceae), 27.i.2011, Y. T. Shih (NTU); Guangxing, Xindian District, New Taipei City (24°54.804' N, 121°32.747' E, 79m), one male from *Ageratum houstonianum* (Asteraceae), 27.ii.2011, J. R. Liao (NTU); Guangxing, Xindian District, New Taipei City (24°54.804' N, 121°32.747' E, 79m), one male from *Persicaria chinensis* (Polygonaceae), 27.ii.2011, J. R. Liao (NTU); Guangxing, Xindian District, New Taipei City (24°54.804' N, 121°32.747' E, 79m), one female from *Debregeasia orientalis* (Urticaceae), 27.ii.2011, J. R. Liao (NTU); Agricultural Insect Building, Da'an District, Taipei City (25°00.747' N, 121°32.831' E, 13m), four females one male from *Bischofia javanica* (Euphorbiaceae), 17.iii.2011, J. R. Liao (NMNS); Agricultural Insect Building, Da'an District, Taipei City (25°00.747' N, 121°32.831' E, 13m), two females one male (MZLQ 7604 to MZLQ 7606) from *Koelreuteria henryi* (Sapindaceae), 17.iii.2011, J. R. Liao (ESALQ-USP); Agricultural Insect Building, Da'an District, Taipei City (25°00.747' N, 121°32.831' E, 13m), two females from *Macaranga tanarius* (Euphorbiaceae), 17.iii.2011, J. R. Liao (NTU); Agricultural Insect Building, Da'an District, Taipei City (25°00.747' N, 121°32.831' E, 13m), one female from *Morus sp.* (Moraceae), 17.iii.2011, J. R. Liao (NTU); Huwei Township, Yunlin County, three females two males from *Morus sp.* (Moraceae),



6.iv.2011, B. C. Liao (NCHU); Zhuolan Township, Miaoli County, one female from *Vitis vinifera* (Vitaceae), 18.xii.2013, Jean Hsu (NTU); Zhuolan Township, Miaoli County, two females from *Vitis vinifera* (Vitaceae), 18.xii.2013, Jean Hsu (NTU); Zhuolan Township, Miaoli County, one female from *Vitis vinifera* (Vitaceae), 24.i.2014, Jean Hsu (NTU); Zhuolan Township, Miaoli County, two females one male from *Vitis vinifera* (Vitaceae), 24.i.2014, Jean Hsu (TARL); Zhuolan Township, Miaoli County, one female from *Vitis vinifera* (Vitaceae), 24.i.2014, Jean Hsu (NTU); Zhuolan Township, Miaoli County, two females one male from *Vitis vinifera* (Vitaceae), 24.i.2014, Jean Hsu (NTU); Zhuolan Township, Miaoli County, one female from *Vitis vinifera* (Vitaceae), 24.i.2014, Jean Hsu (NTU); Zhuolan Township, Miaoli County, two females from *Vitis vinifera* (Vitaceae), 24.i.2014, Jean Hsu (NTU); Zhuolan Township, Miaoli County, one female from *Vitis vinifera* (Vitaceae), 24.i.2014, Jean Hsu (NTU); Heshe, Xinyi Township, Nantou County (23°34.932' N, 120°52.922' E, 866m), one female one male (MZLQ 7607 to MZLQ 7608) from *Cordia dichotoma* (Boraginaceae), 24.iv.2014, J. R. Liao (ESALQ-USP); Danayigu Park, Chiayi County (23°23.411' N, 120°39.917' E, 736m), one female from *Broussonetia papyrifera* (Moraceae), 25.v.2014, J. R. Liao (NTU); Duona Forest Road, Maolin District, Kaohsiung City (22°54.585' N, 120°42.891' E, 450m), three females one male from *Morus* sp. (Moraceae), 25.iv.2014, J. R. Liao (NPUST).

Distribution. Africa: Mauritius (Moutia 1958). Asia: China (Fujian (Wu 1981), Guangdong (Wu 1982), Guangxi (Wu 1982), Hainan (Wu & Ou 2002), Jiangsu (Liang & Ke 1983), Jiangxi (Zhu & Chen 1983), Sichuan (Liang & Ke 1983), Wuling Mountain Region (Wu & Lan 1992), Yunnan (Liang & Ke 1983)), Hong Kong (Swirski & Shechter 1961), India (Gupta 1978), Indonesia (Ehara 2002b), Japan, Malaysia (Evans, 1953), Philippines (Corpuz & Rimando 1966), Sri Lanka (Moraes *et al.* 2004b),

Taiwan (Ehara 1970). North America: Mexico (Chant 1959b). Oceania: Australia (Schicha 1987), Cook Islands (Collyer 1980), Fiji (Collyer 1980), Hawaii (Chant 1959b), New Zealand (Collyer 1964b), Papua New Guinea (Collyer 1980).

Remarks. Schicha (1977) reported that *E. victoriensis* (Womersley, 1954), *E. ovalis*, and *E. elinae* (Schicha, 1977) are similar. We observed that the females of *E. victoriensis* can be identified by dorsal setae $j1 < j3$, $j1$, $j3$, $z2$, $z4$, $Z5$, $s4$ longer; the females of *E. ovalis* can be identified by $j1$, $Z5$ longer; *E. elinae* can be identified by $j1$, $j3$, $Z5$ longer. Additionally, the females of this species resemble *E. mundillovalis* (Schicha, 1987), *E. ovaloides* (Blommers, 1974), *E. similiovalis* (Liang & Ke, 1983), but differ from *E. mundillovalis* in a longer $j1$, and shorter dorsal shield length (approximately 300 μm and 400 μm in *E. mundillovalis*); the females differ from *E. ovaloides* and *E. similiovalis* in anterolateral reticulation on the dorsal shield.

E. ovalis was observed to occur widely during survey in Taiwan, not only in agricultural areas but also on various plant habitats. Typically, *E. ovalis* lives on smooth leaf but not hairy ones. The present study assumed *E. ovalis* dominates at lower altitudes and developed areas, whereas *E. aizawai* and *E. sojaensis* dominates at higher altitudes and less-developed areas. Nguyen & Shih (2010; 2011; 2012) compared the development and predation between *N. womersleyi* and *E. ovalis*. They reported the former had already been considered as crucial biocontrol agent, but the latter also showed greater biocontrol potential for *O. mangiferus*. This species is prevalent in various habitat plants during survey, but is typically occurred when density of spider mite low, and rarely located on the leaves with *Tetranychus* colony. Occasionally, this species is located close to *Oligonychus* and *Panonychus* colony. This species maintains its population by feeding on various food sources. Therefore, this species can play a critical role in the field, but not as an effective biocontrol agent.

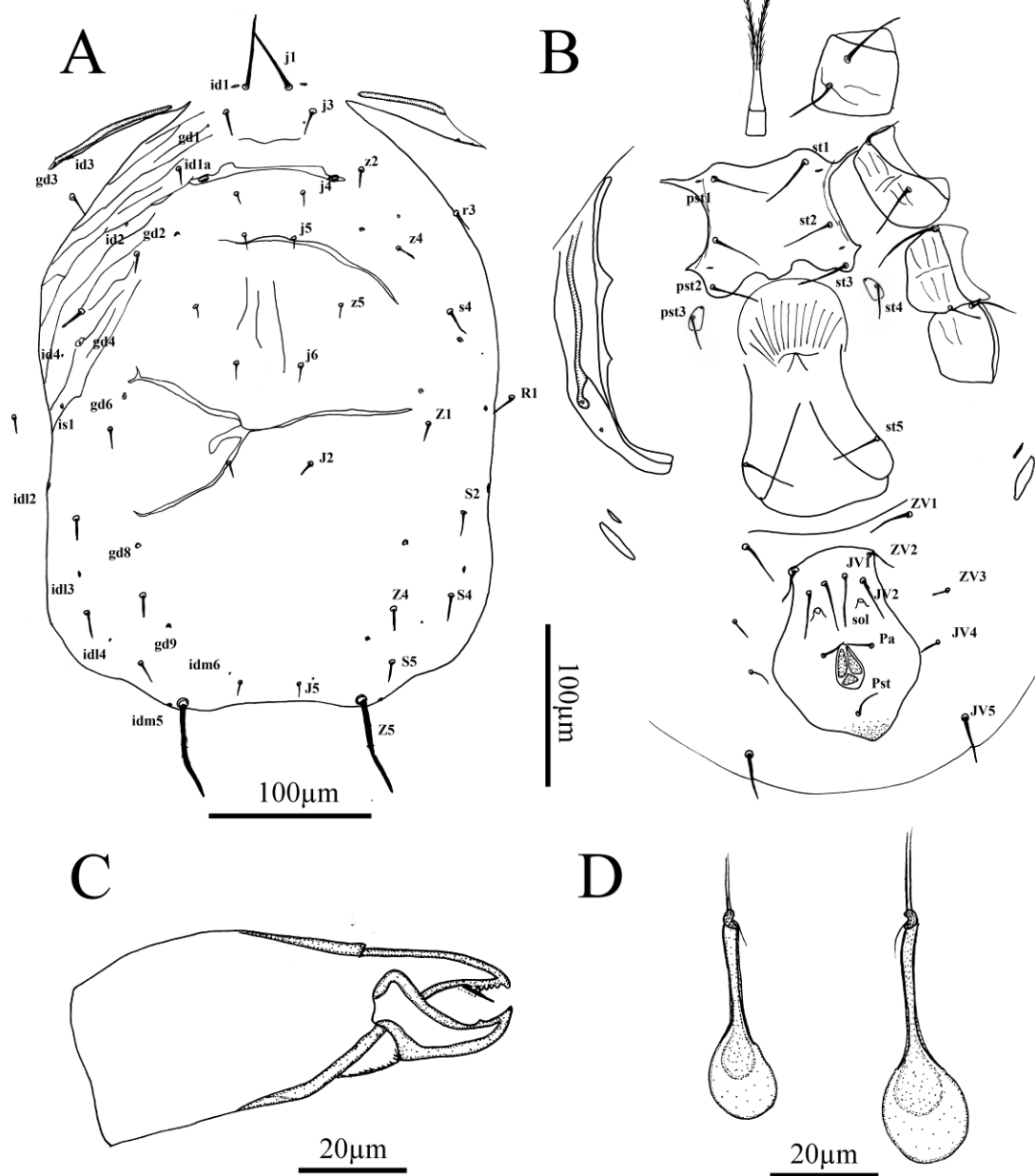


FIGURE 33. *Euseius ovalis* (Evans, 1953), Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

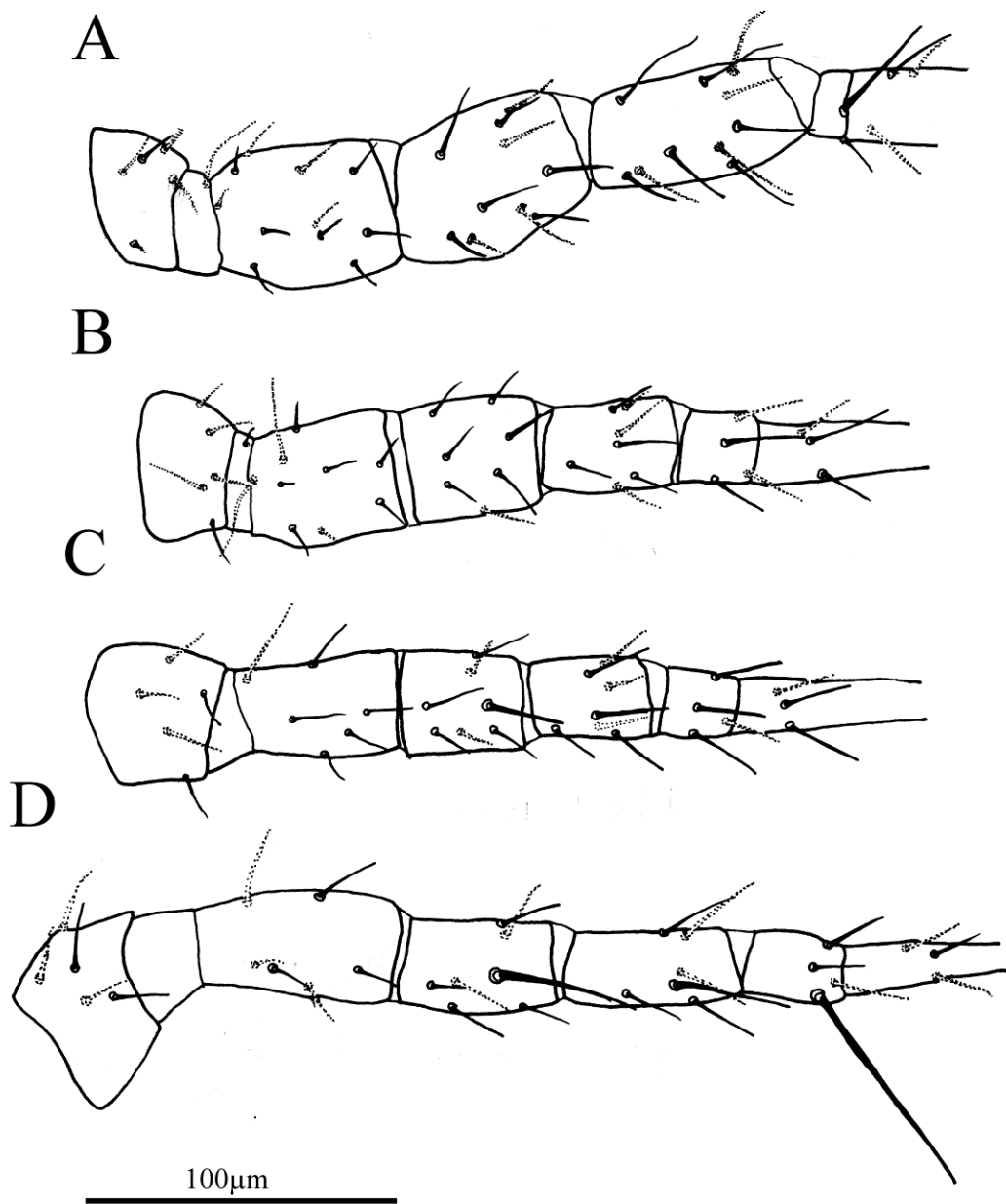


FIGURE 34. *Euseius ovalis* (Evans, 1953), Female, legs A. leg I anterior view, B. leg II anterodorsal view, C. leg III anterodorsal view, D. leg IV anterior view.

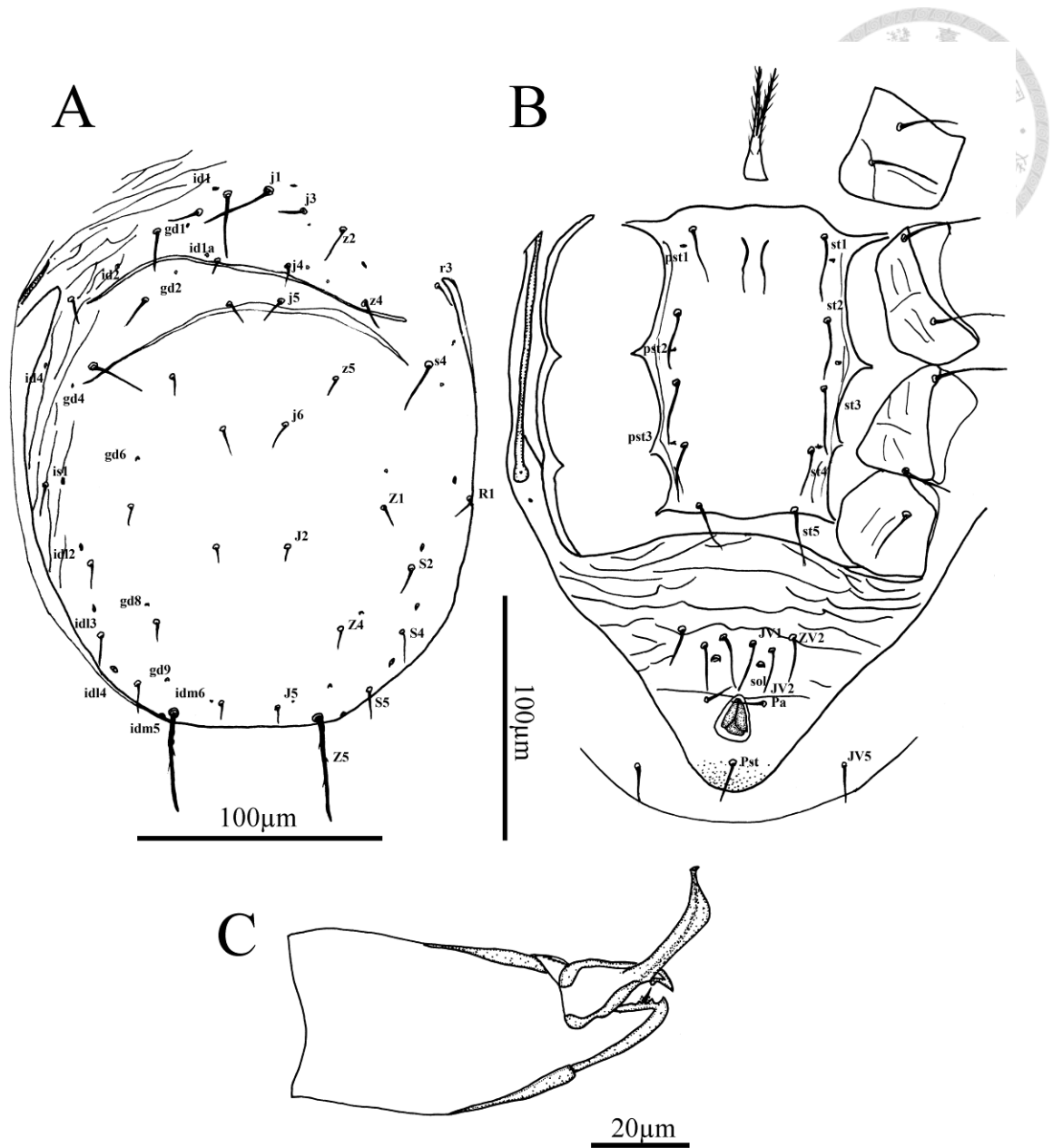


FIGURE 35. *Euseius ovalis* (Evans, 1953), Male, A. dorsal shield, B. ventral idiosoma; C. chelicera and spermatodactyl.

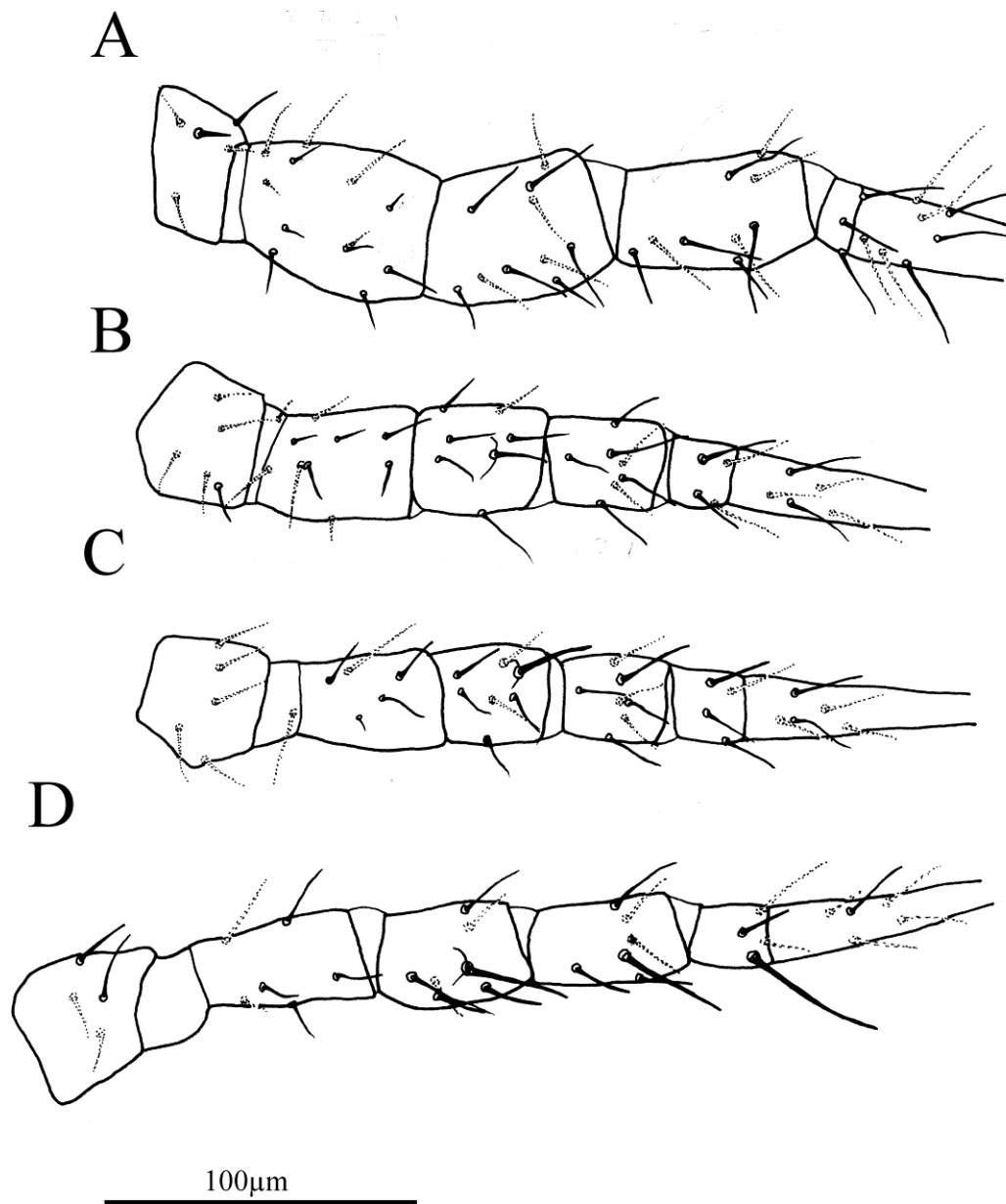


FIGURE 36. *Euseius ovalis* (Evans, 1953), Male, A. leg I anterior view, B. leg II dorsal view, C. leg III posterodorsal view, D. leg IV anterior view.

Euseius paraovalis Liao & Ho, 2017a

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(Figures 37–38)

Euseius paraovalis Liao & Ho, in Liao *et al.*, 2017a: 223.

Female (n=10)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield with strongly reticulated except for central part of podosoma; **347** 338 (321–347) long (*j1*-*J5* level) and **246** 241 (217–252) wide at level of *j6*, **225** 218 (200–226) wide at level of *S4*; six pairs of solenostomes on dorsal shield, (*gd1*, *gd2*, *gd4*, *gd6*, *gd8*, *gd9*), thirteen pairs of lyrifissures, (*id1*, *id1a*, *id2*, *id4*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* **33** 333 (29–35), *j3* **6** 5 (4–6), *j4* **4** 5 (4–5), *j5* **4** 4 (4–5), *j6* **5** 6 (5–7), *J2* **7** 7 (5–8), *J5* **5** 4 (4–5), *z2* **4** 5 (4–6), *z4* **5** 5 (5–6), *z5* **5** 5 (4–6), *Z1* **5** 6 (5–8), *Z4* **7** 7 (5–7), *Z5* **57** 52 (47–57), *s4* **8** 10 (8–11), *S2* **4** 6 (4–7), *S4* **7** 7 (6–8), *S5* **6** 6 (5–7), *r3* **5** 7 (5–10), *R1* **5** 6 (4–8). All setae smooth, except *Z5* slightly serrated.

Peritreme. Peritreme extending to *z2* level; peritremal shield lightly sclerotized, smooth with one pair of solenostomes (*gd3*).

Venter. Sternal shield smooth, posterior margin with medium projection, much wider than long, **62** 67 (62–72) long, **81** 92 (81–100) wide, with three pairs of setae *st1* **29** 27 (24–30), *st2* **27** 24 (20–27), *st3* **25** 22 (19–25), and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae II–IV. Metasternal platelets tear-shaped, with one pair of metasternal setae, *st4* **20** 18 (15–20), with one pair of lyrifissures (*pst3*). Genital shield smooth, with one pair of genital setae *st5* **23** 22 (19–24), **80** 82 (78–87) wide at level of genital setae. Distances between *st1*-*st1* **59** 51 (47–59), *st2*-*st2* **68** 61 (58–68), *st3*-*st3* **77** 68 (65–77), *st1*-*st3* **65** 56 (52–65), *st5*-*st5* **76** 69 (66–76). Ventrianal shield vase-shaped,

smooth, **101** 101 (96–106) long, **76** 76 (72–79) wide at level of ZV2, **60** 51 (46–60) wide at level of anus; with three pairs of pre-anal setae, *JV1* migrate next to *JV2*, *JV1* **23** 23 (21–25), *JV2* **19** 19 (15–22), *ZV2* **14** 14 (11–16), solenostomes *gv3* crescentic; *Pa* **12** 11 (10–12), *Pst* **13** 12 (11–13) on shield. Setae *JV4* **7** 7 (5–10), *JV5* **23** 22 (20–23), *ZV1* **14** 16 (14–18), *ZV3* **8** 6 (5–8) on interscutal membrane. All ventral setae smooth. Two pairs of metapodal plates **24** 22 (20–24) long, **5** 5 (3–5) wide, **11** 9 (7–11) long, **2** 2 (1–2) wide.

Spermatheca. Calyx tubular, elongated, **13** 12 (11–13) long, **2** 2 (2–2) wide, with atrium at the basis, minor duct and major duct visible.

Chelicera. Movable digit **23** 22 (20–24) long, with one tooth; fixed digit **28** 24 (21–28) long, anterior half with three teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* III (ad1) **28** 25 (22–28), *Sti* III (ad1) **23** 22 (20–27), *St* III (ad1) **25** 25 (23–27), *Sge* IV (ad1) **38** 37 (32–40), *Sti* IV (ad1) **33** 32 (28–34), *St* IV (pd1) **58** 55 (51–58).

Specimen examined. Dongqing Sewage Treatment Plant, Lanyu Island, Taitung County (22°03.549' N, 121°33.569' E, 56m), one holotype three paratype females (no. 445–1, 2, 3, 4) from *Macaranga tanarius* (Euphorbiaceae), 3.iv.2010, J. R. Liao & C. C. Ho (NTU); Dongqing, Lanyu Island, Taitung County (22°03.791' N, 121°34.034' E, 46m), two paratype females from *Macaranga tanarius* (Euphorbiaceae), 2.iv.2010, J. R. Liao & C. C. Ho (NMNS); Lanyu Island, Taitung County (22°00.791' N, 121°34.034' E, 32m), one paratype female (no. 463–14) from *Trema orientalis* (Ulmaceae), 4.iv.2010, J. R. Liao (NCHU); Lanyu Island, Taitung County (22°2.042' N, 121°33.040' E, 72m),

one paratype female (HAL099B182) from *Macaranga sinensis* (Euphorbiaceae), 4.iv.2010, C. C. Ho (TARL); Hongtou Village, Lanyu Island, Taitung County, one paratype female from *Morus alba* (Moraceae), 6.iv.2011, Y. J. Lu (NPUST); Lanyu Island, Taitung County (22°02.040' N, 121°33.445' E, 187m), three paratype females (no. 1324–1, 3, 5) (T-MZLQ 3282 to T-MZLQ 3284) from *Morus alba* (Moraceae), 2.vi.2014, J. F. Hsieh (ESALQ-USP).

Distribution. Asia: Taiwan (Lanyu Island (Liao *et al.* 2017a)).

Remarks. The females of this species resemble *E. ovalis* (Evans, 1953) and *E. elinae* (Schicha, 1977), but differ from *E. ovalis* in strong reticulation on the dorsal shield, anterior reticulation on the peritremal shield, and the length of the spermatheca; from *E. elinae* in *j*3 minute (23–26 in *E. elinae*) and strong reticulation on the dorsal shield.

E. ovalis is prevalent in Taiwan and dominates flat ground areas, and we observed that *E. paraovalis* occurred in similar habitat plants to those of *E. ovalis* on Lanyu Island, from the coastal region to the deep forest. The lifestyle of *E. paraovalis* is similar to that of *E. ovalis*, but it is only distributed in Lanyu Island. According to lifestyles by McMurtry *et al.* (2013), *E. paraovalis* may as a generalist predator that also feeds on pollen. They can prey on a broad range of small arthropods and various plant pollens.

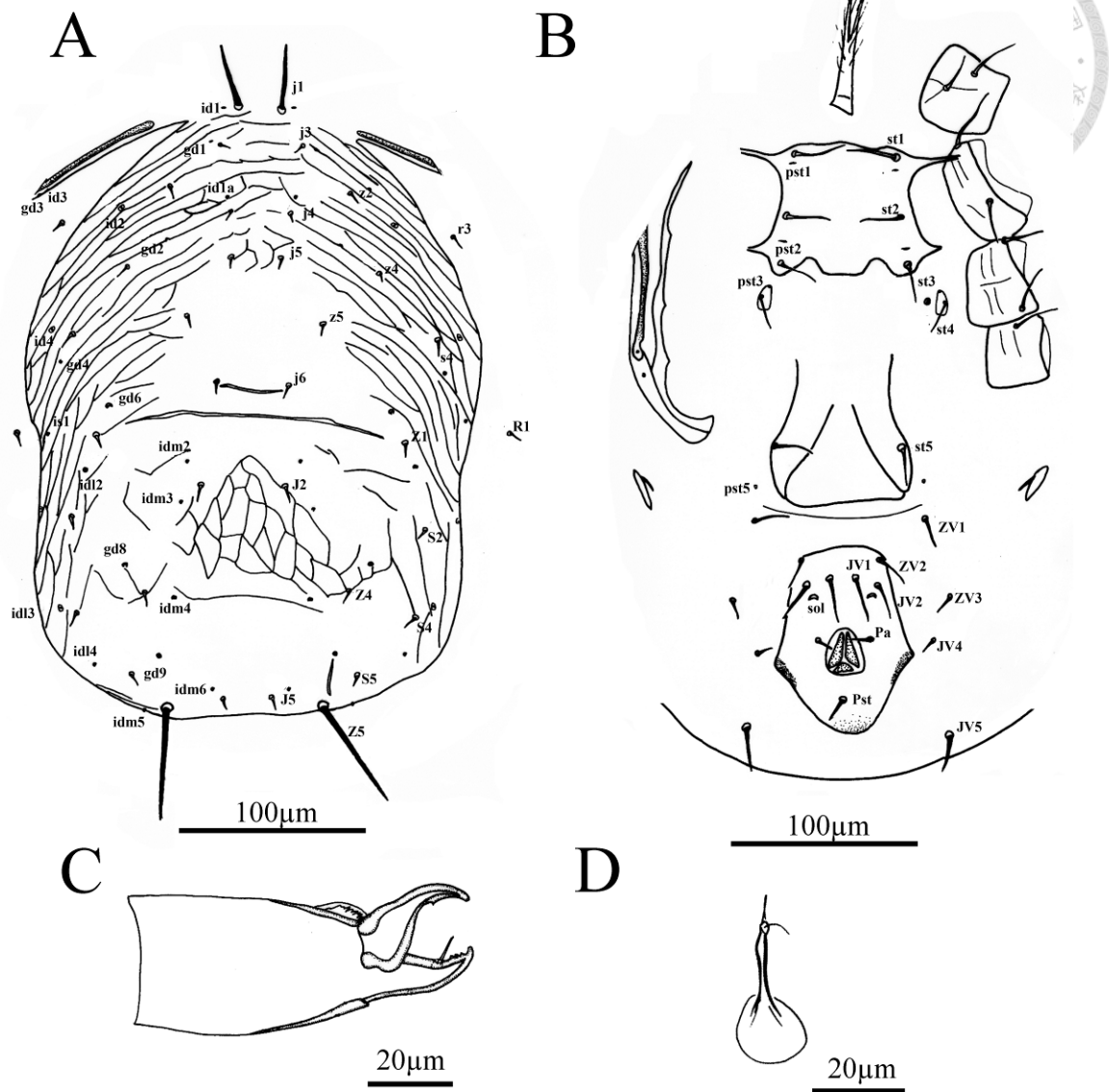


FIGURE 37. *Euseius paraovalis* Liao & Ho, 2017a, Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

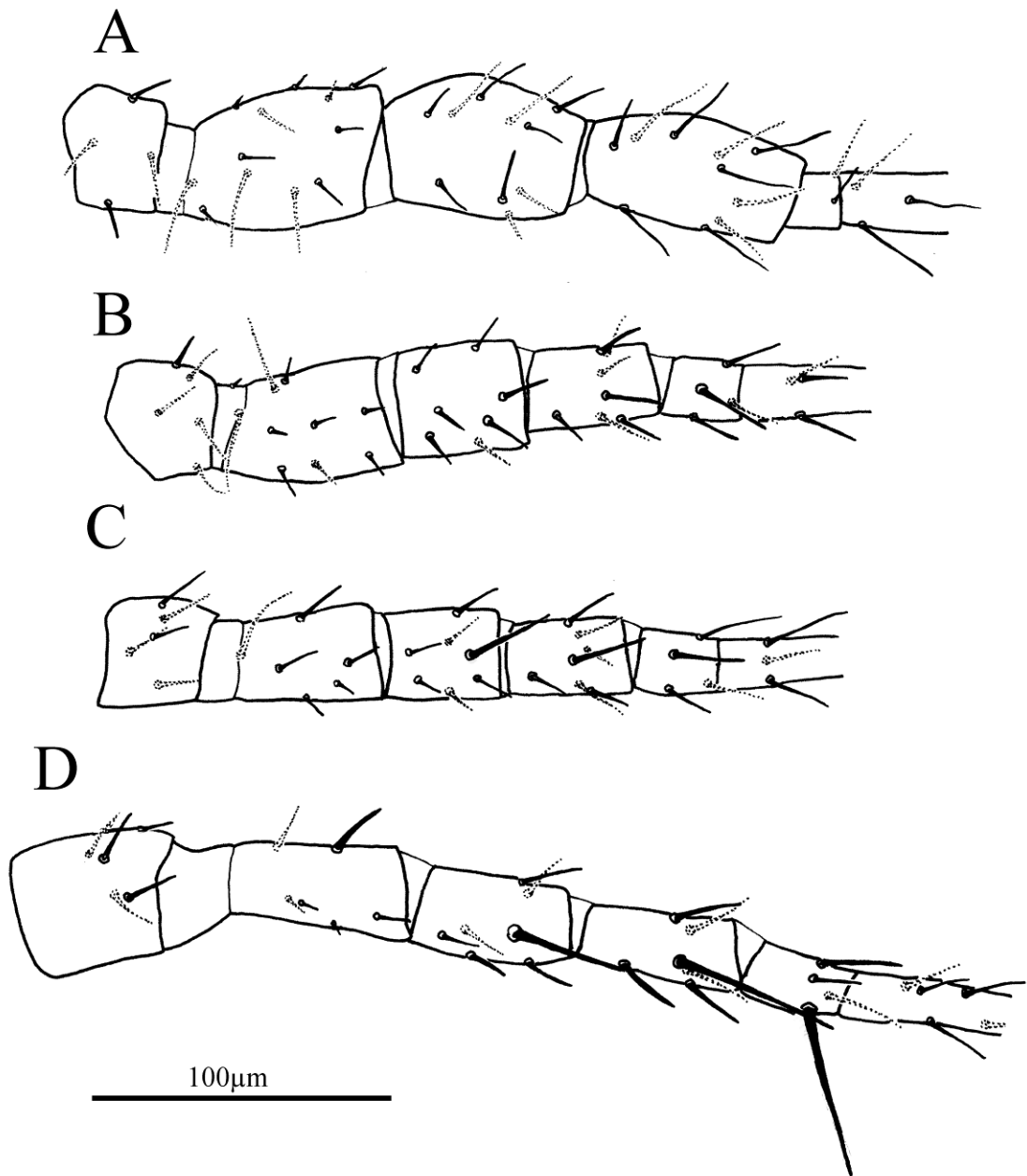


FIGURE 38. *Euseius paraovalis* Liao & Ho, 2017a, A. leg I posterior view, B. leg II anterodorsal view, C. leg III anterodorsal view, D. leg IV anterior view.

***Euseius sojaensis* (Ehara, 1964)**

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(Figures 39–42)

Amblyseius sojaensis Ehara, 1964: 381.

Amblyseius (*Amblyseius*) *sojaensis*.—Ehara, 1966: 24.

Amblyseius (*Euseius*) *sojaensis*.—Ehara & Amano, 1998: 42.

Euseius sojaensis.—Moraes *et al.*, 2004a: 83.

Female (n=10)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield most surface strongly reticulated, 336 (314–366) long (*j1*–*J5* level) and 233 (211–256) wide at level of *j6*, 221 (198–253) wide at level of *S4*; with six pairs of solenostomes (*gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), twelve pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *idm2*, *idm3*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); muscle-marks (sigilla) visible on podosoma; length of setae: *j1* 29 (24–34), *j3* 25 (20–33), *j4* 9 (6–14), *j5* 8 (6–10), *j6* 9 (6–11), *J2* 11 (9–15), *J5* 6 (4–7), *z2* 18 (15–21), *z4* 15 (11–20), *z5* 9 (6–10), *Z1* 12 (10–13), *Z4* 11 (8–15), *Z5* 56 (52–63), *s4* 26 (22–34), *S2* 17 (14–21), *S4* 22 (19–26), *S5* 21 (16–28), *r3* 13 (9–18), *R1* 12 (8–13); All setae smooth, except *Z5* slightly serrated.

Peritreme. Peritreme extending to *z2* level, peritremal shield smooth, lightly sclerotized, with one pair of solenostomes (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, with projection of posterior margin, wider than long, 60 (48–66) long, 87 (77–95) wide at *st3* level, with three pairs of setae *st1* 28 (20–32), *st2* 24 (17–32), *st3* 21 (17–25), and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae I–IV. Metasternal platelets tear-shaped, with one pair metasternal setae, *st4* 19 (16–25), and one pair of lyrifissures (*pst3*). Genital shield smooth, 81 (75–87)

wide at level of genital setae, with one pair of genital setae *st5* 21 (16–25). Distances between *st1-st1* 55 (49–59), *st2-st2* 63 (57–70), *st3-st3* 69 (60–74), *st1-st3* 59 (52–76), *st5-st5* 70 (63–77). Ventrianal shield smooth, vase-shaped, 97 (91–104) long, 50 (44–61) wide at level of ZV2, 74 (69–80) wide at level of anus; with three pairs of pre-anal setae, arranged in triangular pattern, *JV1* 23 (20–27), *JV2* 20 (16–25), *ZV2* 14 (12–16), solenostomes *gv3* crescentic; *Pa* 11 (10–15), *Pst* 11 (8–13) on shield. Setae *JV4* 8 (5–11), *JV5* 31 (26–36), *ZV1* 17 (14–23), *ZV3* 9 (7–11) on interscutal membrane. All ventral setae smooth. Two pairs of metapodal platelets 19 (16–21) long, 5 (4–7) wide, 10 (8–11) long, 2 (2–3) wide.

Chelicera. Movable digit 22 (21–25) long, with one tooth; fixed digit 23 (20–27) long, anterior half with four teeth, with *pilus dentilis*.

Spermatheca. Calyx funnel-shaped, 12 (11–13) long, 7 (6–8) wide, minor duct visible.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* III (ad2) 27 (22–31), *Sti* III (ad) 22 (18–27), *St* III (d) 22 (16–30), *Sge* IV (ad2) 34 (26–37), *Sti* IV (ad) 30 (25–34) and *St* IV (d) 55 (48–63).

Male (n=5)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3, 4:ZV-1, 3.

Dorsum. Dorsal shield most surface strongly reticulated, 249 (238–273) long (*j1-J5* level) and 190 (176–200) wide at level of *j6*, 169 (152–189) wide at level of *S4*; with six pairs of solenostomes (*gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), twelve pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *idm2*, *idm3*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*);

muscle-marks (sigilla) visible on podosoma; length of setae: *j1* 24 (22–28), *j3* 25 (21–28), *j4* 7 (6–8), *j5* 6 (5–8), *j6* 8 (5–10), *J2* 8 (6–11), *J5* 4 (4–5), *z2* 14 (10–17), *z4* 12 (8–16), *z5* 7 (6–9), *Z1* 9 (8–11), *Z4* 8 (7–11), *Z5* 45 (40–50), *s4* 24 (21–31), *S2* 15 (13–17), *S4* 18 (14–26), *S5* 19 (14–23), *r3* 11 (8–16), *R1* 12 (9–14); All setae smooth, except *Z5* slightly serrated. Setae *r3* and *R1* inserted on dorsal shield.

Peritreme. Peritreme extending to *z2* level, peritremal shield smooth, lightly sclerotized, with one pair of solenostomes (*gd3*), one pair of lyrifissures (*id3*).

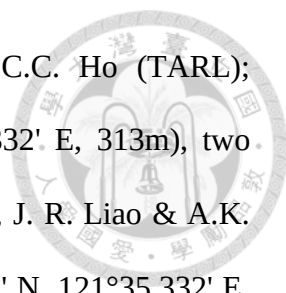
Venter. Sternogenital shield smooth, slightly lateral reticulated, posterior margin almost straight, longer than wide, 115 (113–117) long, 78 (72–90) wide at level of *st5*, with five pairs of setae *st1* 19 (13–23), *st2* 19 (14–26), *st3* 19 (17–23), *st4* 13 (11–17), *st5* 15 (10–18), and three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Distances between *st1-st1* 53 (49–59), *st2-st2* 55 (46–61), *st3-st3* 55 (52–59), *st4-st4* 49 (48–52), *st5-st5* 36 (35–39), *st1-st5* 108 (103–112). Exopodal shield at coxae I–IV. Ventrianal shield subtriangular, slightly reticulated, 99 (87–114) long and 156 (145–177) wide at level of anterior corner, 68 (53–81) wide at level of anus, fused with peritremal shield cingulum, with three pairs of pre-anal setae, arranged in triangular pattern, solenostome *gv3* crescentic, *JV1* 17 (14–20), *JV2* 13 (10–18), *ZV2* 11 (8–16); *Pa* 8 (7–11), *Pst* 9 (6–12) on shield. Setae *JV5* 21 (17–29) on interscutal membrane. All ventral setae smooth.

Chelicera. Movable digit 20 (18–21) long, with one tooth; fixed digit 21 (17–23) long, anterior half with three teeth, with *pilus dentilis*. Spermatodactyl U-shaped, shaft 25 (19–3) long, heel rounded, foot 11 (10–12) long, with expanded toe and lateral thorn-like projection.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1,

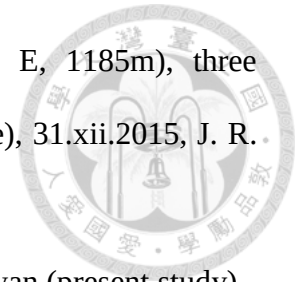
1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* III (ad2) 21 (18–23), *Sti* III (ad) 19 (17–24), *St* III (d) 20 (17–25), *Sge* IV (ad2) 29 (25–32), *Sti* IV (ad) 25 (19–35) and *St* IV (d) 46 (40–53).

Specimens examined. Anma Mountain, Heping District, Taichung City, eight females from unknown plant, 9.iv.1990, C.C. Ho (TARL); East Xue Trail, Heping District, Taichung City, one female from unknown plant, 29.xi.2006, C.C. Ho (TARL); Ci'en Tower, Yuchi Township, Nantou County, one female (TAL095C142) from *Pueraria lobata* (Fabaceae), 7.iv.2006, C. C. Ho (TARL); Lishan, Helping District, Taichung City, five females one male from unknown plant, 1.xii.2006, C.C. Ho (TARL); Lishan, Helping District, Taichung City, one female from *Morus australis* (Moraceae), 1.xii.2006, C.C. Ho (TARL); Qingjing Farm, Ren'ai Township, Nantou County, one female from *Pyrus communis* (Rosaceae), 5.xii.2006, S.C. Chang (TARL); Formosan Aboriginal Culture Village, Yuchi Township, Nantou County, one female one male from *Prunus serrulata* (Rosaceae), 15.v.2007, C.C. Ho (TARL); Taigang, Jianshi Township, Hsinchu County (24°36'37.7" N, 121°16'31.2" E, 1049m), one female (HAL097B638) from *Prunus persica* (Rosaceae), 9.ix.2008, C. C. Ho (TARL); Huanshan, Heping District, Taichung City, three females one male from *Prunus* sp. (Rosaceae), 20.x.2009, C.C. Ho (TARL); Huanshan, Heping District, Taichung City, three females from *Prunus salicina* (Rosaceae), 20.x.2009, C.C. Ho (TARL); Huanshan, Heping District, Taichung City, two females from unknown plant, 20.x.2009, C.C. Ho (TARL); Shigilan Suspension Bridge, Heping District, Taichung City, four females one male from unknown plant, 21.x.2009, C.C. Ho (TARL); Wanfeng Village, Wufeng District, Taichung City, four females two males from bamboo (Poaceae), 9.iii.2010, C.C. Ho (TARL); Lushan, Ren'ai Township, Nantou County, one female from *Calocedrus formosana* (Cupressaceae), 22.xi.2010, C.C. Ho (TARL); Xuejian, Tai'an Township,



Miaoli County, two females from unknown plant, 23.iii.2012, C.C. Ho (TARL); Maokong, Wenshan District, Taipei City (24°58.062' N, 121°35.332' E, 313m), two females (no. 584–1, 2) from *Cocos nucifera* (Arecaceae), 9.vi.2010, J. R. Liao & A.K. Dubey (NTU); Maokong, Wenshan District, Taipei City (24°58.062' N, 121°35.332' E, 313m), six females (574–1, 2, 3, 4, 5, 6) from unknown plant, 9.vi.2010, J. R. Liao & A.K. Dubey (NTU); Paomagudao, Jiaoxi Township, Yilan County (24°50.276' N, 121°46.346' E, 147m), one female (no. 1113–1) from *Carica papaya* (Caricaceae), 9.ii.2011, J. R. Liao (NTU); Xiouluan Road, Jianshi Township, Hsinchu County (24°38.252' N, 121°16.430' E, 1010m), one female (no. 1268–1) from *Dendrocalamus latiflorus* (Poaceae), 17.iv.2014, J. R. Liao (NTU); Xiakelo Historic Trail, Jianshi Township, Hsinchu County (24°35.346' N, 121°15.273' E, 1260m), one female (no. 1283–2) from *Machilus* sp. (Lauraceae), 17.iv.2014, J. R. Liao (NTU); TsaoPingTou, Jianshi Township, Hsinchu County (23°33.447' N, 120°52.515' E, 1095m), two females (no. 1292–1, 2) from *Prunus campanulata* (Rosaceae), 24.iv.2014, J. R. Liao (NTU); TsaoPingTou, Jianshi Township, Hsinchu County (23°33.447' N, 120°52.515' E, 1095m), two females (no. 1293–1, 2) from *Machilus zuihensis* (Lauraceae), 24.iv.2014, J. R. Liao (NTU); Shenshan, Wutai Township, Pingtung County (22°44.986' N, 120°43.640' E, 708m), one female (no. 1471–1) from *Pachira aquatica* (Malvaceae), 25.iv.2014, J. R. Liao (NTU); Jiangshuying Old trail, Wutai Township, Pingtung County (22°24.459' N, 120°45.404' E, 1496m), one female (no. 1461–1) from *Turpinia formosana* (Staphyleaceae), 24.iv.2014, J. R. Liao (NTU); Shihmen Farm, Longtan District, Taoyuan City (24°48.876' N, 121°12.897' E, 544m), three females (no. 1513–1, 2, 3) from *Morus* sp. (Moraceae), 30.v.2015, J. R. Liao (NTU); Jianshi Township, Hsinchu County (24°41.896' N, 121°13.120' E, 376m), three females (no. 1585–1, 4, 5) from *Bauhinia variegata* (Fabaceae), 31.xii.2015, J. R. Liao (NTU);

Jianshi Township, Hsinchu County (24°40.122' N, 121°16.512' E, 1185m), three females (no. 1591–2, 7, 9) from *Debregeasia orientalis* (Urticaceae), 31.xii.2015, J. R. Liao (NTU).



Distribution. Asia: Japan (Ehara 1964; Ohno *et al.* 2012), Taiwan (present study).

Remarks. This species is distributed in Japan (e.g. Honshu, Shikoku, Kyushu, and Okinawa islands) (Ehara 1964; Ohno *et al.* 2012; Toyoshima *et al.* 2018). Shibao *et al.* (2004) reported *E. sojaensis* has potential to be predator for yellow tea thrips (*Scirtothrips dorsalis* Hood) in Japanese vineyards. This species is widely distributed in Taiwan, may have biological control potential in the field, but needs further study.

Liao *et al.* (2017a) mentioned that *E. aizawai* specimens should be separated to three different species. *E. sojaensis* could be identified by dorsal shield most surfaces strongly reticulated and 5 solenostomes on dorsal shield.

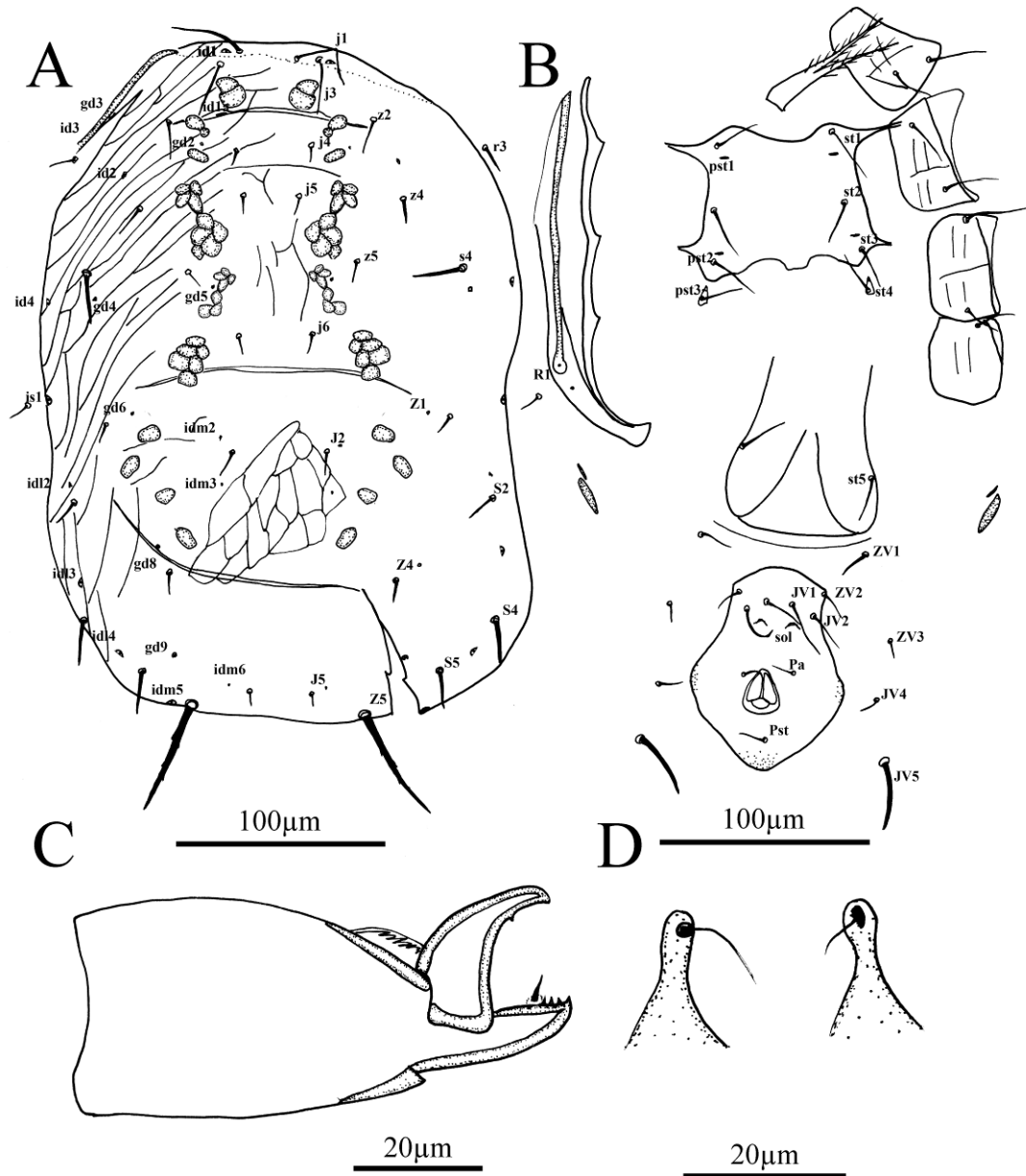


FIGURE 39. *Euseius sojaensis* Ehara, 1964, Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

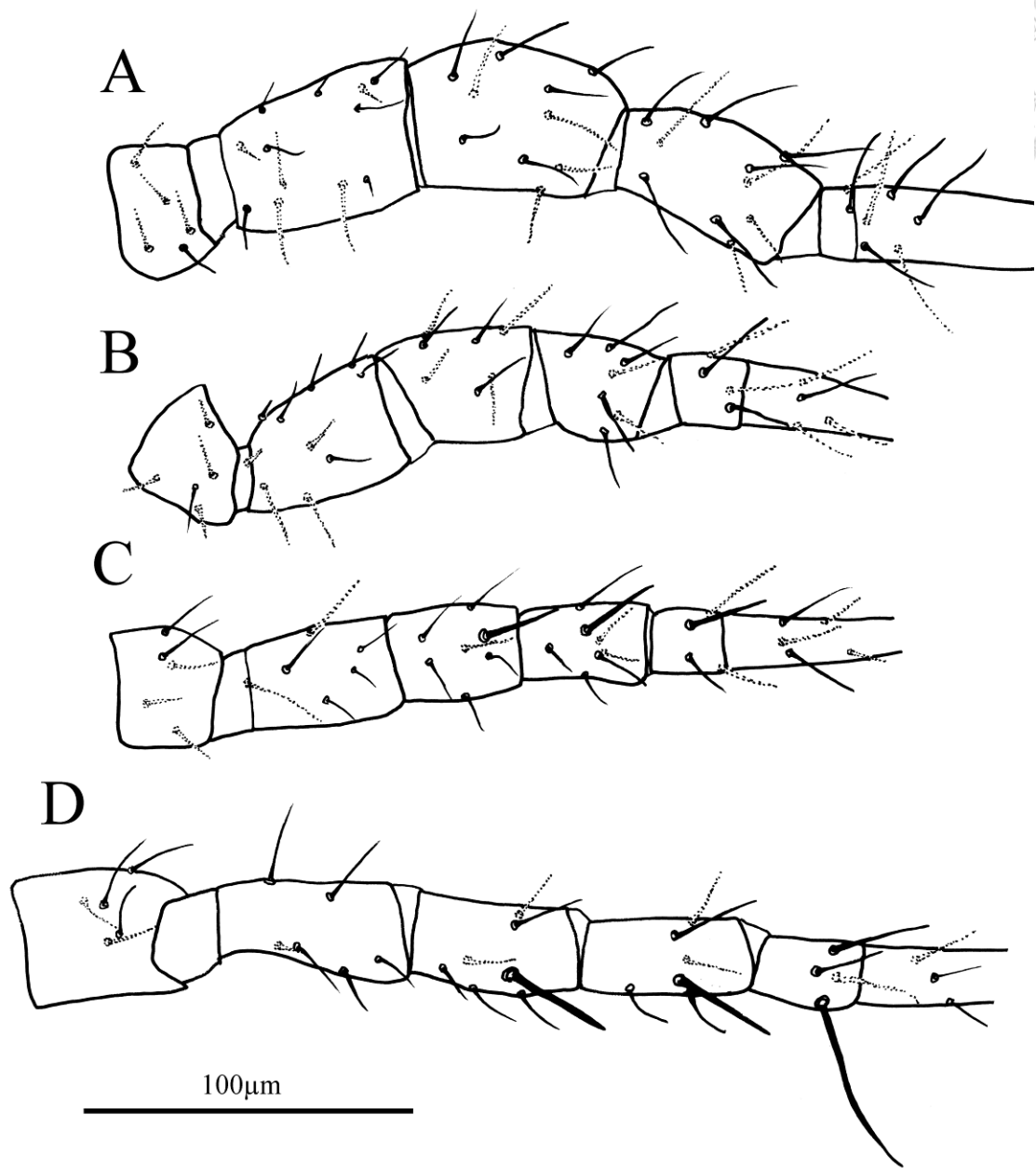


FIGURE 40. *Euseius sojaensis* Ehara, 1964, Female, legs A. leg I posterior view, B. leg II posterior view, C. leg III dorsal view, D. leg IV anterior view.

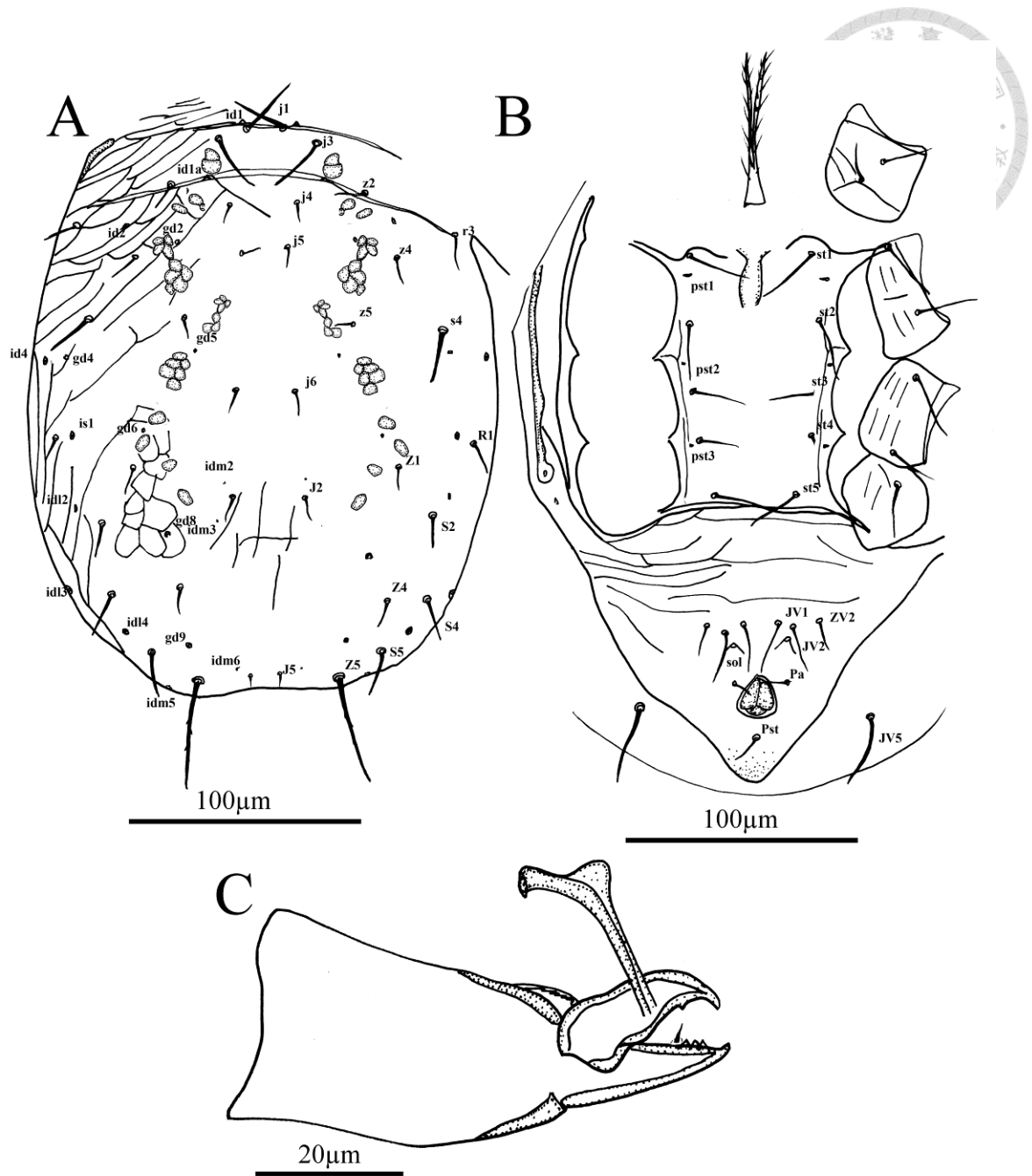


FIGURE 41. *Euseius sojaensis* Ehara, 1964, Male, A. dorsal shield; B. ventral idiosoma; C. chelicera and spermatodactyl.

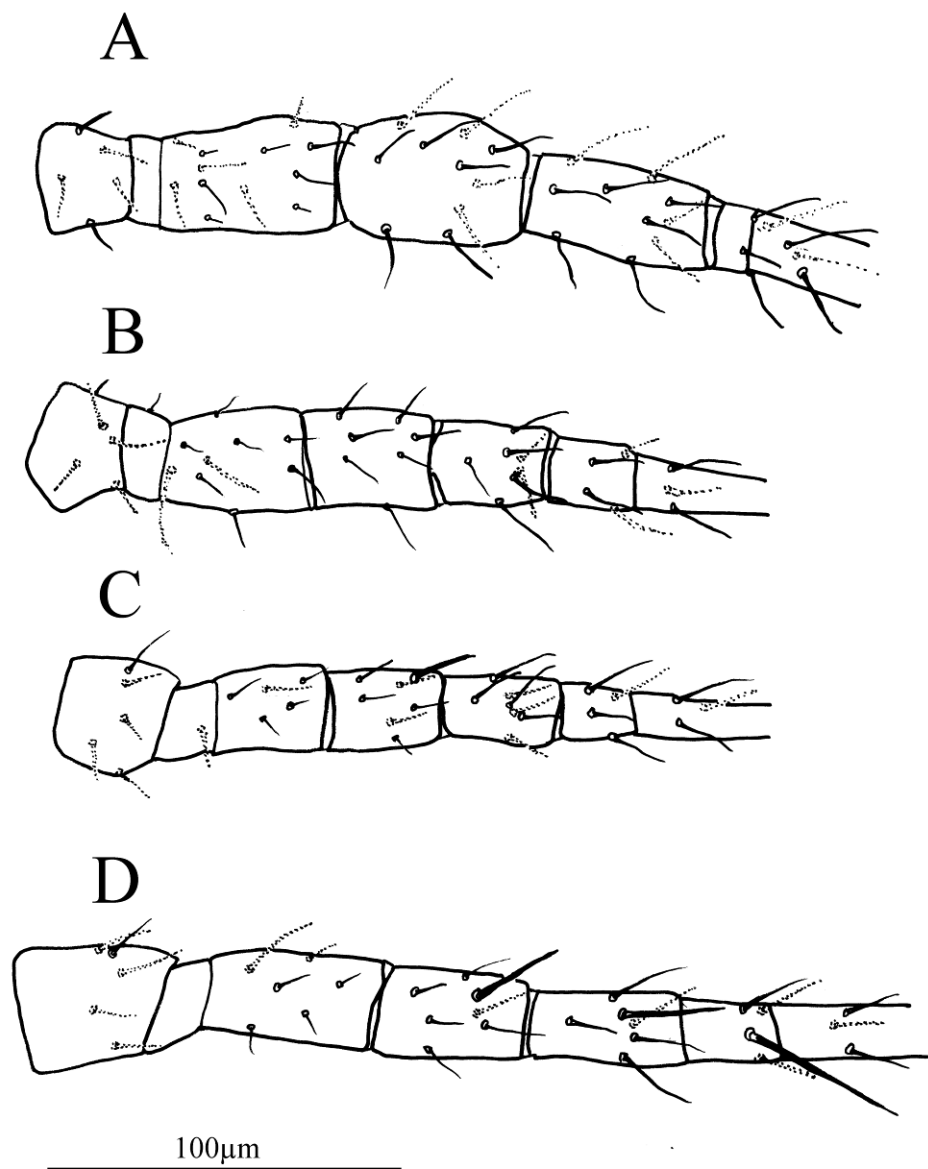


FIGURE 42. *Euseius sojaensis* Ehara, 1964, Male, legs A. leg I dorsal view, B. leg II dorsal view, C. leg III anterodorsal view, D. leg IV dorsal view.

Tribe Kampimodromini Kolodochka, 1998

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Kampimodromini Kolodochka, 1998: 59.



Type genus: *Kampimodromus* Nesbitt, 1951: 53.

This tribe is characterized by seta *S4* absent. The tribe Kampimodromini comprised three subtribes, Typhloseiellina Chant & McMurtry, Kampimodromina Chant & McMurtry, Paraphytoseiina Chant & McMurtry.

Key to the subtribes in the tribe Kampimodromini from Taiwan

1. With notch or incision in lateral margin of dorsal shield at level of seta *s4*
..... subtribe Paraphytoseiina Chant & McMurtry
- Without notch or incision in lateral margin of dorsal shield at level of seta *s4*
..... subtribe Kampimodromina Chant & McMurtry

Subtribe Paraphytoseiina Chant & McMurtry, 2003b

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Paraphytoseiina Chant & McMurtry, 2003b: 211.

Type genus - *Paraphytoseius* Swirski & Schechter, 1961: 327.

This subtribe is characterized by having notch or incised at seta *s4* level on dorsal shield, and also having 3-5 thickened macrosetae on leg IV, having conspicuous *gd5*. The subtribe comprised three genera, *Neoparaphytoseius* Chant & McMurtry, *Amblyseiulella* Muma, *Paraphytoseius* Swirski & Schechter.

Genus *Paraphytoseius* Swirski & Schechter, 1961

擬植綏蟎屬



Paraphytoseius Swirski & Schechter, 1961. Type species: *Paraphytoseius multidentatus*

Swirski & Schechter, 1961 (= *Amblyseius narayanani* Ehara & Ghai, 1967, replacement name for *Typhlodromus (Amblyseius) orientalis* Narayanan, Khaur & Ghai, 1960, a homonym of *Amblyseius orientalis* Ehara, 1959; = *Paraphytoseius ipomeai* E1-Banhawy, 1984, a junior replacement name for *A. orientalis* Narayanan *et al.*).

Amblyseius (Ptenoseius) Pritchard & Baker, 1962. Type species: *Amblyseius (Ptenoseius) horrifer* Pritchard & Baker, 1962.

Ptenoseius.—Schuster & Pritchard, 1963: 198.

Proprioseius (Paraphytoseius).—Karg, 1983: 302.

Amblyseius (Paraphytoseius).—Ehara, 1967b: 77.

Type species - *Typhlodromus (Amblyseius) orientalis* Narayanan, Kaur & Ghai, 1960: 394.

Diagnosis – Idiosomal pattern 10A:5D/JV-3:ZV or 10A:6E/JV-3:ZV. Dorsal shield with strong lateral incision at level of seta *s*₄; with slight waist at level of seta *R*₁; with posterior margin rounded. Solenostome *gd*₅ prominent. Dorsal setae *j*₃, *s*₄, *r*₃, *Z*₄ and *Z*₅ elongate, somewhat thickened, serrated; *S*₂, *R*₁ short/medium in length; dorsocentral setae and *Z*₁ minute. Sternal shield posterior margin concave. Genital shield truncated posteriorly. Female ventrianal shield much longer than wide, with slightly waist, with 3 pair of preanal setae, *gv*₃ conspicuous. Peritreme usually extending to *j*₁ level. Spermatheca simple, with atrium nodular, calyx cup-shaped or bell-shaped. Chelicera fixed digit usually with 7-8 teeth. Leg IV with 3-5 elongate, thickened macrosetae. Ge II

with 7 setae. Male ventrianal shield triangular, spermatodactyl heel-and-toe variant.



Key to the species in the genus *Paraphytoseius* from Taiwan

1. Seta *S5* present, fixed digit with more than 10 teeth..... 2
— Seta *S5* absent, fixed digit with fewer teeth 3
2. Ge II with a macroseta *cracentis* (Corpuz & Rimando, 1966)
— Ge II without a macroseta *hualienensis* Ho & Lo, 1989
3. Anus level of ventrianal shield is wider than *ZV2* level; movable digit with 3 teeth;
Ge I without macroseta
..... *chihpenensis* Ho & Lo, 1989
— *ZV2* level of ventrianal shield is wider than anus level; movable digit with 2 teeth; Ge I
with macroseta
..... *orientalis* (Narayanan, Kaur & Ghai, 1960)

Paraphytoseius chihpenensis Ho & Lo, 1989

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(Figures 43–46)

Paraphytoseius chihpenensis Ho & Lo, 1989: 93

Paraphytoseius chihpensis [sic].—Wu *et al.*, 2010: 296.

Female (n=8)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:5D/JV-3:ZV.

Dorsum. Dorsal shield, smooth, lateral margin of female dorsal shield strongly incised at level of seta *s4*, **286** 281 (266–308) long, **158** 158 (147–164) wide at level of *s4*, **162** 152 (135–164) wide at level of *S4*; seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), fourteen pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *id6*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of dorsal setae: *j1* **40** 34 (27–40), *j3* **97** 90 (79–97), *j4* **4** 5 (4–5), *j5* **6** 6 (5–8), *j6* **5** 6 (4–8), *J5* **5** 6 (5–8), *z2* **7** 7 (6–8), *z4* **8** 7 (5–8), *z5* **9** 7 (6–9), *Z1* **12** 8 (4–14), *Z4* **85** 78 (72–85), *Z5* **106** 101 (92–111), *s4* **132** 124 (112–132), *r3* **52** 47 (40–52), *R1* **34** 33 (30–35). Setae *j1*, *r3*, *R1* elongated and serrated; *j3*, *s4*, *Z4* and *Z5* elongated, thickened, serrated and arising from tubercles; other minute.

Peritreme. Peritreme extending to *j1*, peritremal shield smooth, lightly sclerotized, with one pair of solenostome (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, posterior margin almost straight, wider than long, **64** 70 (64–75) long, **89** 81 (72–90) wide at *st3* level, with three pairs of setae *st1* **24** 24 (21–30), *st2* **24** 22 (18–27), *st3* **25** 23 (19–27) and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae I–IV. Metasternal platelets tear-shaped, with a pair metasternal setae, *st4* **23** 23 (19–27), and one pair of lyrifissures (*pst3*). Genital shield smooth, *st5* **22** 23 (20–29), **85** 84 (72–92) wide. Distances between *st1*–*st1* **64** 59

(53–64), *st2-st2* **64** 62 (57–65), *st3-st3* **78** 73 (71–78), *st1-st3* **65** 64 (59–67), *st5-st5* ? 79 (77–80). Ventrianal shield smooth, much longer than wide, with slightly waist at *JV2* level; **114** 97 (88–114) long, **60** 53 (44–60) wide at level of *ZV2* and **57** 55 (45–62) wide at level of anus; with three pairs of pre-anal setae, *JV1* **16** 17 (15–21), *JV2* **18** 19 (16–25), *ZV2* **16** 15 (12–19), with a pair of minute, widely separated solenostomes *gv3* near lateral margins posterior to setae *JV2*, *Pa* **15** 14 (12–17), *Pst* **21** 17 (14–21) on shield. Setae *JV4* **30** 31 (29–35), *JV5* **76** 72 (66–76), *ZV1* **16** 19 (15–26), *ZV3* **12** 13 (10–19) on interscutal membrane. All ventral setae smooth except seta *JV5* thickened, serrated.

Spermatheca. Calyx of spermatheca disc-shaped, **2** 3 (1–4) long, **6** 8 (6–11) wide, and atrium nodular without neck, major and minor ducts visible.

Chelicera. Movable digit **22** 22 (18–25) long, with three teeth; fixed digit **22** 23 (20–25), anterior half with two teeth, posterior half with five teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/1-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-2/1-1/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* II (pd2) **12** 12 (9–14), *Sge* IV (ad2) **30** 30 (28–32), *Sti* IV (ad) **45** 39 (35–45), *Sbta* IV (d) **52** 49 (45–52), *Sdta* IV (d) **37** 35 (34–37). Macrosetae apically shovel-shaped with expanded blade.

Male (n=1)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:5D/JV-3,4:ZV-1,3.

Dorsum. Dorsal shield smooth; 224 long, 153 wide at level of *s4*, 121 wide at level of *S4*, with seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), fourteen pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *id6*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 25, *j3* 58, *j4* 4, *j5* 5, *j6* 4, *J5* 5 (4–6), *z2* 8, *z4* 6, *z5* 6, *Z1* 10,

Z4 43, Z5 58, s4 86, r3 29, R1 12. Setae *j1*, *r3*, *R1* elongated and serrated; *j3*, *s4*, *Z4* and *Z5* elongated, thickened, serrated and arising from tubercles; other minute. Setae *r3* and *R1* inserted on dorsal shield.

Peritreme. Peritreme extend to *z2* level; peritremal shield lightly sclerotized.

Venter. Sternogenital shield smooth, lateral slightly reticulated, posterior margin almost straight, longer than wide 122 long, 73 wide at level *st2*, with five pairs of setae *st1* 22, *st2* 19, *st3* 22, *st4* 16, *st5* 18, three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Exopodal shield at coxae I–IV. Distance between *st1-st1* 47, *st2-st2* 60, *st3-st3* 67, *st4-st4* 54, *st5-st5* 52, *st1-st5* 102. Ventrianal shield subtriangular, with slightly reticulated, 89 long, 108 wide at level of anterior corner and 68 wide at level of anus, not fused with peritremal shield; with three pairs of pre-anal setae, *JV1* 16, *JV2* 16, *ZV2* 18, solenostome *gv3* small, rounded, *Pa* 11, *Pst* 12 on shield; *JV5* 20 on interscutal membrane. All ventral setae smooth, except seta *JV5* serrated.

Chelicera. Movable digit 15 long, with one tooth; fixed digit 15, anterior half with two teeth, posterior half with four teeth, *pilus dentilis*. Spermatodactyl heel-and-toe variant, shaft 14 long, foot 5 long.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/1-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-2/1-1/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* II (pd2) 10, *Sge* IV (ad2) 20, *Sti* IV (ad) 37, *Sbta* IV (d) 35, *Sdta* IV (d) 27. Macrosetae apically shovel-shaped with expanded blade.

Specimens examined. Zhiben, Beinan Township, Taitung County, one holotype female (87-0530) from *Macaranga tanarius* (Euphorbiaceae), 23.iii.1988, C. C. Ho (TARL); Zhiben, Beinan Township, Taitung County, one paratype male (87-0532) from *Macaranga tanarius* (Euphorbiaceae), 23.iii.1988, C. C. Ho (TARL); Zhiben, Beinan

Township, Taitung County, five females (87-0526, 27, 28, 29, 31) from *Macaranga tanarius* (Euphorbiaceae), 23.iii.1988, C. C. Ho (TARL); Datienchih, Lanyu Island, Taitung County, three females (TAL090D275, 276) associated with eriophyid mites from unknown plant, 10.x.2001, C. C. Ho (TARL).

Distribution. Asia: Taiwan (Ho & Lo 1989)

Remarks. The peritreme of female is extending to *j1* level, but only to *z2* level in male specimens. Ho & Lo (1989) reported that the fixed digit have 7-8 teeth, 2-3 teeth on movable digit; the present study re-examined type specimens and confirmed 7 teeth on fixed digit, 3 teeth on movable digit.

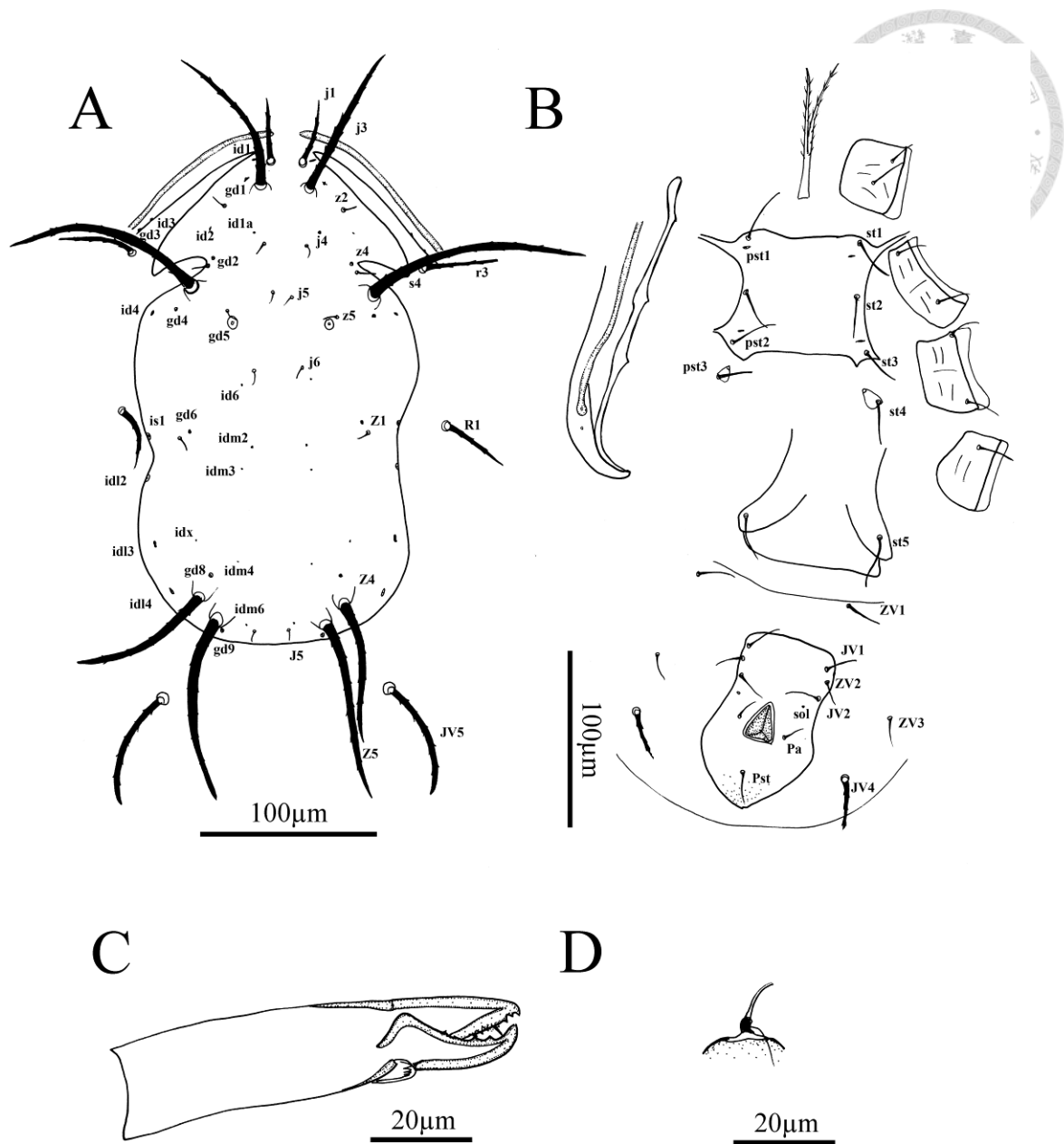


FIGURE 43. *Paraphytoseius chihpenensis* Ho & Lo, 1989, Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

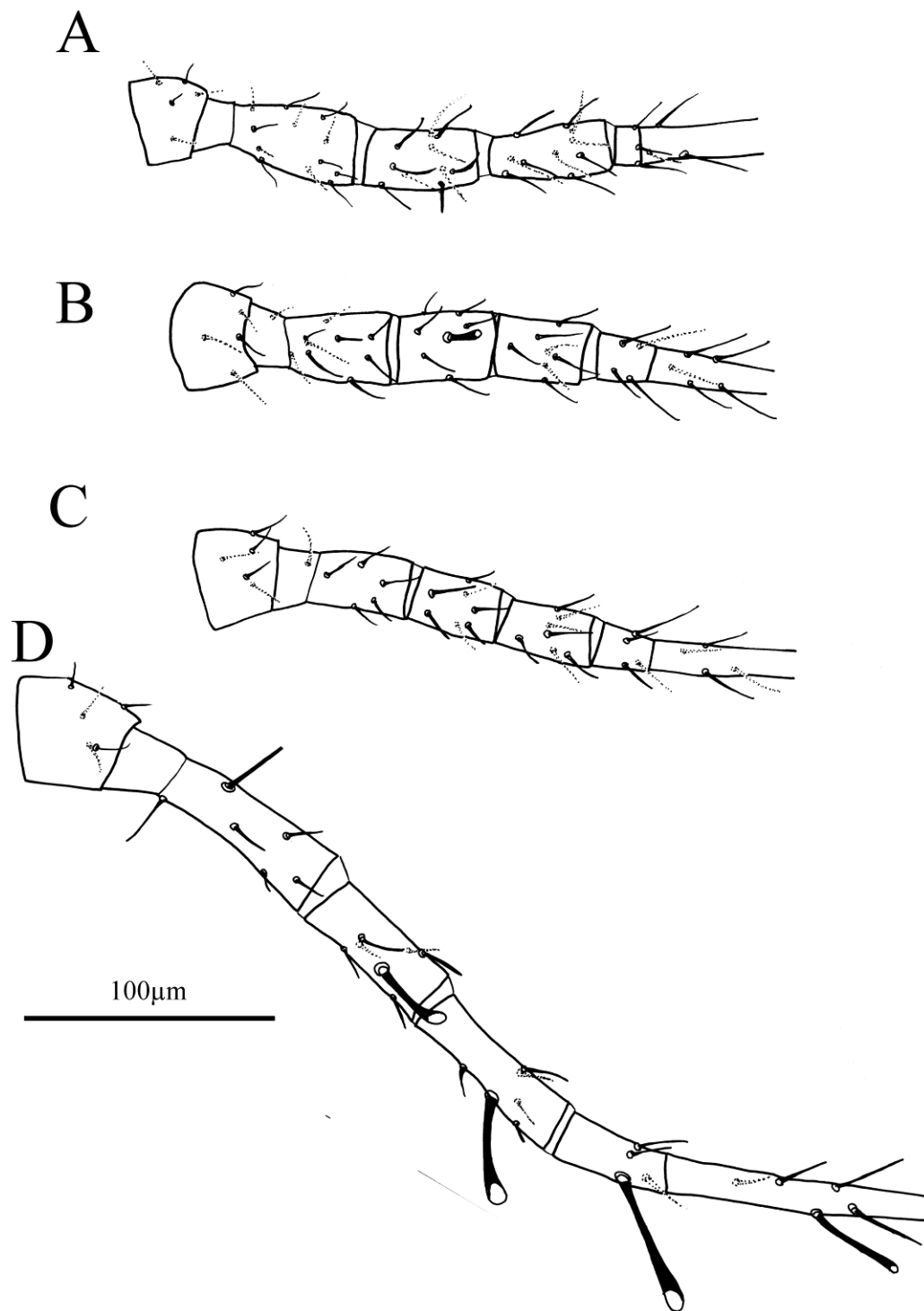


FIGURE 44. *Paraphytoseius chihpenensis* Ho & Lo, 1989, Female, legs A. leg I anterior view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV anterior view.

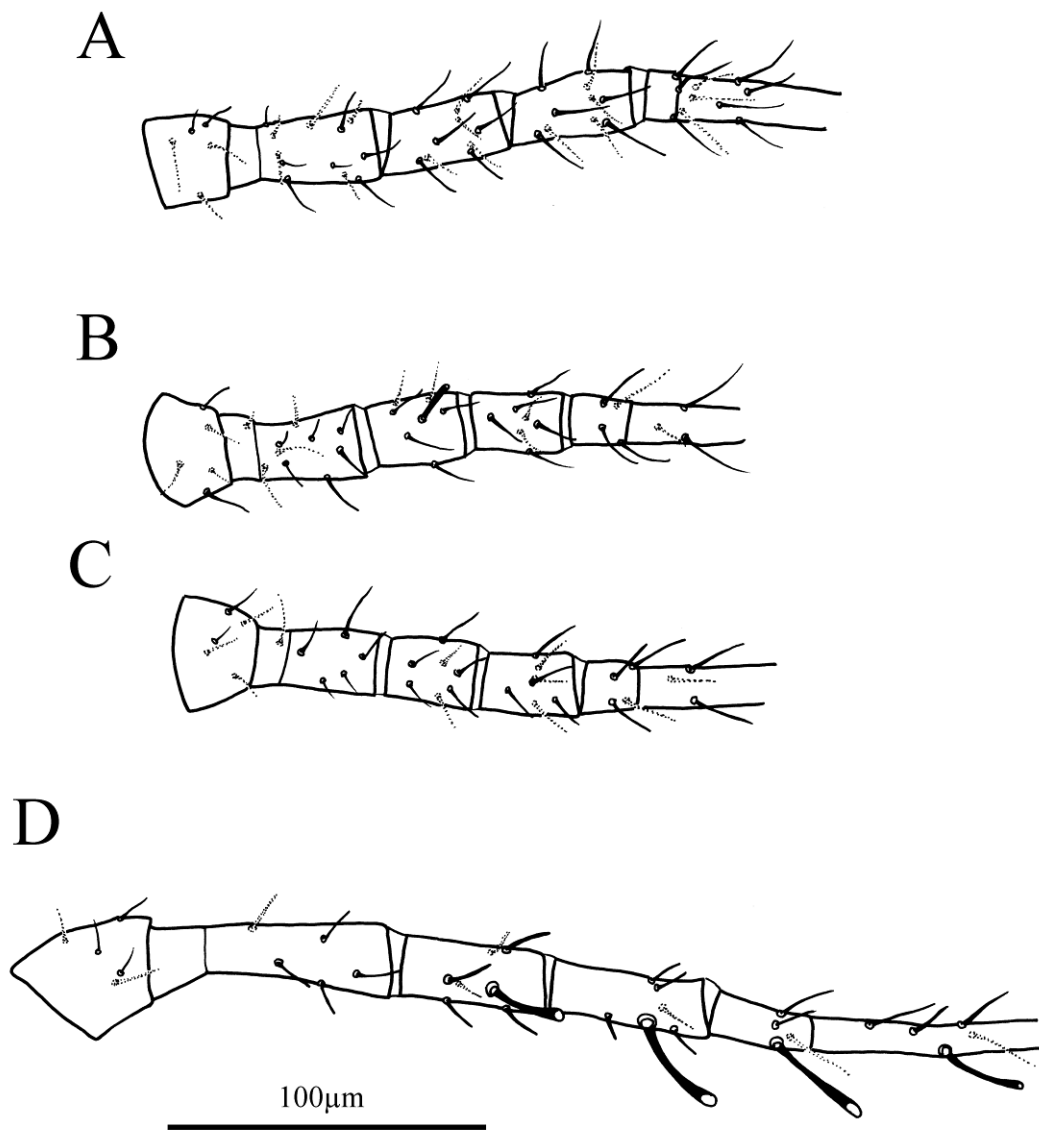


FIGURE 46. *Paraphytoseius chihpenensis* Ho & Lo, 1989, Male, legs A. leg I anterior view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV anterior view.

***Paraphytoseius cracentis* (Corpuz & Rimando, 1966)**

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(Figures 47–50)

Ptenoseius cracentis Corpuz & Rimando, 1966: 115.

Paraphytoseius cracentis.—Swirski & Golan, 1967: 226.

Paraphytoseius multidentatus Swirski & Shechter, 1961: 114. (Synonymy according to Matthysse & Denmark 1981)

Paraphytoseius hyalinus (Tseng, 1973): 77. (Synonymy according to Prasad 2016)

Paraphytoseius nicobarensis (Gupta, 1977): 631. (Synonymy according to Prasad & Karmakar 2015)

Female (n=10)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:6E/JV-3:ZV.

Dorsum. Dorsal shield, smooth, lateral margin of female dorsal shield strongly incised at level of seta *s*₄, 286 (274–293) long, 147 (128–160) wide at level of *s*₄, 137 (119–150) wide at level of *S*₄; seven pairs of solenostomes (*gd*₁, *gd*₂, *gd*₄, *gd*₅, *gd*₆, *gd*₈, *gd*₉), fifteen pairs of lyrifissures (*id*₁, *id*_{1a}, *id*₂, *id*₄, *id*₆, *idm*₂, *idm*₃, *idm*₄, *idm*₅, *idm*₆, *idx*, *is*₁, *idl*₂, *idl*₃, *idl*₄); length of dorsal setae: *j*₁ 30 (23–34), *j*₃ 82 (75–90), *j*₄ 3 (2–6), *j*₅ 4 (3–5), *j*₆ 4 (3–5), *J*₅ 3 (2–4), *z*₂ 6 (5–8), *z*₄ 7 (4–8), *z*₅ 5 (3–6), *Z*₁ 6 (4–9), *Z*₄ 74 (63–85), *Z*₅ 96 (89–106), *s*₄ 118 (112–128), *S*₅ 15 (8–20), *r*₃ 43 (37–50), *R*₁ 29 (25–34). Setae *j*₁, *r*₃, *R*₁ elongated and serrated; *j*₃, *s*₄, *Z*₄ and *Z*₅ elongated, thickened, serrated and arising from tubercles; other minute.

Peritreme. Peritreme extending to *j*₁ level, peritremal shield smooth, lightly sclerotized, with one pair of solenostome (*gd*₃), one pair of lyrifissures (*id*₃).

Venter. Sternal shield smooth, posterior margin almost straight, wider than long, 66 (53–76) long, 77 (66–83) wide at *st*₃ level, with three pairs of setae *st*₁ 29 (22–36), *st*₂

27 (23–31), *st3* 24 (19–29) and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae II–IV. Metasternal platelets tear-shaped, with a pair metasternal setae, *st4* 22 (19–26), and one pair of lyrifissures (*pst3*). Genital shield smooth, *st5* 25 (17–31), 84 (76–92) wide. Distances between *st1-st1* 63 (58–73), *st2-st2* 67 (61–75), *st3-st3* 74 (68–84), *st1-st3* 63 (53–69), *st5-st5* 78 (73–82). Ventrianal shield smooth, much longer than wide, with slightly waist at *JV2* level; 100 (90–111) long, 57 (51–66) wide at level of *ZV2* and 50 (46–56) wide at level of anus; with three pairs of pre-anal setae, *JV1* 18 (14–22), *JV2* 15 (13–17), *ZV2* 16 (13–20), with a pair of minute, widely separated solenostome *gv3* near lateral margins posterior to setae *JV2*, *Pa* 14 (11–18), *Pst* 22 (18–26) on shield. Setae *JV4* 26 (22–32), *JV5* 65 (59–71), *ZV1* 18 (11–26), *ZV3* 13 (9–19) on interscutal membrane. All ventral setae smooth, except *JV5* thickened and serrated. Two pairs of metapodal plates 31 (26–36) long, 2 (1–3) wide, 9 (6–16) long, 2 (1–3) wide.

Spermatheca. Calyx of spermatheca disc-shaped 2 (1–2) long, 8 (7–9) wide, and atrium nodular without neck, major and minor ducts visible.

Chelicera. Movable digit 29 (27–31) long, with three teeth; fixed digit 27 (25–31), anterior half with two teeth, posterior half with nine teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* II (pd2) 10 (8–13), *Sge* IV (ad2) 26 (24–28), *Sti* IV (ad) 37 (32–43), *Sbta* IV (d) 48 (45–49), *Sdta* IV (d) 44 (42–46). Macrosetae apically shovel-shaped with expanded blade.

Male (n=5)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:6E/ JV-3,4:ZV-1,3.

Dorsum. Dorsal shield smooth; 242 (237–254) long, 2136 (131–141) wide at level of *s4*, 110 (99–120) wide at level of *S4*, with seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), fifteen pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *id6*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *idx*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 23 (21–25), *j3* 59 (55–62), *j4* 4 (2–7), *j5* 4 (3–7), *j6* 5 (4–9), *J5* 3 (3–4), *z2* 6 (4–8), *z4* 6 (4–7), *z5* 4 (4–5), *Z1* 6 (5–7), *Z4* 49 (43–52), *Z5* 58 (56–62), *s4* 84 (76–88), *S5* 9 (7–14), *r3* 29 (22–34), *R1* 10 (7–12). Setae *j1*, *r3*, *R1* elongated and serrated; *j3*, *s4*, *Z4* and *Z5* elongated, thickened, serrated and arising from tubercles; other minute. Setae *r3* and *R1* inserted on dorsal shield.

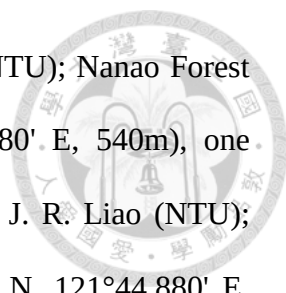
Peritreme. Peritreme extending to *z2* level; peritremal shield lightly sclerotized.

Venter. Sternogenital shield smooth, lateral slightly reticulated, posterior margin almost straight, longer than wide 94 (80–100) long, 119 (101–131) wide at level *st2*, with five pairs of setae *st1* 21 (20–21), *st2* 20 (13–25), *st3* 21 (16–24), *st4* 17 (12–25), *st5* 18 (16–20), three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). xopodal shield at coxae II–IV. Distance between *st1-st1* 63 (53–88), *st2-st2* 60 (58–63), *st3-st3* 65 (56–70), *st4-st4* 63 (58–69), *st5-st5* 53 (48–59), *st1-st5* 111 (101–117). E Ventrianal shield subtriangular, slightly reticulated, 94 (80–100) long, 119 (101–131) wide at level of anterior corner and 65 (57–74) wide at level of anus, fused with peritremal shield cingulum; with three pairs of pre-anal setae, *JV1* 14 (12–18), *JV2* 13 (13–14), *ZV2* 13 (11–16), solenostome *gv3* widely separated, small and rounded, *Pa* 65 (57–74), *Pst* 65 (57–74) on shield; *JV5* 23 (20–24) on interscutal membrane. All ventral setae smooth except *JV5* thickened and serrated.

Chelicera. Movable digit 20 (19–20) long, with one tooth; fixed digit 19 (17–20), anterior half with one teeth, posterior half with six teeth, *pilus dentilis*. Spermatodactyl heel-and-toe variant, shaft 13 (9–15) long, foot 7 (7–8) long.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* II (pd2) 11 (9–13), *Sge* IV (ad2) 20 (18–21), *Sti* IV (ad) 30 (28–34), *Sbta* IV (d) 37 (34–41), *Sdta* IV (d) 36 (34–38). Macrosetae apically shovel-shaped with expanded blade.

Specimens examined. Pingguang Rd., Xindian Dist., New Taipei City (24°53.533' N, 121°29.397' E, 515m), two females one male (no. 1785–4, 5, 6) from *Callicarpa formosana* (Lamiaceae), 20.vii.2016, J. R. Liao (NTU); Mt. Shihzihtou, Xindian Dist., New Taipei City (24°54.160' N, 121°30.074' E, 653m), seven females one male (no. 1791–2, 7, 10, 11, 12, 13, 14, 16) from *Rubus formosensis* (Rosaceae), 20.vii.2016, J. R. Liao (NTU); Mt. Shihzihtou, Xindian Dist., New Taipei City (24°54.160' N, 121°30.074' E, 653m), seven females one male (no. 1791–2, 7, 10, 11, 12, 13, 14, 16) from *Mallotus paniculatus* (Euphorbiaceae), 20.vii.2016, J. R. Liao (NTU); Nanao Forest Road, Nan'ao Township, Yilan County (24°25.075' N, 121°44.768' E, 311m), one female (no. 1802-1) from *Mallotus paniculatus* (Euphorbiaceae), 2.viii.2016, J. R. Liao (NTU); Nanao Forest Road, Nan'ao Township, Yilan County (24°25.075' N, 121°44.768' E, 311m), eight females three males (no. 1806–1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14) from *Callicarpa formosana* (Lamiaceae), 2.viii.2016, J. R. Liao (NTU); Nanao Forest Road, Nan'ao Township, Yilan County (24°25.075' N, 121°44.768' E, 311m), two females (no. 1808–1, 2) from *Mallotus japonicus* (Euphorbiaceae), 2.viii.2016, J. R. Liao (NTU); Nanao Forest Road, Nan'ao Township, Yilan County (24°24.666' N, 121°44.880' E, 540m), three females (no. 1810–3, 10, 11) from *Broussonetia papyrifera* (Moraceae), 2.viii.2016, J. R. Liao (NTU); Nanao Forest Road, Nan'ao Township, Yilan County (24°24.666' N, 121°44.880' E, 540m), three females (no. 1811-1, 2, 3)



from *Mallotus japonicus* (Euphorbiaceae), 2.viii.2016, J. R. Liao (NTU); Nanao Forest Road, Nan'ao Township, Yilan County (24°24.666' N, 121°44.880' E, 540m), one female (no. 1812-9) from *Pueraria lobata* (Fabaceae), 2.viii.2016, J. R. Liao (NTU); Nanao Forest Road, Nan'ao Township, Yilan County (24°24.666' N, 121°44.880' E, 540m), one female one male (no. 1818-2, 3) from *Ampelopsis brevipedunculata* (Vitaceae), 2.viii.2016, J. R. Liao (NTU); Mt. Luyi, Jiashian Dist., Kaohsiung City (23°05.652' N, 120°34.592' E, 608m), one male (no. 1846-6) from *Melastoma malabathricum* (Melastomataceae), 10.viii.2016, J. R. Liao (NTU).

Distribution. Asia: China (Hainan (Wu & Ou 2002a), Wuling Mountain Region (Wu & Lan 1992a), Hong Kong (Schicha 1987)), India (Gupta 1977), Japan (Ehara *et al.* 2000), Philippines (Corpuz & Rimando 1966), Singapore (Corpuz-Raros 1995b), Taiwan (Ho & Lo 1989), Thailand (Ehara & Bhandhufalck 1977). Oceania: New Caledonia (Schicha & Corpuz-Raros 1985).

Remarks. Prasad (2016) provided a complicated review of this species. The tooth numbers are 12 teeth on fixed digit, 3 teeth on movable digit. In present study, 11 teeth on fixed digit, 3 teeth on movable digit.

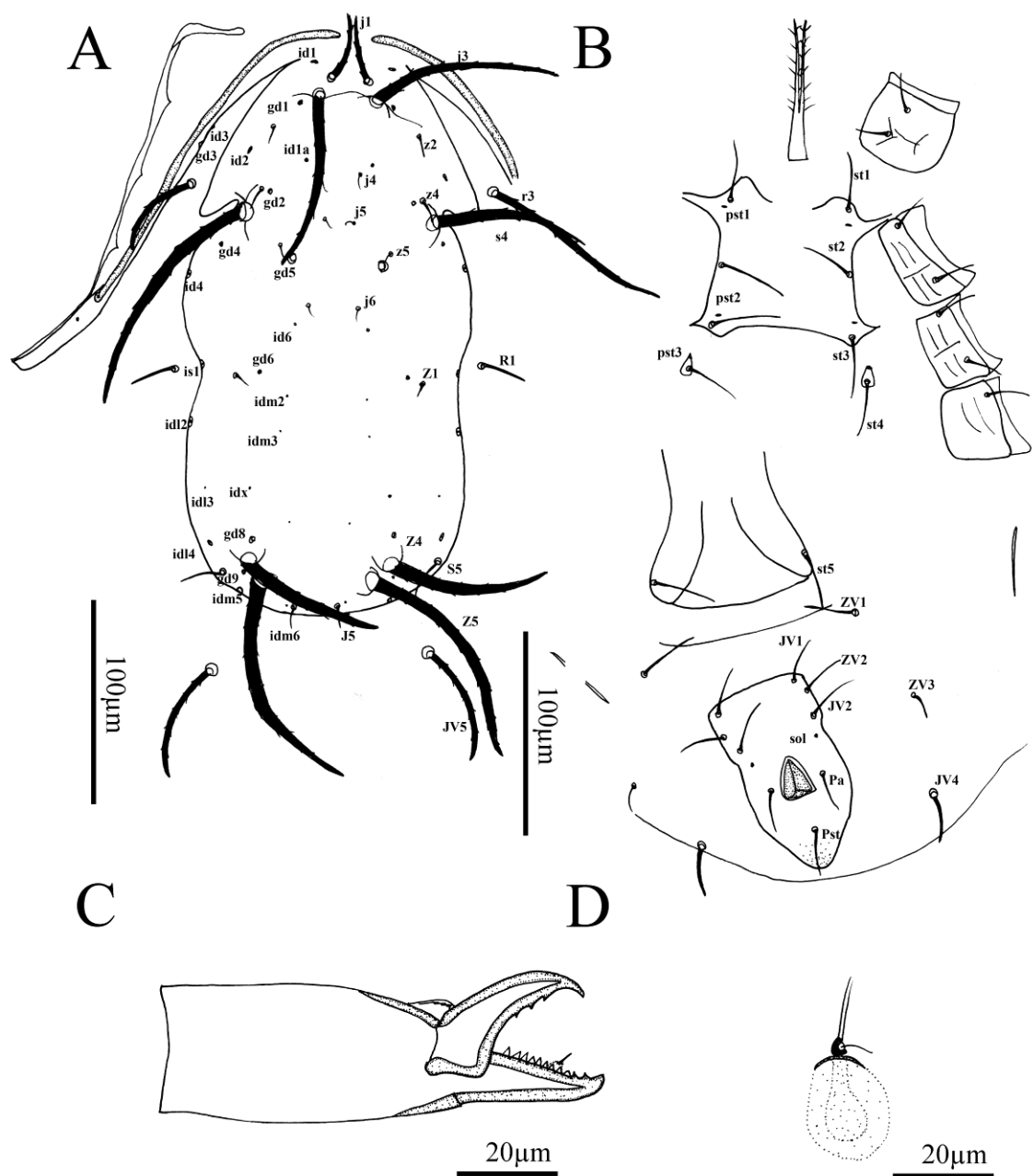


FIGURE 47. *Paraphytoseius cracentis* (Corpuz & Rimando, 1966), Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

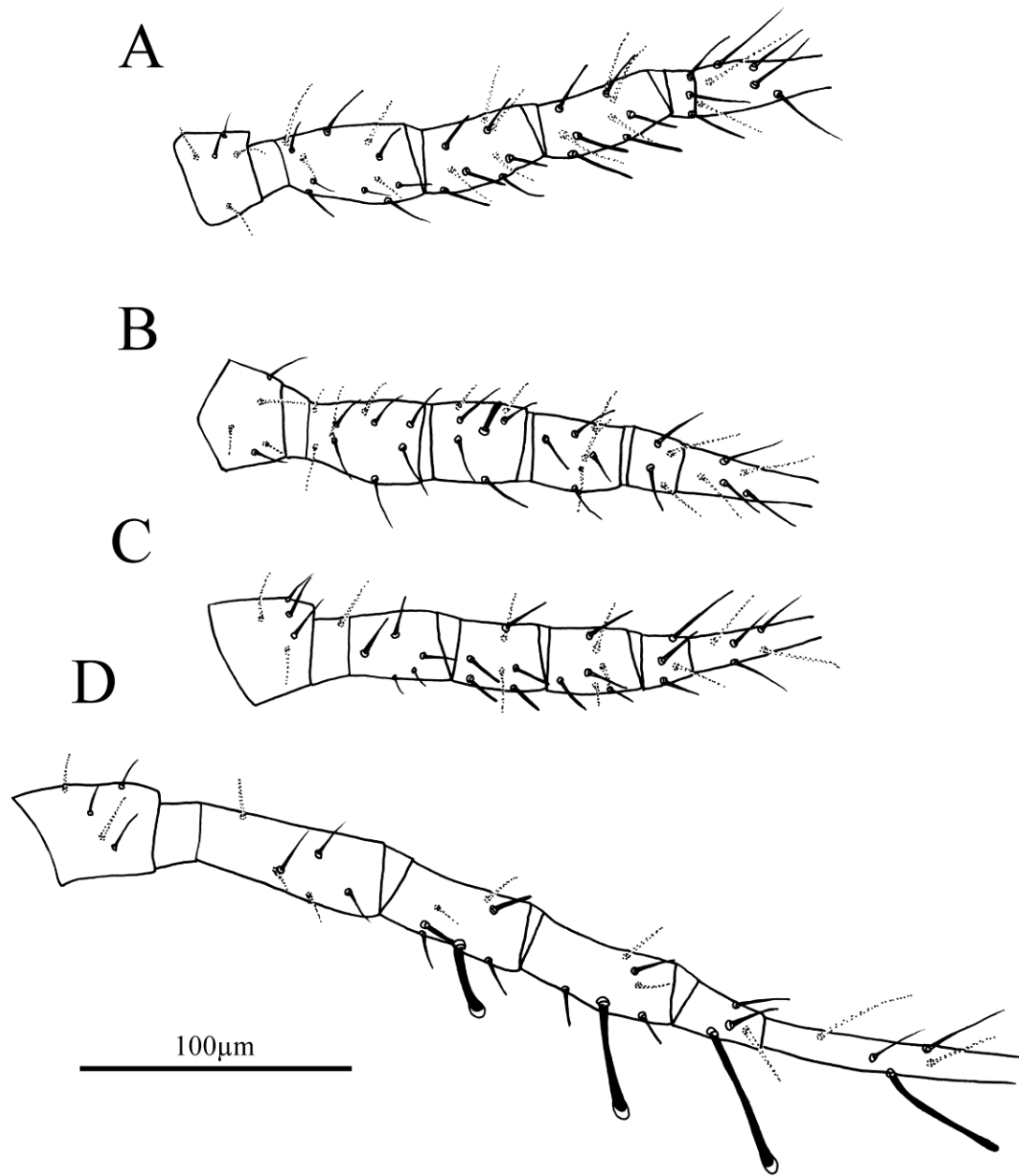


FIGURE 48. *Paraphytoseius cracentis* (Corpuz & Rimando, 1966), Female, legs A. leg I anterior view, B. leg II dorsal view, C. leg III anterior view, D. leg IV anterior view.

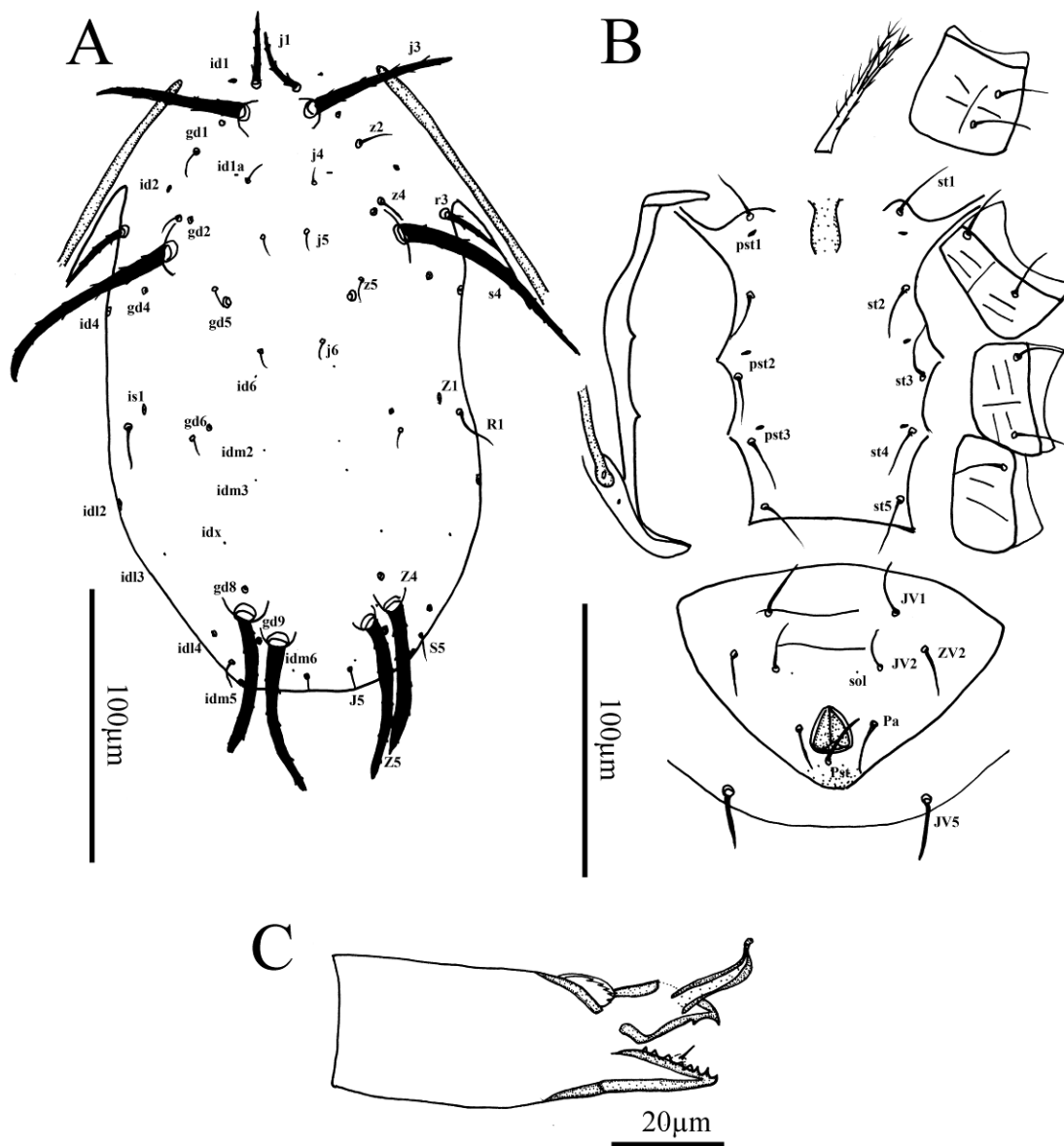


FIGURE 49. *Paraphytoseius cracentis* (Corpuz & Rimando, 1966), Male, A. dorsal shield; B. ventral idiosoma; C. chelicera and spermatodactyl.

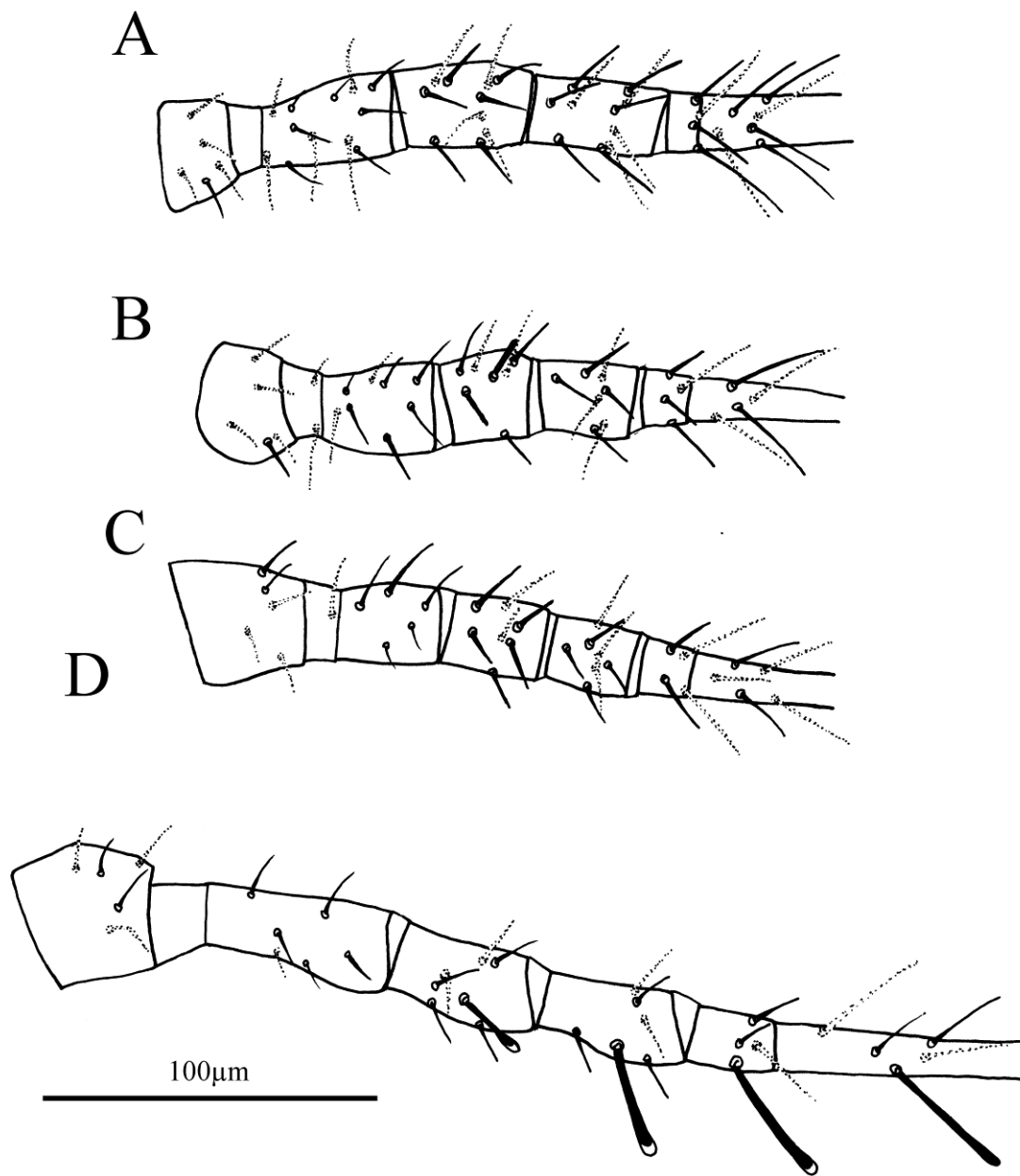


FIGURE 50. *Paraphytoseius cracentis* (Corpuz & Rimando, 1966), Male, legs A. leg I posterordorsal view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV anterior view.

***Paraphytoseius hualienensis* Ho & Lo, 1989**

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(Figures 51–54)

Paraphytoseius hualienensis Ho & Lo, 1989: 97.

Female (n=3)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:6E/JV-3:ZV.

Dorsum. Dorsal shield, smooth, lateral margin of female dorsal shield strongly incised at level of seta *s4*, **280** 272 (263–280) long, **127** 144 (127–158) wide at level of *s4*, **158** 152 (139–159) wide at level of *S4*; seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), fifteen pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *id6*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *idx*, *is1*, *idl2*, *idl3*, *idl4*); length of dorsal setae: *j1* **36** 30 (27–36), *j3* **96** 84 (78–96), *j4* **4** 4 (4–4), *j5* **4** 5 (4–6), *j6* **7** 6 (4–7), *J5* **5** 6 (5–6), *z2* **4** 7 (4–8), *z4* **5** 5 (5–6), *z5* **4** 6 (4–8), *Z1* **6** 7 (6–9), *Z4* **85** 75 (69–85), *Z5* **118** 102 (91–118), *s4* **133** 113 (102–133), *S5* **15** 16 (12–20), *r3* **46** 41 (38–46), *R1* **26** 26 (24–28). Setae *j1*, *r3*, *R1* elongated and serrated; *j3*, *s4*, *Z4* and *Z5* elongated, thickened, serrated and arising from tubercles; other minute.

Peritreme. Peritreme extending to *j1* level, peritremal shield smooth, lightly sclerotized, with one pair of solenostome (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, posterior margin almost straight, wider than long, **62** 67 (62–76) long, **89** 85 (78–89) wide at *st3* level, with three pairs of setae *st1* **28** 29 (28–30), *st2* **29** 28 (27–29), *st3* **30** 26 (22–30) and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae I–IV. Metasternal platelets tear-shaped, with a pair metasternal setae, *st4* **27** 24 (22–27), and one pair of lyrifissures (*pst3*). Genital shield smooth, *st5* **28** 22 (18–28), **87** 80 (74–84) wide. Distances between *st1-st1* **52** 57 (52–62), *st2-st2* **75** 69 (62–75), *st3-st3* **78** 74 (71–78), *st1-st3* **54** 65 (54–72), *st5-st5* **77**

70 (66–77). Ventrianal shield smooth, much longer than wide, with slightly waist at *JV2* level; **104** 98 (92–104) long, **60** 72 (60–92) wide at level of *ZV2* and **45** 51 (45–55) wide at level of anus; with three pairs of pre-anal setae, *JV1* **16** 14 (12–16), *JV2* **18** 15 (14–18), *ZV2* **21** 16 (13–21), with a pair of minute, solenostomes *gv3* locate on normal postion, *Pa* **14** 13 (12–14), *Pst* **17** 18 (15–20) on shield.. Setae *JV4* **17** 18 (17–19), *JV5* **79** 71 (63–79), *ZV1* **14** 15 (13–17), *ZV3* **12** 13 (12–13) on interscutal membrane. All ventral setae smooth, except seta *JV5* thickened, serrated. One pair of metapodal plates **27** 28 (25–30) long, **2** 3 (2–4) wide.

Spermatheca. Calyx of spermatheca disc-shaped, **2** 2 (2–3) long, **9** 7 (7–9) wide and atrium nodular without neck, major and minor ducts visible.

Chelicera. Movable digit **30** 30 (30–30) long, with three teeth; fixed digit **28** 26 (24–28), anterior half with two teeth, posterior half with nine teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/1-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* IV (ad2) **31** 28 (26–31), *Sti* IV (ad) **43** 41 (38–43), *Sbta* IV (d) **49** 45 (40–49), *Sdta* IV (d) **49** 45 (38–49). Macrosetae apically shovel-shaped with expanded blade.

Male (n=1)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:6E/ JV-3,4:ZV-1,3.

Dorsum. Dorsal shield smooth, laterally reticulated; 234 long, 134 wide at level of *s4*, 121 wide at level of *S4*, with ; seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), fifteen pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *id6*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *idx*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 24, *j3* 66, *j4* 6, *j5* 5, *j6* 5, *J5* 5, *z2* 5, *z4* 7, *z5* 6, *Z1* 12, *Z4* 46, *Z5* 57, *s4* 91, *S5* 7, *r3* 30, *R1* 17. Setae *j1*, *r3*, *R1* elongated and

serrated; *j3*, *s4*, *Z4* and *Z5* elongated, thickened, serrated and arising from tubercles; other minute. Setae *r3* and *R1* inserted on dorsal shield.

Peritreme. Peritreme extending to *z2* level; peritremal shield lightly sclerotized.

Venter. Sternogenital shield smooth, lateral slightly reticulated, posterior margin almost straight, longer than wide 116 long, 75 wide at level *st2*, with five pairs of setae *st1* 28, *st2* 20, *st3* 23, *st4* 21, *st5* 20, three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Exopodal shield at coxae I–IV. Distance between *st1-st1* 54, *st2-st2* 58, *st3-st3* 67, *st4-st4* 56, *st5-st5* 42, *st1-st5* 111. Ventrianal shield subtriangular, with slightly reticulation, 89 long, 132 wide at level of anterior corner and 53 wide at level of anus, fused with peritremal shield cingulum; with three pairs of pre-anal setae, *JV1* 15, *JV2* 11, *ZV2* 14, solenostome *gv3* crescentic, *Pa* 10, *Pst* 13 on shield; *JV5* 22 on interscutal membrane. All ventral setae smooth except seta *JV5* serrated.

Chelicera. Movable digit 19 long, with one tooth; fixed digit 19, anterior half with two teeth, posterior half with six teeth, *pilus dentilis*. Spermatodactyl heel-and-toe variant, shaft 13 long, foot 6 long.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/1-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* IV (ad2) 15, *Sti* IV (ad) 28, *Sbta* IV (d) 37, *Sdta* IV (d) 33. Macrosetae apically shovel-shaped with expanded blade.

Specimens examined. Tea field, Hegang Village, Ruisui Township, Hualien County, one holotype (88-0533) female from *Melastoma candidum* (Melastomataceae), 22.iii.1988, C. C. Ho (TARI); Tea field, Hegang Village, Ruisui Township, Hualien County, one paratype (88-0534) female from *Melastoma candidum* (Melastomataceae), 22.iii.1988, C. C. Ho (TARL); Mt. Naren, Manzhou Township, Pingtung County, one

female from *Melastoma candidum* (Melastomataceae), 26.xi.1988, C. C. Ho (TARL).

Distribution. Asia: Taiwan (Ho & Lo 1989)

Remarks. Prasad (2016) considered this species is junior synonym of *P. cracentis*.

Some differences are observed in present study, such as length of seta *JV5*. This study still consider the *P. hualienensis* is a valid species until we have more evidences in future.

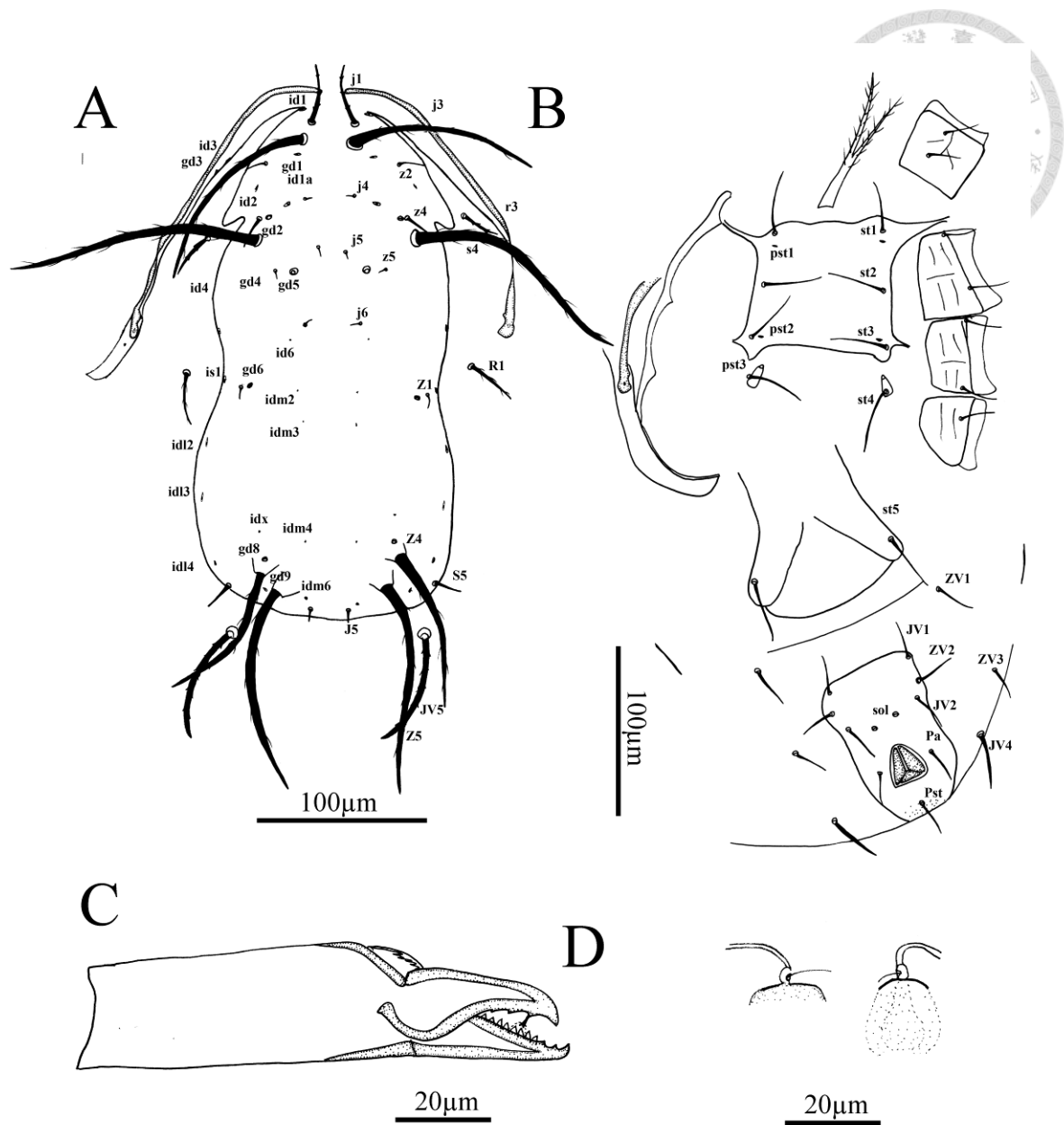


FIGURE 51. *Paraphytoseius hualienensis* Ho & Lo, 1989, Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

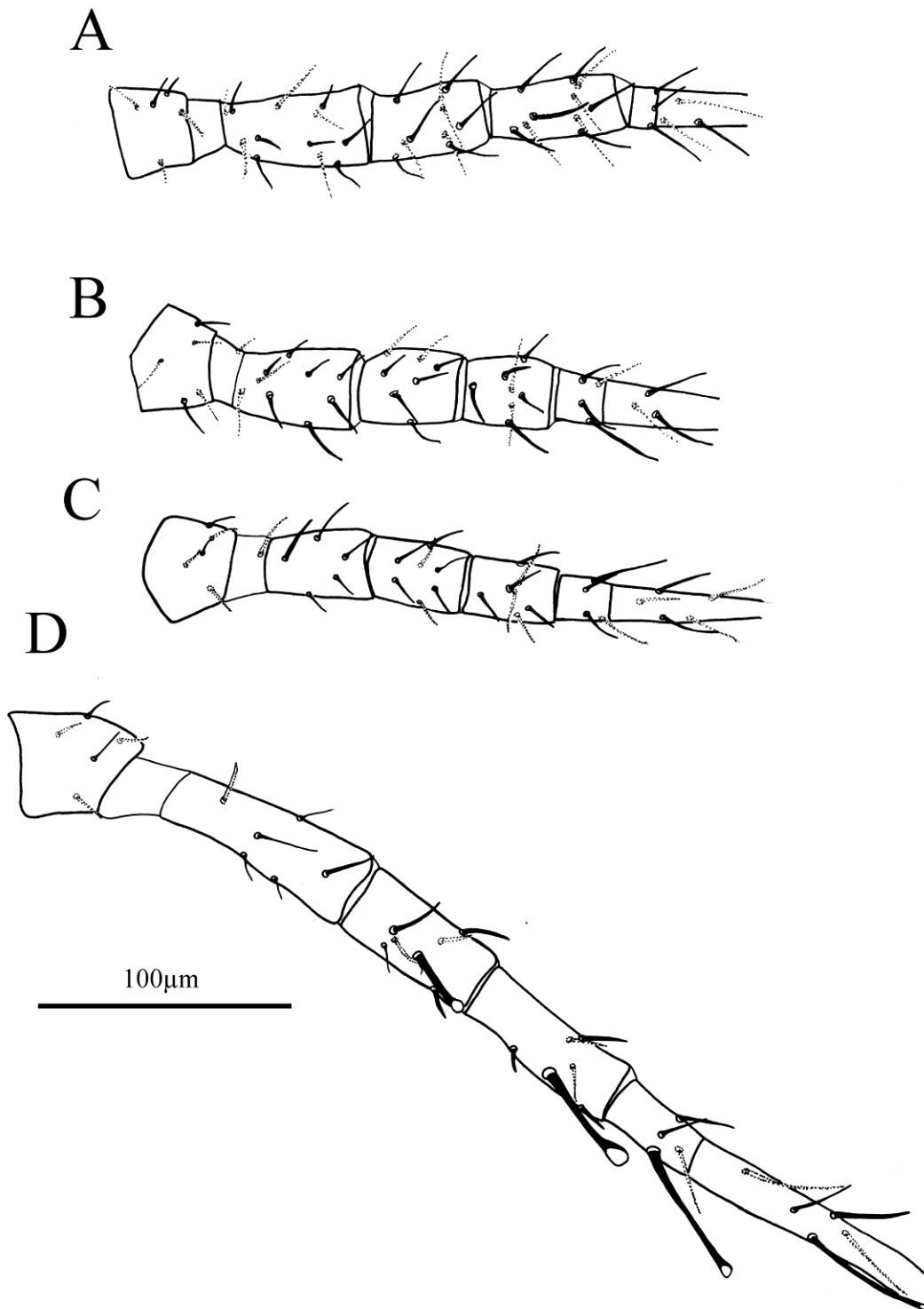


FIGURE 52. *Paraphytoseius hualienensis* Ho & Lo, 1989, Female, legs A. leg I anterior view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV anterior view.

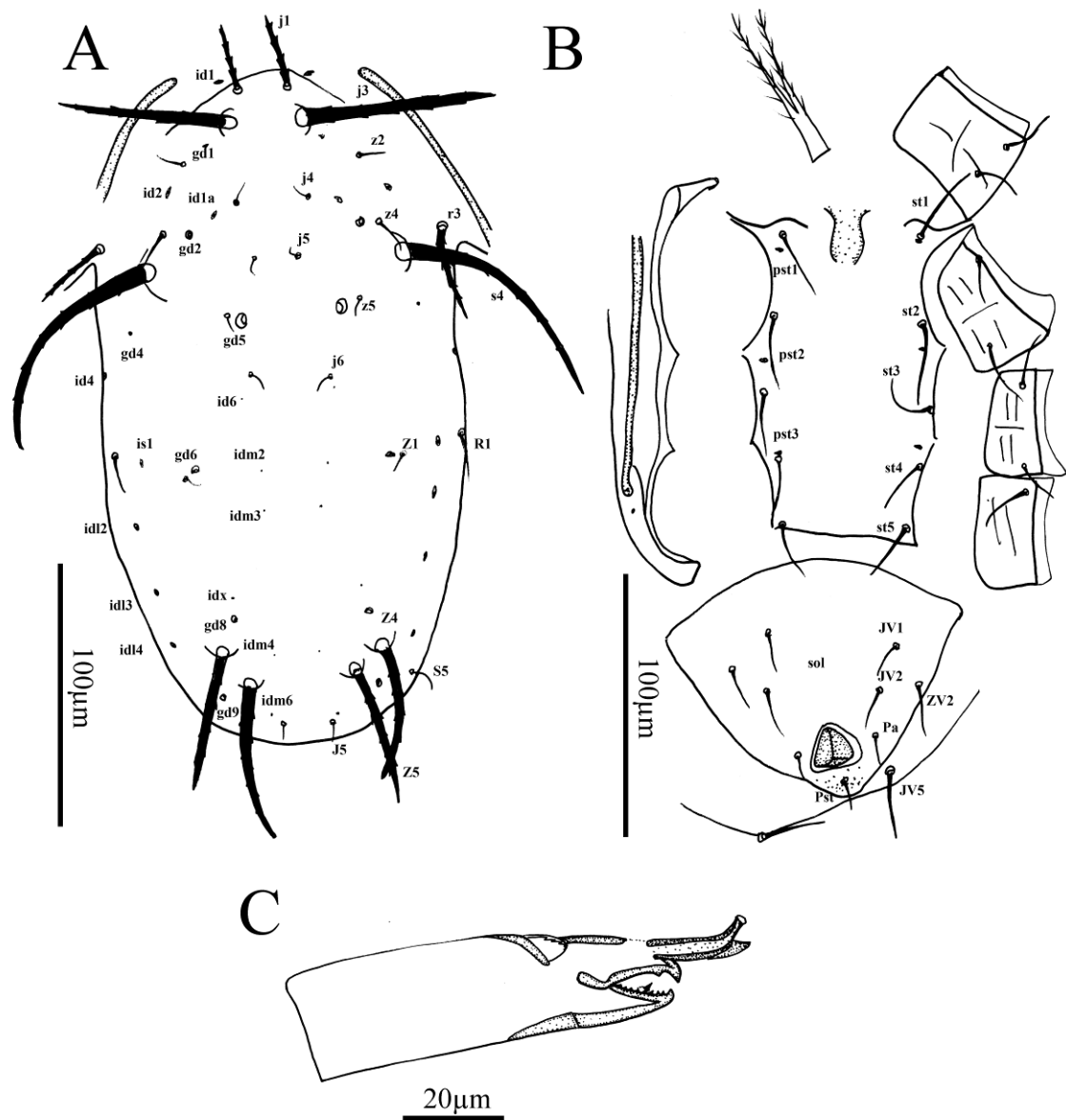


FIGURE 53. *Paraphytoseius hualienensis* Ho & Lo, 1989, Male, A. dorsal shield; B. ventral idiosoma; C. chelicera and spermatodactyl.

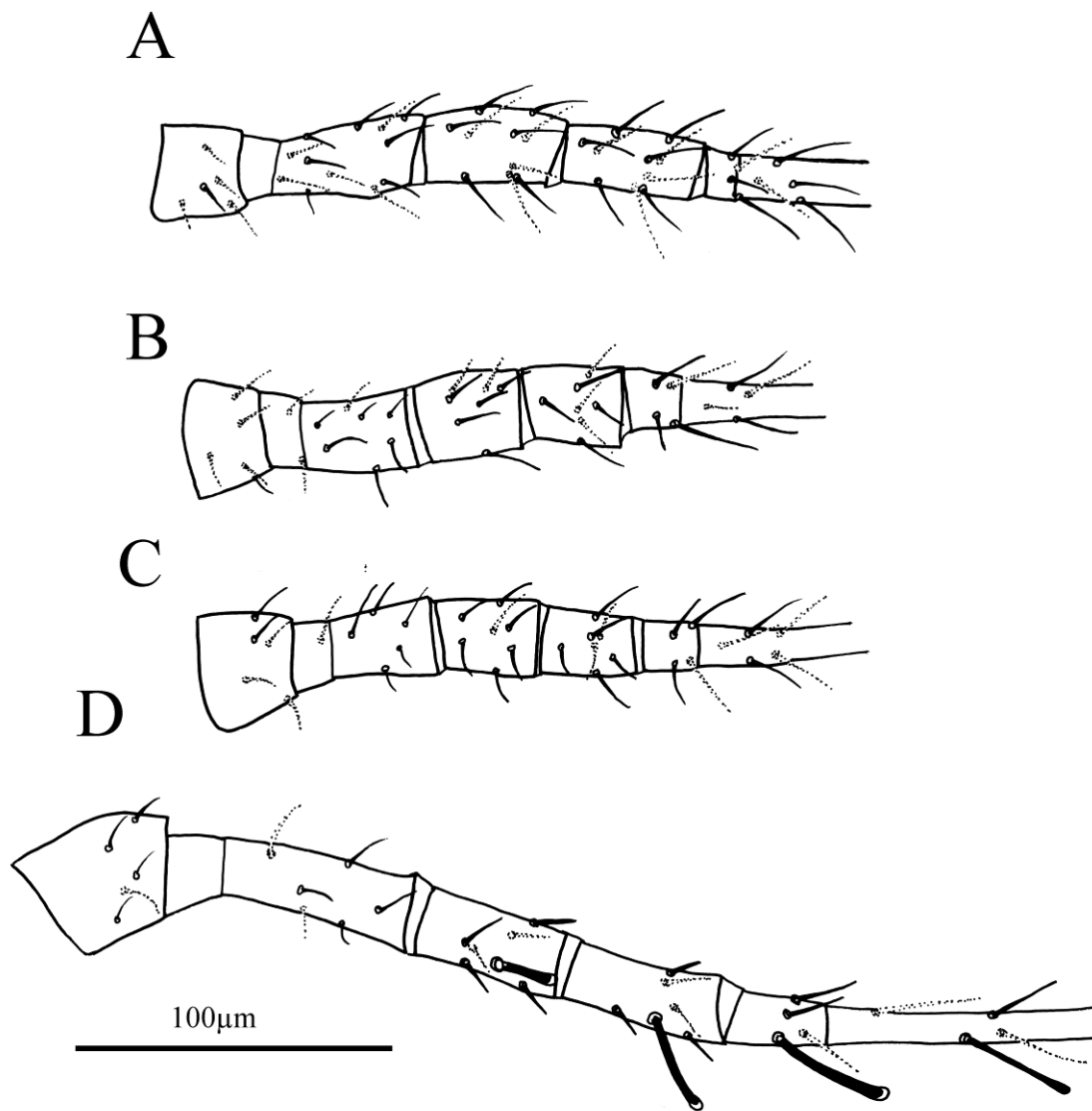


FIGURE 54. *Paraphytoseius hualienensis* Ho & Lo, 1989, Male, legs A. leg I posterior view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV anterior view.

***Paraphytoseius orientalis* (Narayanan, Kaur & Ghai, 1960)**

東方擬植綏蟎



(Figures 55–58)

Typhlodromus (*Amblyseius*) *orientalis* Narayanan, Kaur & Ghai, 1960: 394.

Paraphytoseius orientalis.—Ehara, 1966: 25.

Paraphytoseius ipomeai (El-Banhawy, 1984): 126. (Synonymy according to Chant & McMurtry 2003b)

Paraphytoseius multidentatus Swirski & Shechter, 1961: 114. (Synonymy according to Chant & McMurtry 2003b)

Paraphytoseius narayanani (Ehara & Ghai, 1967), in Ehara, 1967: 77. (Synonymy according to Chant & McMurtry 2003b)

Paraphytoseius santurcensis De Leon, 1965: 130. (Synonymy according to Chant & McMurtry 2003b)

Paraphytoseius seychellensis Schicha & Corpuz-Raros, 1985: 71. (Synonymy according to Chant & McMurtry 2003b)

Paraphytoseius subtropicus (Tseng, 1972): 1. (Synonymy according to Matthysse & Denmark 1981)

Female (n=10)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:5D/JV-3:ZV.

Dorsum. Dorsal shield, smooth, lateral margin of female dorsal shield strongly incised at level of seta *s*₄, 277 (251–300) long, 149 (142–160) wide at level of *s*₄, 135 (127–145) wide at level of *S*₄; seven pairs of solenostomes (*gd*₁, *gd*₂, *gd*₄, *gd*₅, *gd*₆, *gd*₈, *gd*₉), sixteen pairs of lyrifissures (*id*₁, *id*_{1a}, *id*₂, *id*₄, *id*₆, *idm*₁, *idm*₂, *idm*₃, *idm*₄, *idm*₅, *idm*₆, *idx*, *is*₁, *idl*₂, *idl*₃, *idl*₄); length of dorsal setae: *j*₁ 35 (23–40), *j*₃ 82 (79–87), *j*₄ 4 (2–5), *j*₅ 4 (2–7), *j*₆ 4 (3–6), *J*₅ 4 (2–6), *z*₂ 6 (4–9), *z*₄ 7 (5–9), *z*₅ 4 (3–6), *Z*₁ 5

(3–8), *Z4* 69 (64–79), *Z5* 89 (78–100), *s4* 115 (106–124), *r3* 44 (38–53), *R1* 26 (22–29). Setae *j1*, *r3*, *R1* elongated and serrated; *j3*, *s4*, *Z4* and *Z5* elongated, thickened, serrated and arising from tubercles; other minute.

Peritreme. Peritreme extending to *j1* level, peritremal shield smooth, lightly sclerotized, with one pair of solenostome (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, posterior margin straight, wider than long, 72 (64–79) long, 80 (77–84) wide at *st3* level, with three pairs of setae *st1* 32 (24–38), *st2* 28 (22–34), *st3* 25 (19–33) and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae I–IV. Metasternal platelets tear-shaped, with a pair metasternal setae, *st4* 24 (18–35), and one pair of lyrifissures (*pst3*). Genital shield smooth, *st5* 28 (22–33), 83 (73–91) wide. Distances between *st1-st1* 63 (57–71), *st2-st2* 64 (61–67), *st3-st3* 72 (69–77), *st1-st3* 65 (63–68), *st5-st5* 74 (70–77). Ventrianal shield smooth, much longer than wide, with slightly waist at *JV2* level; 94 (87–98) long, 49 (43–57) wide at level of *ZV2* and 52 (45–57) wide at level of anus; with three pairs of pre-anal setae, *JV1* 19 (11–24), *JV2* 16 (11–20), *ZV2* 14 (11–18), with a pair of minute, widely separated solenostomes *gv3* near lateral margins posterior to setae *JV2*, *Pa* 14 (11–17), *Pst* 18 (15–21) on shield. Setae *JV4* 24 (21–29), *JV5* 64 (61–70), *ZV1* 22 (15–29), *ZV3* 13 (9–14) on interscutal membrane. All ventral setae smooth, except seta *JV5* thickened and serrated. Two pairs of metapodal plates 34 (28–40) long, 2 (1–4) wide, 8 (5–13) long, 2 (1–3) wide.

Spermatheca. Calyx of spermatheca disc-shaped, 2 (1–3) long, 10 (8–12) wide, and atrium nodular without neck, major and minor ducts visible.

Chelicera. Movable digit 26 (24–28) long, with two teeth; fixed digit 24 (20–28), anterior half with two teeth, posterior half with six teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/2-1,

2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* I (pd2) 11 (8–13), *Sge* II (pd2) 15 (14–16), *Sge* IV (ad2) 27 (23–30), *Sti* IV (ad) 36 (31–41), *Sbta* IV (d) 46 (43–49), *Sdta* IV (d) 38 (33–48). Macrosetae apically shovel-shaped with expanded blade.

Male (n=3)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:5D /JV-3,4:ZV-1,3.

Dorsum. Dorsal shield smooth; 224 (222–227) long, 131 (126–134) wide at level of *s4*, 102 (98–107) wide at level of *S4*, with seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), sixteen pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *id6*, *idm1*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *idx*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 24 (24–25), *j3* 60 (58–62), *j4* 3 (1–5), *j5* 4 (3–4), *j6* 4 (2–6), *J5* 3 (2–4), *z2* 6 (4–7), *z4* 6 (5–6), *z5* 4 (3–5), *Z1* 5 (4–6), *Z4* 44 (39–50), *Z5* 55 (52–57), *s4* 82 (81–83), *r3* 31 (28–36), *R1* 14 (13–16). Setae *j1*, *r3*, *R1* elongated and serrated; *j3*, *s4*, *Z4* and *Z5* elongated, thickened, serrated and arising from tubercles; other minute. Setae *r3* and *R1* inserted on dorsal shield.

Peritreme. Peritreme extending to *z2* level; peritremal shield lightly sclerotized.

Venter. Sternogenital shield smooth, lateral slightly reticulated, posterior margin almost straight, longer than wide 132 (115–150) long, 76 (75–78) wide at level *st2*, with five pairs of setae *st1* 20 (20–20), *st2* 18 (17–19), *st3* 16 (14–17), *st4* 17 (15–19), *st5* 13 (9–16), three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Distance between *st1-st1* 54 (53–56), *st2-st2* 57 (57–57), *st3-st3* 65 (63–66), *st4-st4* 53 (52–54), *st5-st5* 43 (42–45), *st1-st5* 107 (104–111). Exopodal shield at coxae I–IV. Ventrianal shield subtriangular, with slightly reticulation, 79 (66–87) long, 106 (103–108) wide at level of anterior corner and 59 (51–67) wide at level of anus, not fused with peritremal shield; with three pairs of pre-anal setae, *JV1* 11 (7–16), *JV2* 9 (5–12), *ZV2* 11 (8–15); solenostome *gv3* small

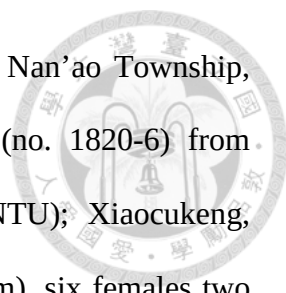
and rounded, *Pa* 11 (9–15), *Pst* 14 (9–19) on shield; *JV5* 18 (15–21) on interscutal membrane. All ventral setae smooth except *JV5* thickened and serrated.

Chelicera. Movable digit 17 (15–199) long, with one tooth; fixed digit 18 (17–18), anterior half with one tooth, posterior half with six teeth, *pilus dentilis*. Spermatodactyl heel-and-toe variant, shaft 13 (12–13) long, foot 7 (7–8) long.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/2-1, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* I (pd2) 11 (10–11), *Sge* II (pd2) 10 (8–11), *Sge* IV (ad2) 21 (20–22), *Sti* IV (ad) 30 (27–34), *Sbta* IV (d) 33 (31–36), *Sdta* IV (d) 30 (27–32). Macrosetae apically shovel-shaped with expanded blade.

Specimens examined. PHILIPPINES: College, UPLB, Laguna Province, Luzon, one female (Aca-3813) from *Ehretia macrophylla* (Boraginaceae), 14.ii.1967, F. Velasquez (UPLB-MNH); College, UPLB, Laguna Province, Luzon, one female (Aca-3814) from *Blumea balsamifera* (Asteraceae), 14.ii.1967, F. Velasquez (UPLB-MNH); College, UPLB, Laguna Province, Luzon, three females (Aca-3791) from *Sandoricum koetjape* (Meliaceae), 10.iii.1973, A. Sayaboc (UPLB-MNH); College, UPLB, Laguna Province, Luzon, one female (Aca-3790) from *Sandoricum koetjape* (Meliaceae), 12.iii.1973, A. M. Adatc (UPLB-MNH); College, UPLB, Laguna Province, Luzon, one male (Aca-3793) from *Sandoricum koetjape* (Meliaceae), 5.iii.1980, J. Soriano Jr. (UPLB-MNH); College, UPLB, Laguna Province, Luzon, one female (Aca-3785) from *Broussonetia papyrifera* (Moraceae), ?.iii.2001, J. L. Facundo (UPLB-MNH).

TAIWAN: Pingguang Rd., Xindian Dist., New Taipei City (24°53.533' N, 121°29.397' E, 515m), three females one male (no. 1787-7, 9, 10, 11) from *Mallotus paniculatus*



(Euphorbiaceae), 20.vii.2016, J. R. Liao (NTU); Kinyang Village, Nan'ao Township, Yilan County (24°25.208' N, 121°44.200' E, 192m), one male (no. 1820-6) from *Macaranga tanarius* (Euphorbiaceae), 2.viii.2016, J. R. Liao (NTU); Xiaocukeng, Xindian Dist., New Taipei City (24°55.950' N, 121°33.908' E, 255m), six females two males (no. 1853-1, 2, 3, 4, 6, 7, 10) from *Mallotus paniculatus* (Euphorbiaceae), 14.viii.2016, J. R. Liao (NTU); Xiaocukeng, Xindian Dist., New Taipei City (24°55.950' N, 121°33.908' E, 255m), six females two males (no. 1853-1, 2, 3, 4, 6, 7, 10) from *Mallotus paniculatus* (Euphorbiaceae), 14.viii.2016, J. R. Liao (NTU); Mt. Datong, Wulai Dist., New Taipei City (24°52.975' N, 121°34.152' E, 563m), two females (no. 1880-2, 4) from *Morus* sp. (Moraceae), 18.viii.2016, J. R. Liao (NTU).

Distribution. Africa: Benin (Moraes *et al.* 1989a), Dr Congo (Moraes *et al.* 1989a), Kenya (Moraes *et al.* 2007b), Madagascar Island (Blommers 1976), Mozambique (Moraes *et al.* 2007b), Nigeria (Matthysse & Denmark 1981), Rwanda (Moraes *et al.* 2007b). Asia: China (Fujian (Wu 1981), Guangdong (Chen *et al.* 1980), Hainan (Chen *et al.* (1980), Hong Kong (Swirski & Shechter 1961), Jiangxi (Zhu & Chen 1983a), Wuling Mountain Region (Wu & Lan 1992a)), India (Narayanan *et al.* 1960), Japan (Ohno *et al.* 2012), Malaysia (Ehara 2002a), Pakistan (Chaudhri *et al.* 1979), Philippines (Schicha & Corpuz-Raros 1985), Taiwan (Ho & Lo 1989), Vietnam (Nguyen *et al.* 2016). Central America: Costa Rica (Denmkar *et al.* 1999). North America: Martinique (Moraes *et al.* 2000). Oceania: New Caledonia (McMurtry & Moraes 1984). South America: Argentina (Guanilo *et al.* 2008a), Brazil (Feres *et al.* 2007), Venezuela (Aponte & McMurtry 1993), Colombia (Moraes & Mesa 1988).

Remarks. Ho & Lo (1989) reported that the fixed digit have 7-8 teeth, 2-3 teeth on movable digit; the present study re-examined type specimens and confirmed 8 teeth on fixed digit, 2 teeth on movable digit.

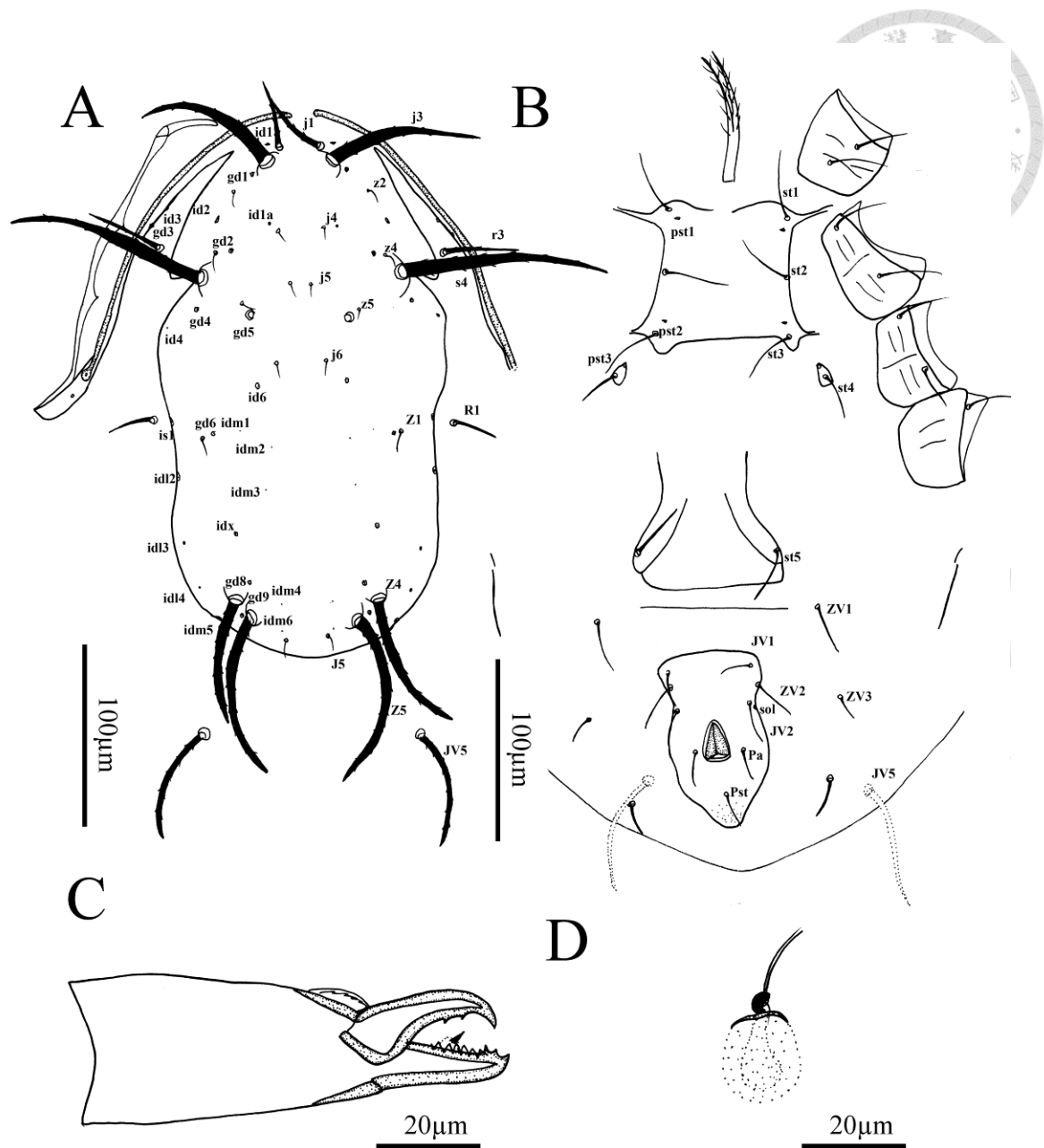


FIGURE 55. *Paraphytoseius orientalis* (Narayanan, Kaur & Ghai, 1960), Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

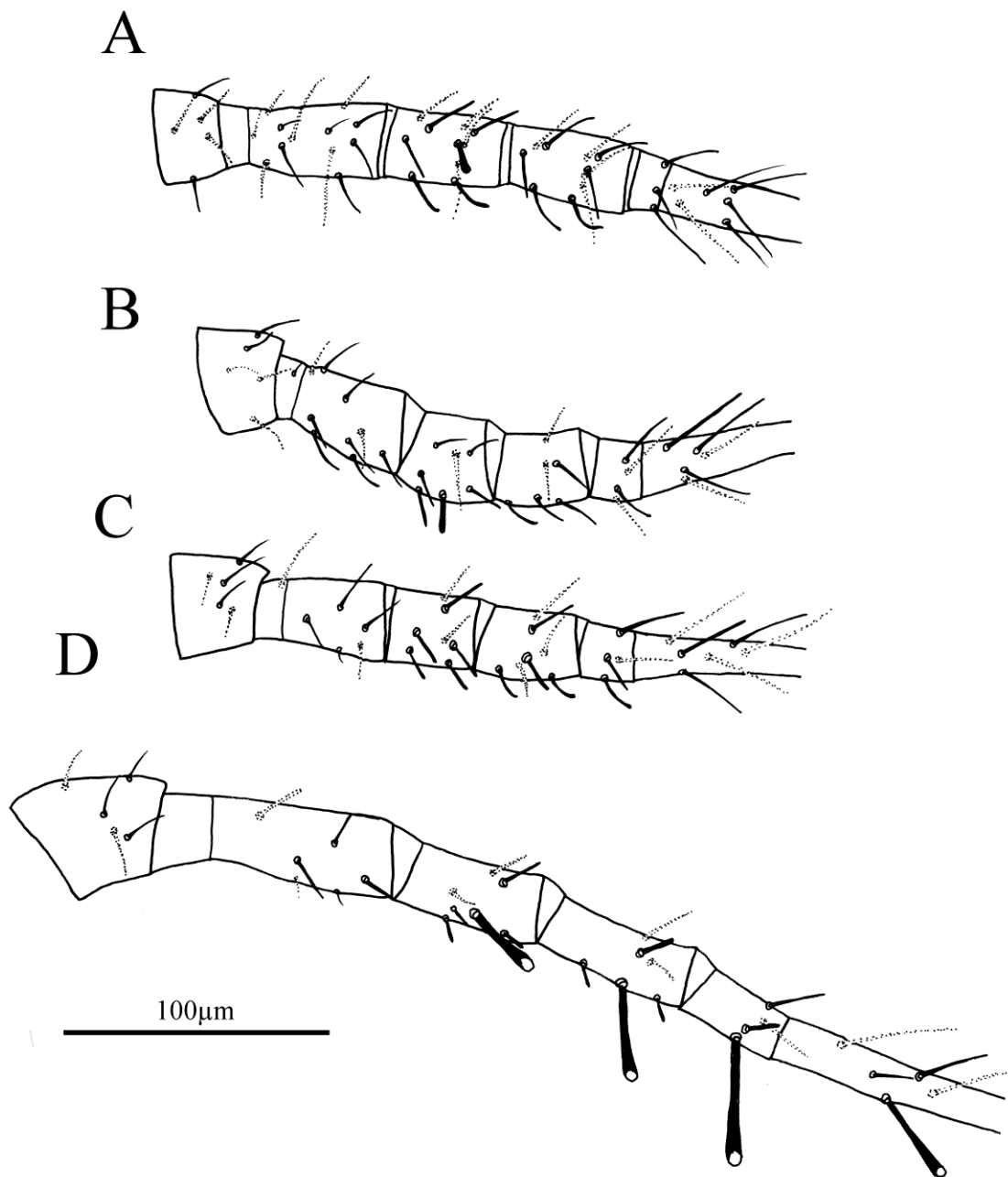


FIGURE 56. *Paraphytoseius orientalis* (Narayanan, Kaur & Ghai, 1960), Female, legs
 A. leg I dorsal view, B. leg II anterior view, C. leg III anterodorsal view, D. leg IV
 anterior view.

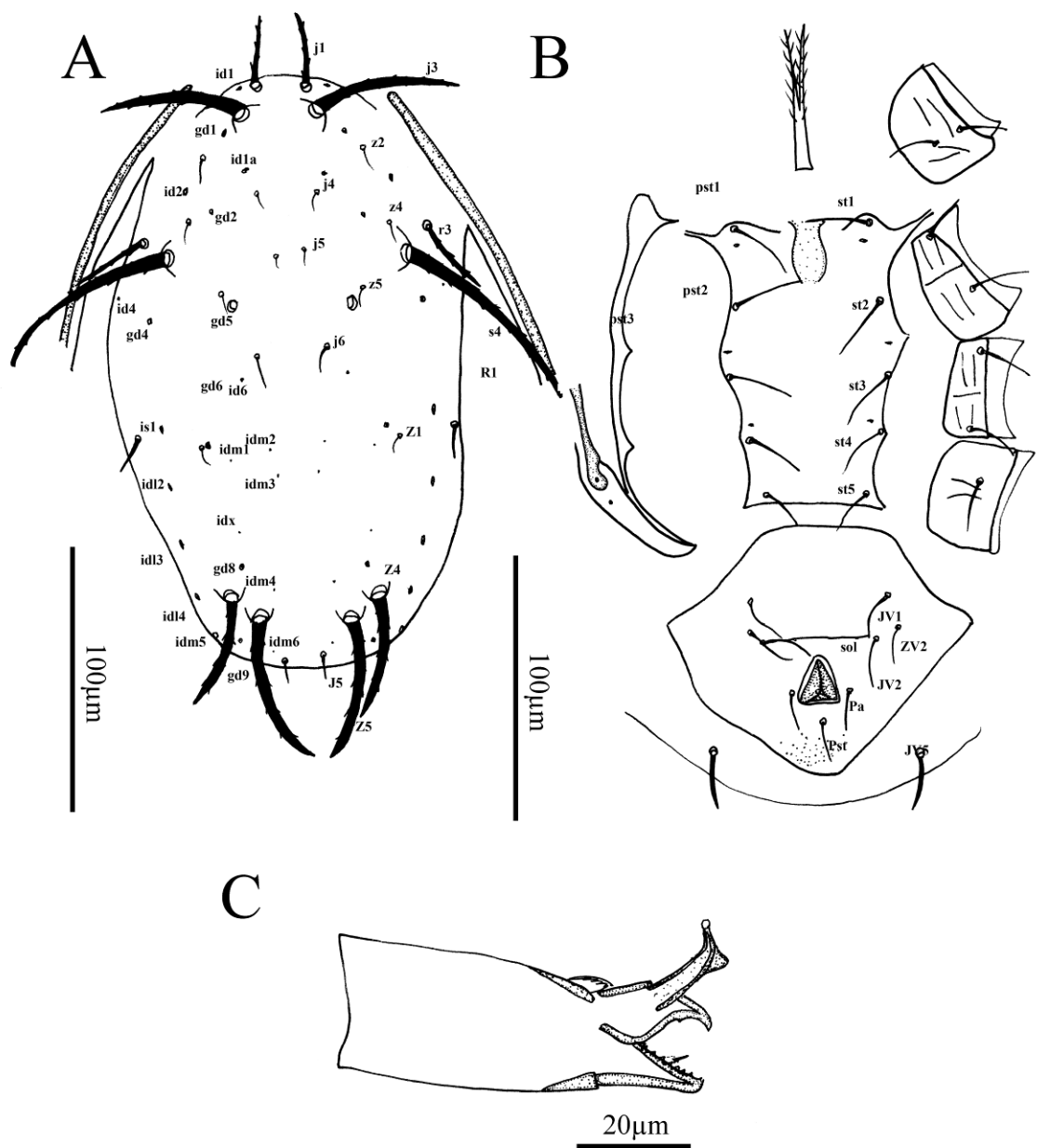


FIGURE 57. *Paraphytoseius orientalis* (Narayanan, Kaur & Ghai, 1960), Male, A. dorsal shield; B. ventral idiosoma; C. chelicera and spermatodactyl.

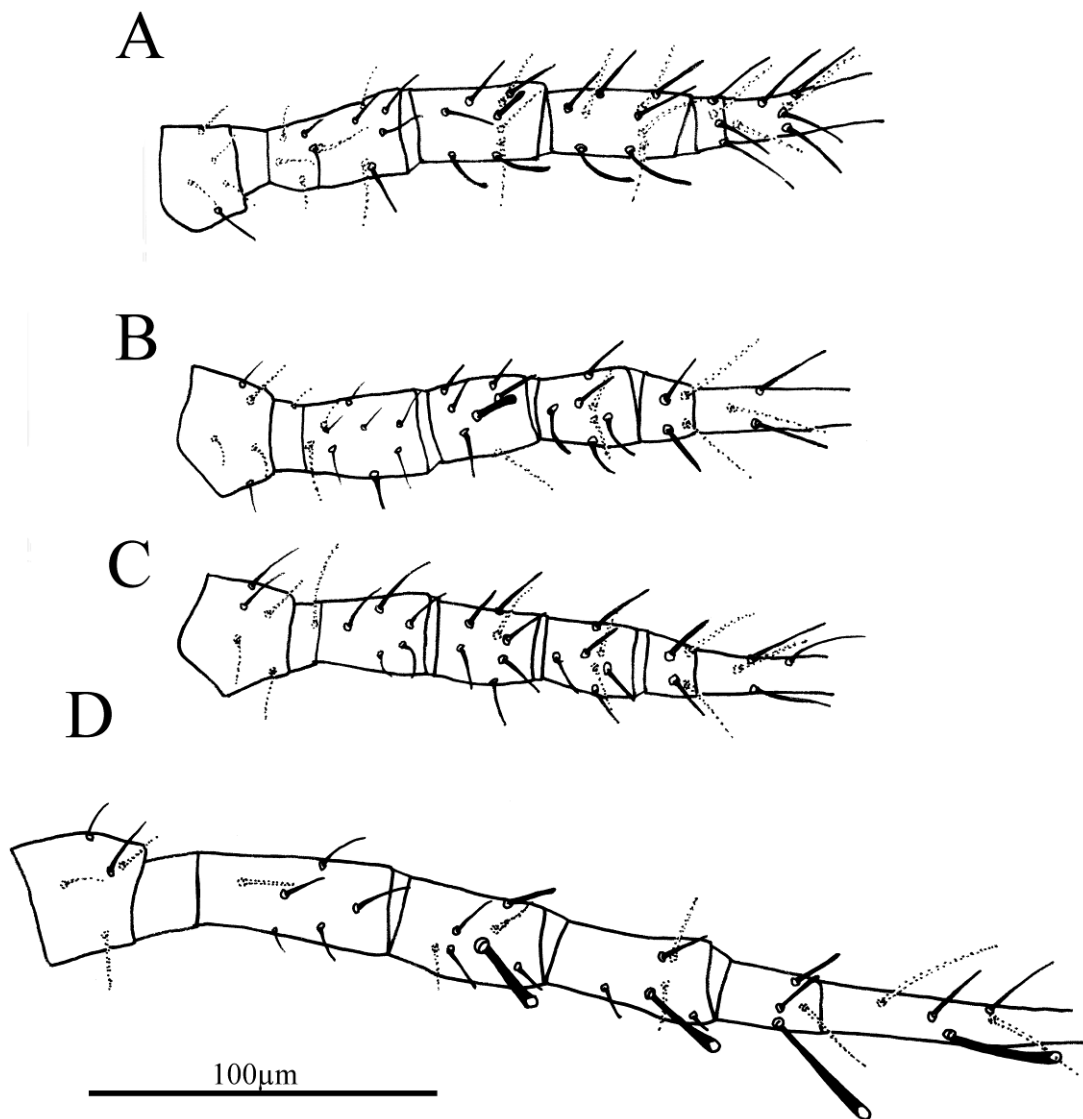


FIGURE 58. *Paraphytoseius orientalis* (Narayanan, Kaur & Ghai, 1960), Male, legs A. leg I posterodorsal view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV dorsal view.

Subtribe Kampimodromina Chant & McMurtry, 2003b

斜行綏蟎亞族

Kampimodromina Kolodocka Chant & McMurtry, 2003b: 193.



Type genus: *Kampimodromus* Nesbitt, 1951: 53.

The species in this subtribe are characterized by without a distinct notch or incision in the lateral margin of the dorsal shield at the level of seta s4. In addition, leg IV never with very long, greatly thickened macrosetae; lateral dorsal setae usually but not always of approximately the same length; fixed digit of chelicera usually with few teeth; usually without a prominent pair of pores associated with seta z5. Eight genera belong to this subtribe, including *Asperoseius* Chant, *Eharius* Tuttle and Muma, *Kampimodromus* Nesbitt, *Kampimoseiulella* Chant & McMurtry, *Okiseius* Ehara, *Paraamblyseiulella* Chant & McMurtry, *Parakampimodromus* Chant & McMurtry, *Proprioseius* Chant.

Genus *Okiseius* Ehara, 1967

沖綏蟎屬

Okiseius Ehara, 1967a: 77.

Okiseius (*Kampimodromellus*).—Kolodochka & Denmark, 1996: 2. Type species -

Amblyseius (*Kampimodromus*) *maritimus* Ehara, 1967b.

Okiseius (*Okiseius*).—Kolodochka & Denmark, 1996: 233.

Type species - *Okiseius subtropicus* Ehara, 1967: 77.

There are 17 valid species in this genus (Demite *et al.* 2019). Chant & McMurtry

(2003b) proposed 2 species group by insertion of seta *R1*, *subtropicus* group on dorsal shield, *maritimus* group on lateral integument.



Diagnosis – Idiosomal pattern 10A:7E/JV-3:ZV, or 10A:6E/JV-3:ZV (*O. cowbay*).

Dorsal shield lightly to strongly sclerotized, with strong sculpturing; with notch at level of seta *r3*. Solenostome *gd5* prominent. Dorsal setae short to medium in length, most setae thickened and serrated, some arising from tubercles. Sternal shield posterior margin concave. Genital shield truncated posteriorly. Female ventrianal shield much longer than wide, with slightly waist, with 3 pair of preanal setae, *gv3* conspicuous. Peritreme usually extending to *j1* level. Spermatheca simple, with atrium nodular, calyx cup-shaped or goblet-shaped. Chelicera fixed digit usually with 2-6 teeth, movable digit with 1-2 teeth. Leg IV with 1-3 short, stout macrosetae. Ge II with 7 setae. Male ventrianal shield triangular.

Key to species in the genus *Okiseius* from Taiwan

1. Dorsal shield with lateral incision at seta *R1* level
 *subtropicus* Ehara, 1967
 — Dorsal shield without lateral incision at seta *R1* level
 *formosanus* Tseng, 1972

***Okiseius subtropicus* Ehara, 1967**

亞熱沖綏蟎



(Figures 59–62)

Okiseius subtropicus Ehara, 1967: 77.

Platyseiella (Noeledius) subtropicus.—Tseng, 1976: 102.

Proprioseius (Okiseius) subtropicus.—Karg, 1983: 19.

Amblyseius (Kampimodromos) subtropicus.—Ueckermann & Loots, 1985: 195.

Okiseius (Okiseius) subtropicus.—Kolodochka & Denmark, 1996: 235.

Amblyseius (Okiseius) subtropicus.—Ehara & Amano, 1998: 45.

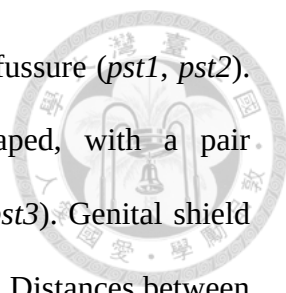
Female (n=10)

A heavily sclerotized mite. Idiosomal setal pattern: 10A:7E/JV-3:ZV.

Dorsum. Dorsal shield heavily sclerotized, with strong sculpturing, with notch at setae *r3*, *R1* level; **274** 306 (274–328) long, **158** 17 (158–196) wide at level of *s4*, **149** 170 (147–188) wide at level of *S4*; six pairs of solenostomes (*gd1*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), fourteen pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *id6*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of dorsal setae: *j1* **17** 20 (17–23), *j3* **17** 20 (13–24), *j4* **9** 13 (9–15), *j5* **14** 14 (10–16), *j6* **22** 24 (21–27), *J5* **6** 7 (4–9), *z2* **18** 22 (18–25), *z4* **16** 24 (16–29), *z5* **15** 17 (13–20), *Z1* **30** 30 (21–42), *Z4* **44** 49 (42–60), *Z5* **42** 53 (42–63), *s4* **29** 31 (24–39), *S2* **37** 39 (36–43), *S5* **16** 19 (16–24), *r3* **24** 27 (23–34), *R1* **23** 26 (21–33). All setae thickened and strongly serrated, *Z5* arising from tubercles. Setae *R1* inserted on dorsal shield.

Peritreme. Peritreme extending to to *j1* level, peritremal shield smooth, lightly sclerotized, with one pair of solenostome (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, posterior margin almost straight, wider than long, **49** 60 (49–67) long, **61** 71 (59–80) wide at *st3* level, with three pairs of setae *st1* **15** 17



(13–24), *st2* **16** 16 (11–24), *st3* **14** 16 (12–20) and two pairs of lyrifissure (*pst1*, *pst2*). Exopodal shield at coxae II–IV. Metasternal platelets tear-shaped, with a pair metasternal setae, *st4* **15** 15 (14–18), and one pair of lyrifissures (*pst3*). Genital shield smooth, truncate posteriorly, *st5* **14** 15 (13–16), **51** 60 (51–67) wide. Distances between *st1-st1* **52** 47 (37–52), *st2-st2* **52** 53 (48–64), *st3-st3* **57** 58 (51–68), *st1-st3* **46** 56 (46–67), *st5-st5* **45** 53 (45–64). Ventrianal shield smooth, much longer than wide, with slightly waist at JV2 level; **87** 96 (87–105) long, **45** 54 (45–63) wide at level of ZV2 and **50** 57 (50–66) wide at level of anus; with three pairs of pre-anal setae, *JV1* **11** 10 (8–12), *JV2* **11** 11 (10–14), *ZV2* **10** 11 (9–13); *Pa* **45** 54 (45–63), *Pst* **45** 54 (45–63) on shield. Setae *JV4* **6** 8 (6–10), *JV5* **18** 25 (18–29), *ZV1* **11** 11 (9–11), *ZV3* **9** 10 (8–13) on interscutal membrane. All ventral setae smooth except seta *JV5* thickened and serrated. Two pairs of metapodal plates extremely long **31** 32 (29–36) long, **3** 3 (2–4) wide, **8** 9 (5–11) long, **2** 3 (2–4) wide.

Spermatheca. Calyx of spermatheca cup-shaped, **3** 3 (2–5) long, **8** 8 (6–9) wide and atrium nodular, major and minor ducts visible.

Chelicera. Movable digit **18** 18 (16–19) long, with one tooth; fixed digit **18** 18 (14–21), with two teeth on anterior half, one tooth one posterior half, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/1-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sbta* IV (d) **17** 17 (15–18), *Sdta* IV **15** 16 (15–17). Macrosetae short, stout.

Male (n=2)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:7E/JV-3,4:ZV-1,3.

Dorsum. Dorsal shield heavily sclerotized, with strong sculpturing; 222 (203–241)

long, 147 (140–153) wide at level of *s4*, 113 (110–115) wide at level of *S4*, with six solenostomes (*gd1*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), fourteen pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *id6*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 16 (14–18), *j3* 15 (14–16), *j4* 8 (8–9), *j5* 9 (7–10), *j6* 20 (19–20), *J5* 4 (3–6), *z2* 16 (16–17), *z4* 17 (16–18), *Z1* 18 (17–19), *Z4* 32 (31–34), *Z5* 32 (30–33), *s4* 22 (21–22), *S2* 23 (21–24), *S5* 13 (12–14), *r3* 19 (18–20), *R1* 17 (17–18). All setae thickened and strongly serrated, *Z5* arising from tubercles. Setae *r3* and *R1* inserted on dorsal shield.

Peritreme. Peritreme extending to seta *j1* level; peritremal shield lightly sclerotized.

Venter. Sternogenital shield smooth, posterior margin straight, 104 (101–108) long, 62 (57–67) wide at level *st2*, with five pairs of setae *st1* 14 (13–15), *st2* 11 (11–11), *st3* 11 (9–13), *st4* 14 (13–14), *st5* 11 (11–12), three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Distance between *st1-st1* 38 (33–44), *st2-st2* 38 (31–45), *st3-st3* 57 (56–59), *st4-st4* 35 (32–38), *st5-st5* 29 (27–32), *st1-st5* 98 (88–109). Exopodal shield at coxae II–IV. Ventrianal shield subtriangular, with slightly reticulation, 95 (93–97) long, 101 (97–106) wide at level of anterior corner and 68 (66–70) wide at level of anus, not fused with peritremal shield; with three pairs of pre-anal setae, *JV1* 9 (9–10), *JV2* 7 (7–7), *ZV2* 10 (10–11); *Pa* 8 (7–9), *Pst* 9 (8–9) on shield; *JV5* 21 (20–21) on interscutal membrane. All ventral setae smooth.

Chelicera. Movable digit 12 (10–13) long, with one tooth; fixed digit 12 (12–12), with two teeth on anterior half, one tooth on posterior half, with *pilus dentilis*. Spermatodactyl L-shaped, shaft 11 (11–11) long, heel rounded, foot 8 (8–8) long, with rounded toe and lateral thorn-like projection.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/1-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1;

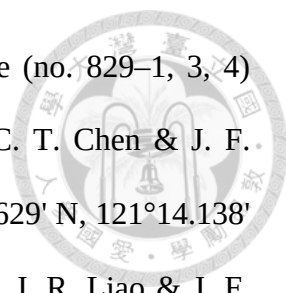
leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1 Macrosetae: *Sbta* IV (d) 11 (10–11), *Sdta* IV 7 (7–8). Macrosetae short, stout.

Specimens examined. CHINA: Sun Yat-sen University, Haizhu District, Guangzhou City, Guangdong Province, one female from *Hibiscus rosa-sinensis* (Malvaceae), 3.v.1984, W. N. Wu (GIBAR); Jinshan District, Shanghai City, one female from *Polygonum perfoliatum* (Polygonaceae), 6.viii.1988, W. N. Wu (GIBAR); Yantian District, Shenzhen City, Guangdong Province, one female from shrub, 27.ix.1983, W. N. Wu (GIBAR); Renshan Town, Huidong County, Huizhou City, Guangdong Province, one female from shrub, 17.ix.1988, W. N. Wu (GIBAR); Fujian Province, one female from *Vitex* sp. (Viticoideae), 18.viii.1988, W. N. Wu (GIBAR).

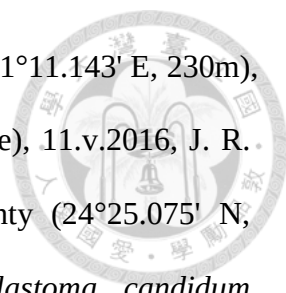
JAPAN: Itoman City, Okinawa Prefecture, one holotype female (ZIHU-3435) from *Hibiscus tiliaceus* (Malvaceae), 22.iv.1966, K. Miyara *et al.* (HUM).

PHILIPPINES: Visca, Baybay City, Leyte, one female from *Cupressus* sp. (Cupressaceae), 22.viii.1988, V. Tiempo (UPLB-MNH).

TAIWAN: TARI, Wufeng Dist., Taichung City, three females (TAL078B018, 23, 24) from *Hibiscus* sp. (Malvaceae), 12.x.1988, S. M. Yu (TARL); Yanxiu, Dongyin Township, Lienchiang County, one female (TAL091F002) from soil of *Ricinus communis* (Euphorbiaceae), 4.vi.2002, C. C. Ho (TARL); Yangmingshan, Beitou Dist., Taipei City (25°09.681' N, 121°32.668' E, 858m), one female (no. 223–1) from *Hibiscus rosa-sinensis* (Malvaceae), 9.xi.2009, S. F. Lin & J. R. Liao (NTU); Wanfeng, Wufeng Dist., Taichung City, six females two males (HAL099B703, 04, 09, 10, 11, 14, 29, 40) from *Acacia confusa* (Fabaceae), 8.viii.2010, C. C. HO (TARL); Lvyue Mountain Villa, Shangbaling. Fuxing Dist., Taoyuan City, one female (HAL099B8437) from unknown plant, 20.viii.2010, C. C. Ho (TARL); Shangbaling, Fuxing Dist., Taoyuan



City (24°41.463' N, 121°24.717' E, 1207m), two females one male (no. 829–1, 3, 4) from *Mallotus japonicus* (Euphorbiaceae), 28.x.2010, J. R. Liao, C. T. Chen & J. F. Hsieh (NTU); Shangde, Donghe Township, Taitung County (22°57.629' N, 121°14.138' E, 566m), one female (no. 1096-3) from unknown plant, 25.i.2011, J. R. Liao & J. F. Hsieh (NTU); Shuangtai Road, Shuangxi Dist., New Taipei City (24°59.925' N, 121°50.753' E, 470m), two females (no. 1169–4, 5) from *Mallotus paniculatus* (Euphorbiaceae), 28.ii.2011, J. R. Liao (NTU); Jinping Road, Jianshi Township, Hsinchu County (24°40.185' N, 121°16.216' E, 1063m), two females (no. 1259–1, 3) from *Mallotus japonicus* (Euphorbiaceae), 17.iv.2011, J. R. Liao (NTU); Taigang, Jianshi Township, Hsinchu County (24°36.588' N, 121°17.024' E, 1075m), two females (no. 1272–2, 4) from *Prunus* sp. (Rosaceae), 17.iv.2011, J. R. Liao (NTU); Xuejian, Tai'an Township, Miaoli County, one female (HAL101B119) from *Schima superba* var. *superba* (Theaceae), 23.iii.2012, C. C. Ho (TARL); Mountain behind Chaoyang University of Technology, Wufeng Dist., Taichung City, three females two males from *Acacia confusa* (Fabaceae), 30.v.2012, C. C. Ho (TARL); Wanfeng, Wufeng Dist., Taichung City, six females two males (HAL101B205, 6) from *Acacia confusa* (Fabaceae), 2.vi.2012, C. C. Ho (TARL); Guangxing, Xindian Dist., New Taipei City (24°53.578' N, 121°29.702' E, 704m), one female (no. 1372–5) from *Morus* sp. (Moraceae), 18.viii.2014, J. R. Liao (NTU); Dahan Road, Chunri Township, Pingtung County (22°24.701' N, 120°44.226' E, 1173m), four females (no. 1466–1, 2, 4, 5) from *Macaranga tanarius* (Euphorbiaceae), 24.v.2015, J. R. Liao (NTU); Mt. Danfeng, Beitou Dist., Taipei City (25°07.947' N, 121°30.687' E, 149m), three females (no. 1599–2, 8, 10) from *Schefflera octophylla* (Araliaceae), 2.iii.2016, J. R. Liao (NTU); Mt. Luyi, Jiaxian Dist., Kaohsiung City (23°04.703' N, 120°34.727' E, 314m), two females one male (no. 1617–6, 9, 17) from *Pueraria lobata* (Fabaceae), 12.iii.2016, J. R. Liao



(NTU); TRES, Yangmei Township, Taoyuan City (24°54.354' N, 121°11.143' E, 230m), one female (no. 1682–9) from *Mallotus paniculatus* (Euphorbiaceae), 11.v.2016, J. R. Liao (NTU); Nan'ao Forest Rd., Nan'ao Township, Yilan County (24°25.075' N, 121°44.768' E, 311m), one female (no. 1801–2) from *Melastoma candidum* (Melastomataceae), 2.viii.2016, J. R. Liao (NTU); Nan'ao Forest Rd., Nan'ao Township, Yilan County (24°25.075' N, 121°44.768' E, 311m), one female (no. 1802–3) from *Mallotus paniculatus* (Euphorbiaceae), 2.viii.2016, J. R. Liao (NTU); Xiaocukeng, Xindian Dist., New Taipei City (24°55.950' N, 121°33.908' E, 255m), one female (no. 1853–12) from *Mallotus paniculatus* (Euphorbiaceae), 14.viii.2016, J. R. Liao (NTU).

Distribution. Asia: China (Fujian (Wu & Qian, 1983a), Guangdong (Wu & Qian 1983), Wuling mountain region (Wu & Lan 1992)), Japan (Ehara 1967), Malaysia (Ehara, 2006), Philippines (Corpuz-Raros & Garcia 1994), Taiwan (Tseng, 1976). Oceania: Australia (Walter 1999).

Remarks. Ehara (1967) described this species from *Hibiscus tiliaceus* (Malvaceae) in Okinawa. The present study examined type specimen (from Japan), Taiwanese specimens, Chinese specimens, and also Philippine specimens. No significant differences were found among these specimens. Taiwanese specimens were usually collected from mountainous area, the highest mountain is about 1,000 m altitude.

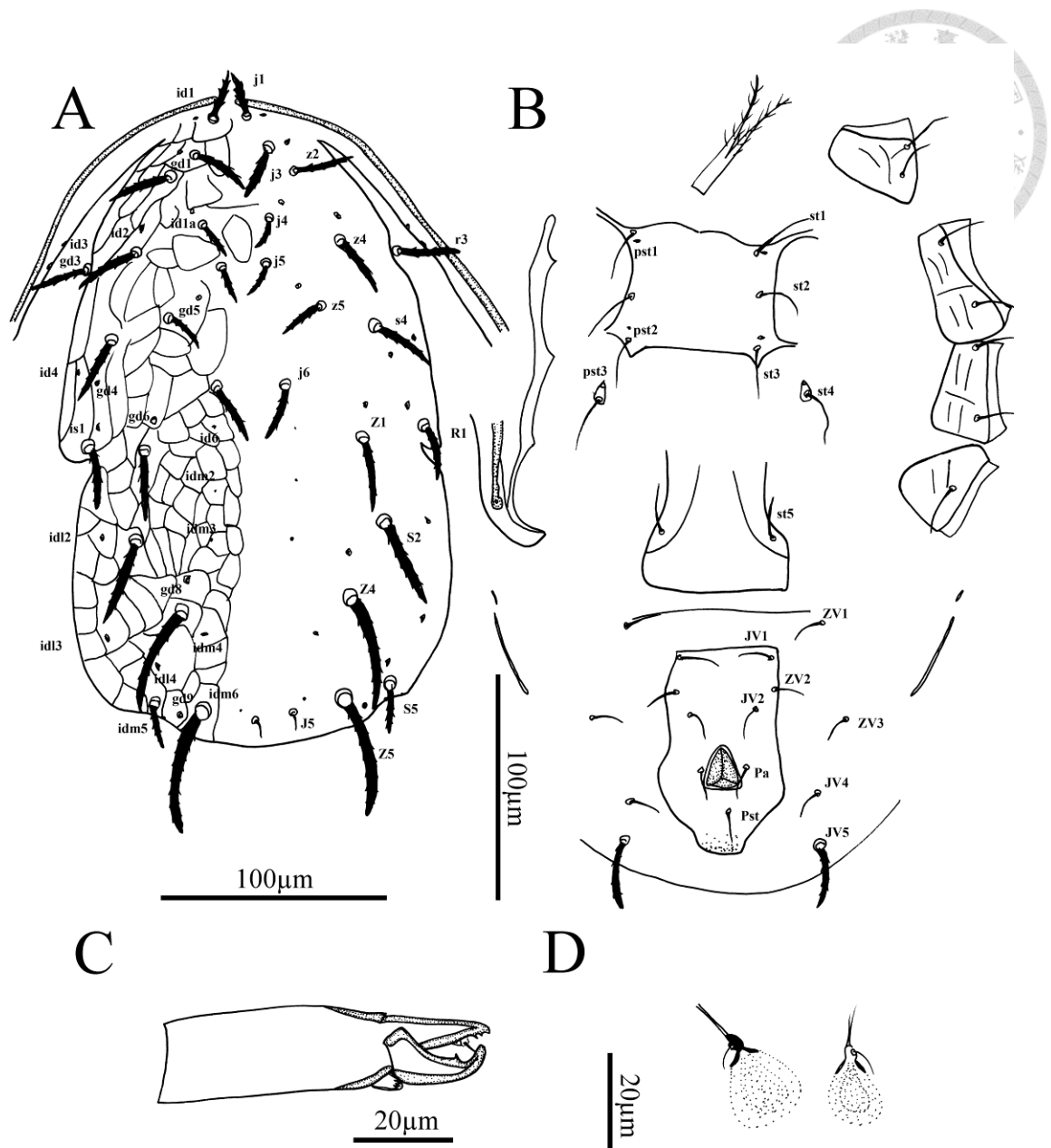


FIGURE 59. *Okiseius subtropicus* Ehara, 1967, Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

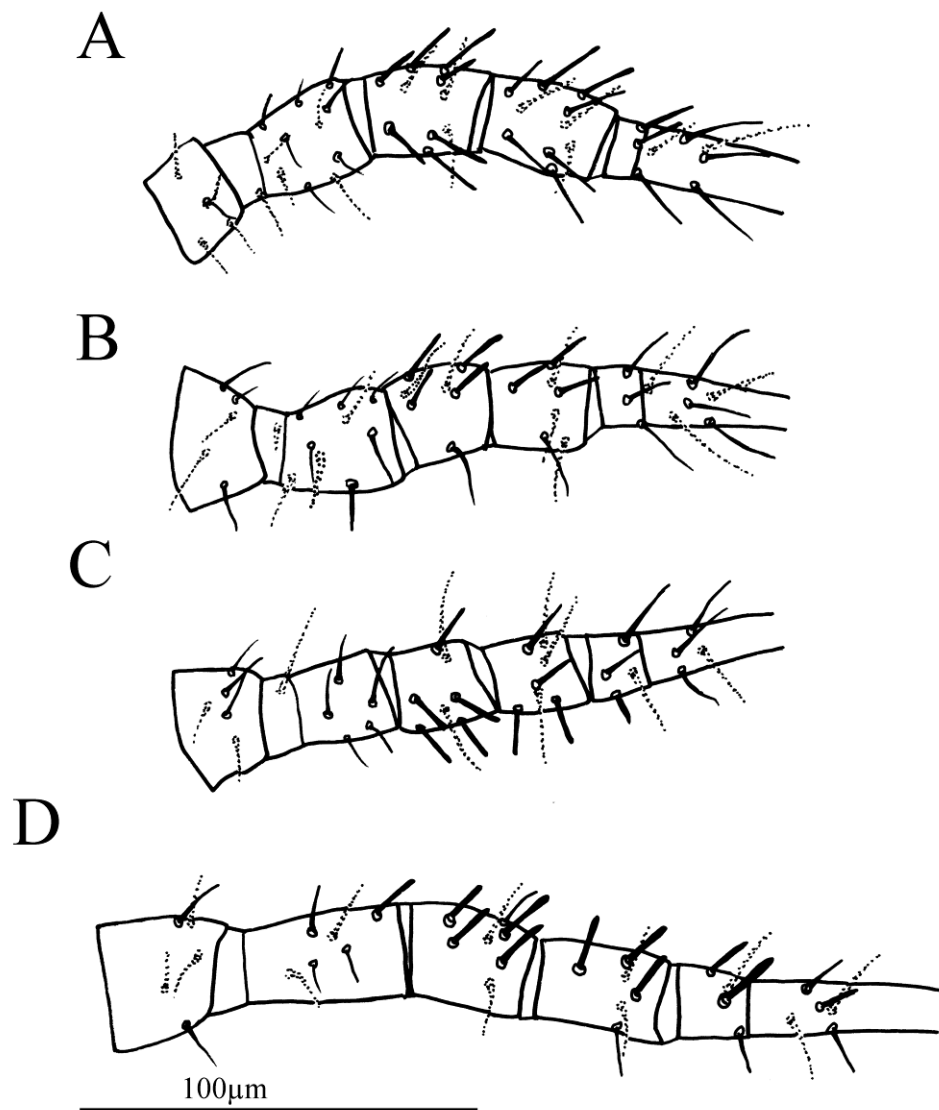


FIGURE 60. *Okiseius subtropicus* Ehara, 1967, Female, legs A. leg I posterior view, B. leg II posterior view, C. leg III anterior view, D. leg IV posterior view.

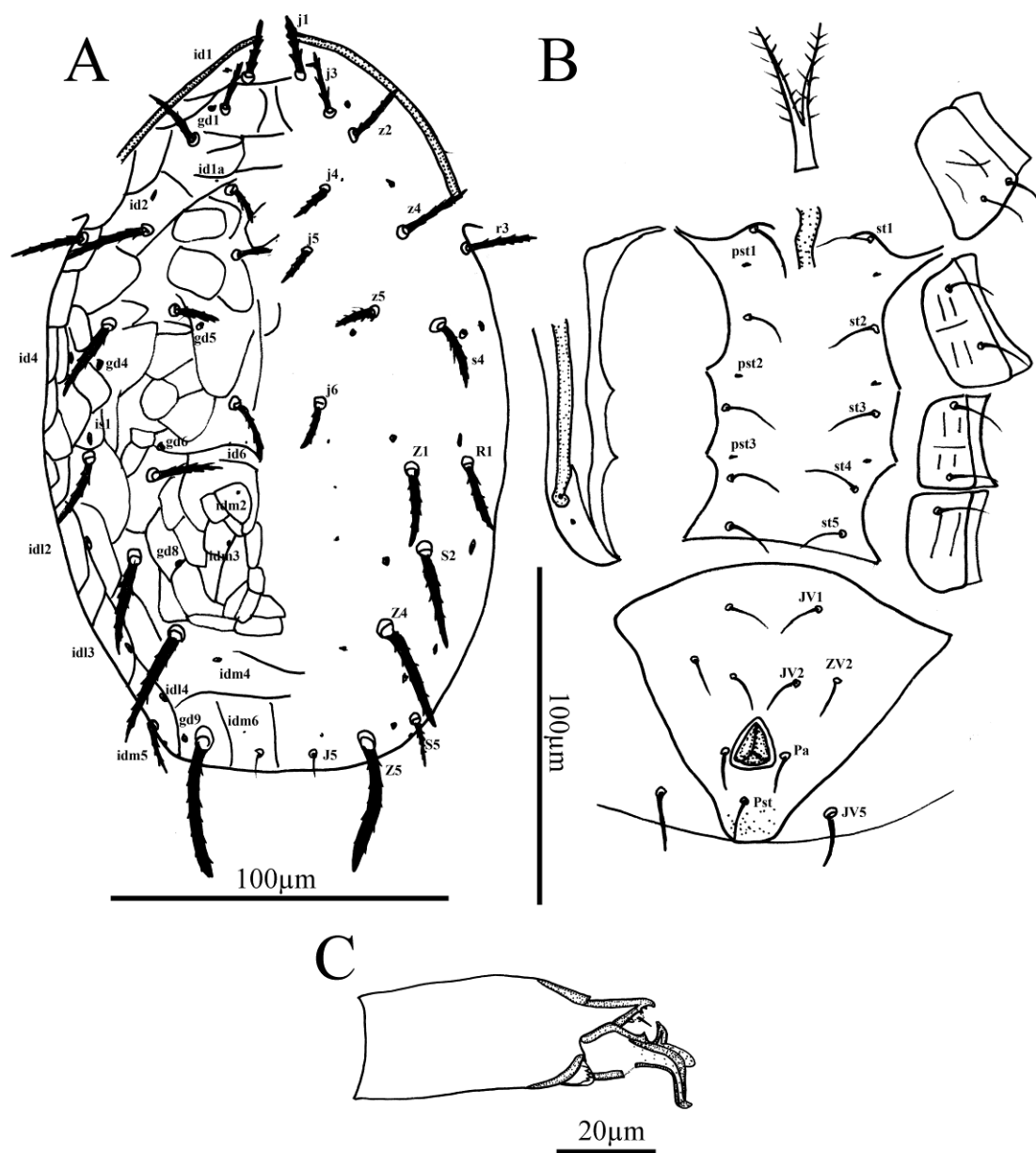


FIGURE 61. *Okiseius subtropicus* Ehara, 1967, Male, A. dorsal shield; B. ventral idiosoma; C. chelicera and spermatodactyl.

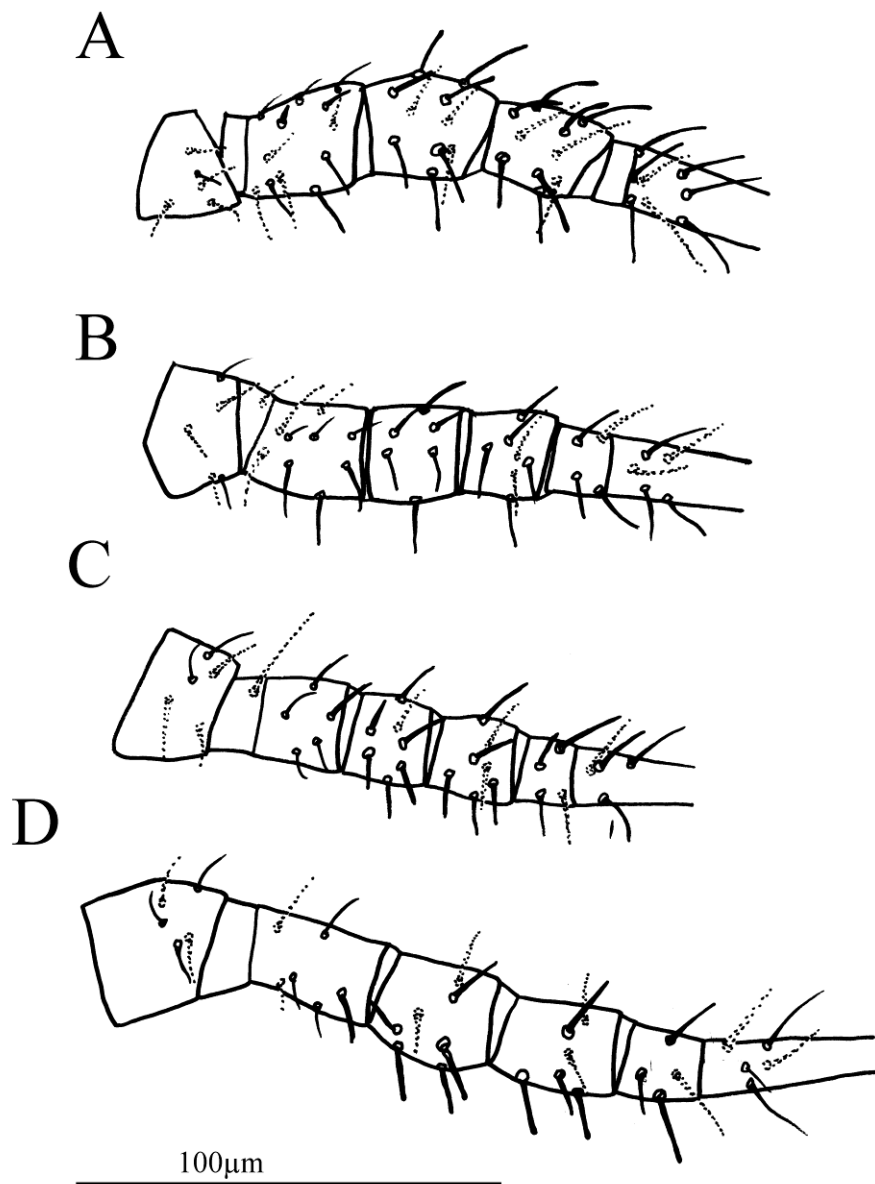


FIGURE 62. *Okiseius subtropicus* Ehara, 1967, Male, A. leg I posterior view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV anterior view.

***Okiseius formosanus* Tseng, 1972**

臺灣沖綏蟎



(Figures 63–64)

Okiseius formosanus Tseng, 1972: 2.

Platyseiella (Noeledius) formosanus.—Tseng, 1976: 104.

Female

A heavily sclerotized mite. Idiosomal setal pattern: 10A:7E/JV-3:ZV.

Dorsum. Dorsal shield heavily sclerotized, with strong sculpturing, without notch on dorsal shield; 223.1 (?) long, 145.5 (?) wide; length of dorsal setae: *j1* 20.7, *j3* 16.7, *j4* 13.8, *j5* 24.5, *j6* 28.75, *J5* 4.6, *z2* 21.8, *z4* 24.15, *z5* 16.1, *Z1* 28.2, *Z4* 40.2, *Z5* 46, *s4* 24.15, *S2* 34.5, *S5* 12.5, *r3* 20.7, *R1* 20.7. All setae thickened and strongly serrated, *Z5* arising from tubercles.

Peritreme. Peritreme extending to *j1* level.

Venter. Sternal shield smooth, posterior margin concave, wider than long, 69 long, 34 wide, with three pairs of setae *st1*, *st2*, *st3*. Metasternal platelets tear-shaped, with a pair metasternal setae, *st4*. Genital shield smooth, with *st5*. Ventrianal shield smooth, much longer than wide; 96.6 long, 48.3 wide; with three pairs of pre-anal setae, *JV1*, *JV2*, *ZV2*. Setae *JV4*, *JV5* 25.7, *ZV1*, *ZV3* on interscutal membrane. Two pairs of metapodal plates extremely long.

Spermatheca. Calyx of spermatheca cup-shaped and atrium nodular.

Chelicera. Movable digit with one tooth; fixed digit with three teeth.

Legs. Macrosetae short, stout.

Male

A heavily sclerotized mite. Idiosomal setal pattern: 10A:7E/JV-3,4:ZV-1,3.

Dorsum. Dorsal shield heavily sclerotized, with strong sculpturing, without notch

on dorsal shield; 223.1 (?) long, 145.5 (?) wide; length of dorsal setae: *j1* 20.7, *j3* 16.7, *j4* 13.8, *j5* 24.5, *j6* 28.75, *J5* 4.6, *z2* 21.8, *z4* 24.15, *z5* 16.1, *Z1* 28.2, *Z4* 40.2, *Z5* 46, *s4* 24.15, *S2* 34.5, *S5* 12.5, *r3* 20.7, *R1* 20.7. All setae thickened and strongly serrated, *Z5* arising from tubercles. Setae *R1* inserted on dorsal shield.

Peritreme. Peritreme extending to *j1* level.

Venter. Sternogenital shield, with five pairs of setae *st1*, *st2*, *st3*, *st4*, *st5*. Ventrianal shield subtriangular, with slightly reticulation; with three pairs of pre-anal setae, *JV1*, *JV2*, *ZV2*. Setae *JV5* 15.8 on interscutal membrane.

Chelicera. Spermatodactyl L-shaped.

Legs. Macrosetae short, stout.

Specimens examined. No specimens.

Distribution. Taiwan (Tseng 1972)

Remarks. Tseng (1972) described this species from unknown plant and *Morus* sp. in Chia-Yi Hsien (Chiayi County). The measurements of original descriptions seem terribly wrong. Tseng (1972) reported that female and male specimens with same length and width of dorsal shields. Besides, Tseng (1972) reported that the male “*Sternal shield 69 μ long, 34 μ wide, with three preanal setae*”. This sentence should be corrected to “*Sternogenital shield with five pair of setae*”, and the measurements also wrong (it belongs to sternal shield of female). Liao *et al.* (2017b) reported the Tseng’s specimens were lost. This study did not find this species during the survey.

O. formosanus was reported several times on the previous studies. Kolodochka & Denmark (1996) excluded this species based on seta *S5* rather than *S4* is absent, and also does not have a lateral incision in the margin of the dorsal shield posterior to seta *R1*. Chant & McMurtry (2003c) considered the questioned seta is *S5*, and *S4* is absent.

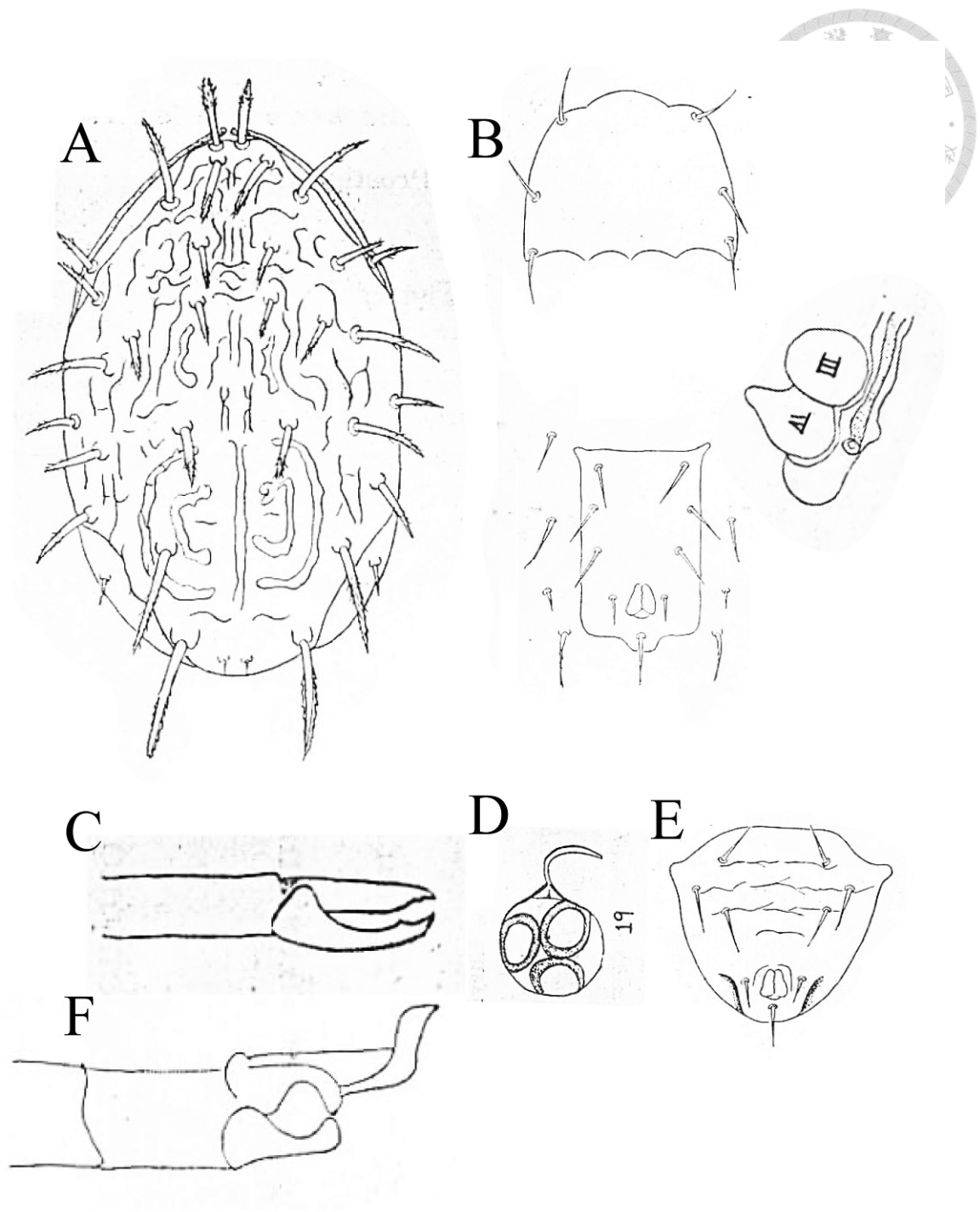


FIGURE 63. *Okiseius formosanus* Tseng, 1972, (after Tseng 1972), A. dorsal shield; B. ventral idiosoma; C. chelicera; D. spermatheca; E. male ventrianal shield; F. chelicera and spermatodactyl.

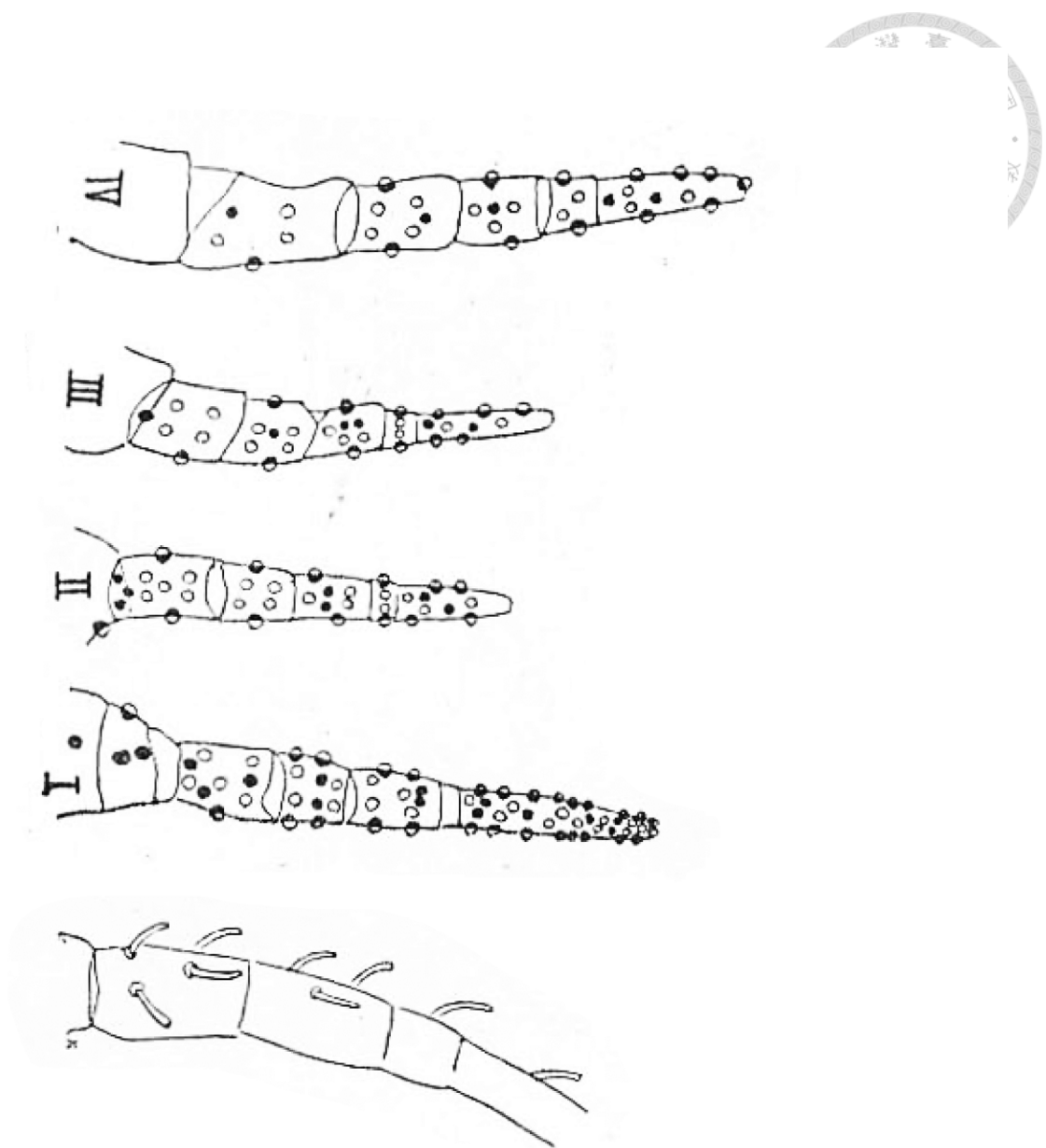


FIGURE 64. *Okiseius formosanus* Tseng, 1972, (after Tseng 1972), legs.



Tribe AMBLYSEIINI Muma, 1961

鈍綏蟎族

Amblyseiinae Muma, 1961: 273.

Amblyseiini.—Wainstein, 1962: 26.

Macroseiinae Chant *et al.*, 1959: 808.

Type genus - *Amblyseius* Berlese, 1914: 143.

The tribe Amblyseiini is defined above all by the ratio of the length of seta *s4* to that of seta *Z1*, which equals 3.0:1.0 or greater, usually much greater.

Key to subtribes in the tribe Amblyseiini from Taiwan

1. Sternal shield narrower..... subtribe Amblyseiina Muma
— Sternal shield broader..... 2
2. Seta *J2* usually present, or if absent, seta *j5* also absent
..... subtribe Arrenoseina Chant & McMurtry
— Seta *J2* absent, seta *j5* present subtribe Proprioseiopsina Chant & McMurtry

Subtribe Amblyseiina Chant & McMurtry, 2004a

鈍綏蟎亞族

Amblyseiina.—Chant & McMurtry, 2004a: 179.

Type genus - *Amblyseius* Berlese, 1914: 143.

This subtribe is characterized by sternal shield narrower, L/W ratio ca. 1.0:1.0. Seven genera in the subtribe, including *Amblyseiella* Muma, *Amblyseius* Berlese, *Chelaseius* Muma & Denmark, *Graminaseius* Chant & McMurtry, *Honduriella* Denmark & Evans, *Maunaseius* Chant & McMurtry, *Transeius* Chant & McMurtry.

Genus *Amblyseius* Berlese, 1914

鈍綏蟎屬

Amblyseius Berlese, 1914: 143.

Amblyseiopsis Garman, 1948: 17. Type species - *Amblyseiopsis americanus* Garman, 1948: 17.

Amblyseius (*Amblyseius*) Muma, 1961: 287.

Amblyseius (*Amblyseiulus*) Muma, 1961: 287. Type species - *Amblyseiopsis largoensis* Muma, 1955: 266.

Amblyseius (*Amblyseius*) section *Italoseius* Wainstein, 1962b: 15. Type species - *Typhlodromus* (*Amblyseius*) *italieus* Chant, 1959b: 70.

Amblyseiulus Muma, 1965: 245.

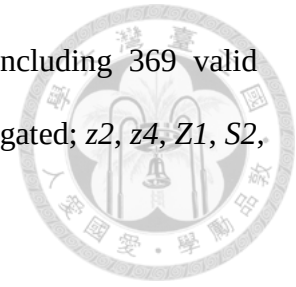
Proprioseiopsis (*Peloiseius*) Karg, 1983: 303. Type species - *Amblyseius dorsatus* Muma, 1961: 278. Note: this species lacks seta *J2* and Chant & McMurtry (2004a) placed it in the *pusillus* species group in the genus *Amblyseius*.

Amblyseius (*Multiseius*) Denmark & Muma, 1989: 82. Type species - *Typhlodromus* (*Amblyseius*) *andersoni* Chant, 1957a: 296.

Amblyseius (*Pauciseius*) Denmark & Muma, 1989: 132. Type species - *Amblyseius meridionalis* Berlese, 1914: 144.

Type species - *Zereon obtusus* Koch, 1839: 27.13, *sensu* Karg, 1960: 440.

This is the largest genus in the subfamily Amblyseiinae, including 369 valid species in the world. All species having setae *s4*, *Z4*, *Z5* greatly elongated; *z2*, *z4*, *Z1*, *S2*, *S4*, *S5* short or minute.

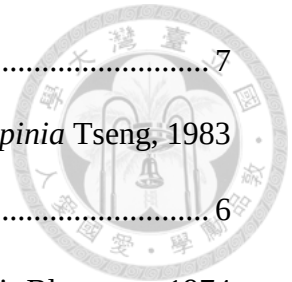


Diagnosis – Idiosomal pattern 10A:9B/JV-3:ZV. Dorsal shield lightly sclerotized. Dorsal setae *z2*, *z4*, *Z1*, *S2*, *S4*, *S5* short/minute. Sternal shield smooth or reticulated, posterior margin straight, concave, or with median projection. Genital shield truncated posteriorly. Female ventrianal shield pentagonal, vase-shaped or divided into separated shields, with 3 pair of preanal setae, *gv3* conspicuous. Peritreme usually extending to *j1* level. Spermatheca variable. Chelicera normal size, fixed digit usually with many teeth, movable digit with 3-4 teeth. Leg IV with 3 slender macrosetae. Ge II with 7 setae. Male ventrianal shield triangular. Spermatodactyl heel-and-toe variety, or L-shaped with the heel suppressed, or wand-shaped.

Key to species in the genus *Amblyseius* from Taiwan

1. Female ventrianal shield vase-shaped 2
 - Female ventrianal shield not vase-shaped 4
2. Spermatheca calyx tubular, parallel-sided *largoensis* (Muma, 1955)
 - Spermatheca calyx not tubular 3
3. Sternal shield straight; movable digit with 4 teeth *herbicolus* (Chant, 1959b)
 - Sternal shield posterior margin with median projection; movable digit with 3 teeth
..... *eharai* Amitai & Swirski, 1981
4. Spermatheca calyx ratio L/W at mid-point > 3.0:1.0 (e.g. saccular, tubular) 5
 - Spermatheca calyx ratio L/W at mid-point < 3.0:1.0 (e.g. dish-shaped, cup-shaped,

bell-shaped, or V-shaped)	7
5. Spermatheca calyx saccular	<i>alpinia</i> Tseng, 1983
— Spermatheca calyx tubular	6
6. Spermatheca calyx tubular, parallel-sided	<i>tamatavensis</i> Bloomers, 1974
— Spermatheca calyx tubular, flaring distally.....	<i>pascalis</i> Tseng, 1983
7. Spermatheca calyx cup-shaped	<i>trisetosus</i> Tseng, 1983
— Spermatheca calyx V-shaped	<i>bellatulus</i> Tseng, 1983



***Amblyseius alpinia* Tseng, 1983**

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(Figures 65–68)

Amblyseius alpinia Tseng, 1983: 49

Female (n=10)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield, smooth, anterolaterally reticulated, 378 (342–417) long, 214 (193–241) wide at level of *s4*, 206 (180–227) wide at level of *S4*; seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), twelve pairs of lyrifissures (*id1*, *id2*, *id4*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of dorsal setae: *j1* 28 (19–33), *j3* 49 (43–55), *j4* 7 (5–9), *j5* 5 (4–8), *j6* 7 (4–10), *J2* 7 (5–10), *J5* 7 (5–8), *z2* 13 (7–18), *z4* 12 (7–16), *z5* 7 (5–9), *Z1* 9 (8–10), *Z4* 103 (87–127), *Z5* 215 (176–259), *s4* 77 (63–89), *S2* 9 (6–14), *S4* 7 (6–10), *S5* 8 (5–9), *r3* 15 (12–21), *R1* 11 (8–13). Setae *j1*, *j3*, *s4* longer and smooth; *Z4*, *Z5* greatly elongated, slightly serrated; other minute.

Peritreme. Peritreme extending beyond to *j1*, peritremal shield smooth, lightly sclerotized, with one pair of solenostome (*gd3*) and one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, posterior margin concave, wider than long, 74 (60–91) long, 92 (80–108) wide at *st3* level, with three pairs of setae *st1* 26 (21–33), *st2* 22 (16–26), *st3* 23 (19–30) and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae II–IV. Metasternal platelets tear-shaped, with a pair metasternal setae, *st4* 21 (14–25), and one pair of lyrifissures (*pst3*). Genital shield smooth, *st* –85), *st1*–*st3* 66 (61–72), *st5*–*st5* 69 (59–78). Ventrianal shield smooth, pentagonal with slightly waist; 119 (110–131) long, 81 (73–91) wide at level of *ZV2* and 71 (62–86) wide at level of anus; with three pairs of pre-anal setae, *JV1* 17 (12–21), *JV2* 16 (11–21), *ZV2* 14 (12–17), solenostome *gv3* crescentic, *Pa* 15 (12–17), *Pst* 16 (12–21). Setae *JV4* 10

(8–15), *JV5* 67 (54–84), *ZV1* 14 (12–17), *ZV3* 10 (5–13) on interscutal membrane. All ventral setae smooth. Two pairs of metapodal plates 20 (16–23) long, 5 (4–7) wide, 10 (9–13) long, 2 (1–3) wide.

Spermatheca. Calyx of spermatheca saccular, 15 (12–18) long, 4 (3–5) wide, and atrium nodular, major duct and minor duct visible.

Chelicera. Movable digit 32 (28–35) long, with three teeth; fixed digit 31 (25–37) long, anterior half with two teeth, posterior half with eight teeth, with *pilus dentilis*.

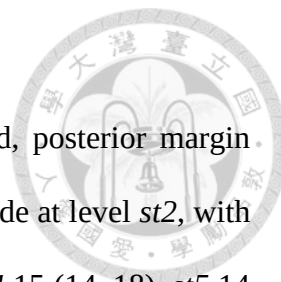
Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* I (pd2) 31 (26–40), *Sge* II (pd2) 33 (31–36), *Sge* III (ad2) 45 (31–51), *Sti* III (ad) 38 (33–40), *Sge* IV (ad2) 102 (86–113), *Sti* IV (ad) 66 (54–78), *St* IV (d) 68 (63–75).

Male (n=5)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3,4:ZV-1,3.

Dorsum. Dorsal shield smooth, anterolaterally reticulated; 293 (270–309) long, 174 (165–181) wide at level of *s4*, 145 (133–153) wide at level of *S4*, with seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), twelve pairs of lyrifissures (*id1*, *id2*, *id4*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 19 (15–23), *j3* 38 (34–42), *j4* 6 (5–9), *j5* 7 (5–10), *j6* 8 (5–12), *J2* 7 (5–9), *J5* 7 (5–9), *z2* 12 (8–14), *z4* 10 (6–14), *z5* 7 (5–10), *Z1* 8 (7–10), *Z4* 70 (62–79), *Z5* 142 (131–155), *s4* 65 (57–68), *S2* 10 (9–12), *S4* 9 (7–10), *S5* 8 (7–10), *r3* 10 (9–11), *R1* 11 (8–15). Setae *j1*, *j3*, *s4* longer and smooth; *Z4*, *Z5* greatly elongated, slightly serrated; other minute. Setae *r3* and *R1* inserted on dorsal shield.

Peritreme. Peritreme extending to *j1* level; peritremal shield lightly sclerotized,



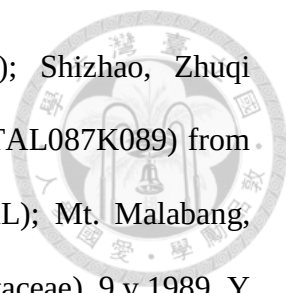
with one pair of solenostome (*gd3*).

Venter. Sternogenital shield smooth, lateral slightly reticulated, posterior margin almost straight, longer than wide 128 (112–148) long, 82 (69–95) wide at level *st2*, with five pairs of setae *st1* 17 (15–19), *st2* 17 (14–20), *st3* 16 (13–19), *st4* 15 (14–18), *st5* 14 (13–14), three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Exopodal shield at coxae II–IV. Distance between *st1-st1* 49 (46–52), *st2-st2* 60 (58–61), *st3-st3* 58 (52–64), *st4-st4* 48 (43–54), *st5-st5* 40 (34–45), *st1-st5* 113 (105–126). Exopodal shield at coxae II–IV. Ventrianal shield subtriangular, slightly reticulated, 121 (105–136) long, 156 (149–163) wide at level of anterior corner and 55 (49–61) wide at level of anus, fused with peritremal shield cingulum; with three pairs of pre-anal setae, *JV1* 12 (9–13), *JV2* 11 (10–13), *ZV2* 10 (10–11), solenostome *gv3* crescentic, *Pa* 12 (10–14), *Pst* 11 (10–13) on shield; *JV5* 37 (28–45) on interscutal membrane. All ventral setae smooth.

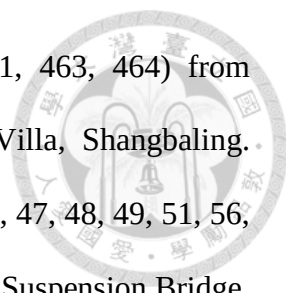
Chelicera. Movable digit 20 (16–23) long, with one tooth; fixed digit 19 (17–23), with two teeth on anterior half, six teeth on posterior teeth, with *pilus dentilis*. Spermatodactyl heel-and-toe variant, shaft 18 (16–21) long, heel rounded, foot 9 (8–10) long.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* I (pd2) 31 (30–32), *Sge* II (pd2) 24 (22–25), *Sge* III (ad2) 29 (27–31), *Sti* III (ad) 24 (24–24), *Sge* IV (ad2) 60 (52–67), *Sti* IV (ad) 36 (32–38), *St* IV (d) 57 (49–66).

Specimens examined. Meifeng, Ren'ai Township, Nantou County, one female (TAL074C005) from *Viburnum luzonicum* (Adoxaceae), 17.x.1985, C. C. Ho (TARL); Qingjue Temple, Beinan Township, Taitung County, one female (TAL077J008) from



Hibiscus rfragilis (Malvaceae), 23.iii.1988, C. C. Ho (TARL); Shizhao, Zhuqi Township, Chiayi County, four females (TAL077G005, 006, 009, TAL087K089) from witch's broom of bamboo (Poaceae), 15.vi.1988, C. C. Ho (TARL); Mt. Malabang, Dahu Township, Miaoli County, one female from *Citrus nobilis* (Rutaceae), 9.v.1989, Y. J. Wang (TARL); Mt. Anma, Heping Dist., Taichung City, one female (TAL079B023) from unknown plant, 9.iv.1990, C. C. Ho (TARL); Meiyin Farm, Lishan, Heping Dist., Taichung City, one female (TAL089G26) from *Prunus* sp. (Rosaceae), 25.vii.2000, C. C. Ho (TARL); Kaohsiung City, one female (TAL094Y071) from *Debregeasia orientalis* (Urticaceae), 20.iv.2005, C. C. Ho (TARL); Mt. Chiyau, Wuling, Heping Dist., Taichung City, one male (HAL095G763) from *Miscanthus transmorrisonensis* (Poaceae), 30.xi.2006, C. C. Ho (TARL); Guanyuan, Xiulin Township, Hualien County, one female (HAL096C088) from *Rhaphiolepis indica* (Rosaceae), 31.vii.2007, C. C. Ho (TARL); Wuling Farm, Heping Dist., Taichung City, three females one male (HAL098B499, 501) from unknown plant, 19.x.2009, C. C. Ho (TARL); Zhiliang, Heping Dist., Taichung City (24°20.144' N, 121°18.756' E, 1924m), one female (no.157–4) from *Salix argyracea* (Salicaceae), 19.x.2009, C. C. Ho & J. R. Liao (NTU); Huanshan, Heping Dist., Taichung City (24°20.539' N, 121°18.486' E, 2334m), four females one male (no.160–1, 2, 4, 5, 6) from *Quercus variabilis* (Fagaceae), 19.x.2009, C. C. Ho & J. R. Liao (NTU); Lishan, Heping Dist., Taichung City, one female (HAL098B481) from unknown plant, 20.x.2009, C. C. Ho (TARL); Huanshan, Heping Dist., Taichung City (24°20.219' N, 121°19.025' E, 2101m), four females (no.169–1, 2, 3, 4) from *Cunninghamia lanceolata* (Cupressaceae), 20.x.2009, C. C. Ho & J. R. Liao (NTU); Lishan, Heping Dist., Taichung City (24°15.263' N, 121°15.057' E, 1989m), two females from *Ulmus uyematsui* (Ulmaceae), 20.x.2009, C. C. Ho & J. R. Liao (NTU); Sijilan Suspension Bridge, Huanshan, Heping Dist., Taichung City (24°19.119'



N, 121°17.151' E, 1723m), four female one male (HAL098B461, 463, 464) from unknown plant, 21.x.2009, C. C. Ho (TARL); Lvy Mountain Villa, Shangbaling, Fuxing Dist., Taoyuan City, five females three males (HAL099B845, 47, 48, 49, 51, 56, 57, 59) from unknown plant, 20.viii.2010, C. C. Ho (TARL); Sijilan Suspension Bridge, Huanshan, Heping Dist., Taichung City (24°19.119' N, 121°17.151' E, 1723m), two females (no. 187–1, 4) from *Tabebuia chrysantha* (Bignoniaceae), 21.x.2009, C. C. Ho & J. R. Liao; Dalu Forest Road, Wufeng Dist., Hsinchu County (24°34.030' N, 121°05.530' E, 734m), one female (no. 278–5) from *Trema orientalis* (Cannabaceae), 20.i.2010, Y. H. Chiang & J. R. Liao (NTU); Wufeng Dist., Hsinchu County, one female from unknown plant, 20.i.2010, Y. H. Chiang & J. R. Liao; Simaxian, Taian Township, Miaoli County (24°24.679' N, 120°56.725' E, 852m), one female (no. 907–4) from *Debregeasia orientalis* (Urticaceae), 31.x.2010, W. C. Yang & J. R. Liao; Cuifeng, Renai Township, Nantou County (24°06.413' N, 121°11.929' E, 2331m), one female (no. 984–7) from *Debregeasia orientalis* (Urticaceae), 5.xii.2010, J. R. Liao (NTU); Xuejian, Taian Township, Miaoli County, one female one male (HAL101B120) from *Schima superba* (Theaceae), 23.iii.2012, C. C. Ho (TARL)

Distribution. Asia: Taiwan (Tseng, 1983).

Remarks. This species was reported by only one holotype female from Neimen, Kaohsiung Hsien (present Neimen Dist., Kaohsiung City). Tseng (1983) provided the illustration of this species, which contain 9 pores on dorsal shields, some of them probably are lyrifissures, but it should have 6 solenostomes (*gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*); present study reported 7 solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*) on the dorsal shield. Besides, Tseng (1983) reported 8 setae on Ge II, and present study found 7 setae. The type locality is flat ground area, but most of specimens of present study from mountain area, even in high mountain area (more than 2000m).

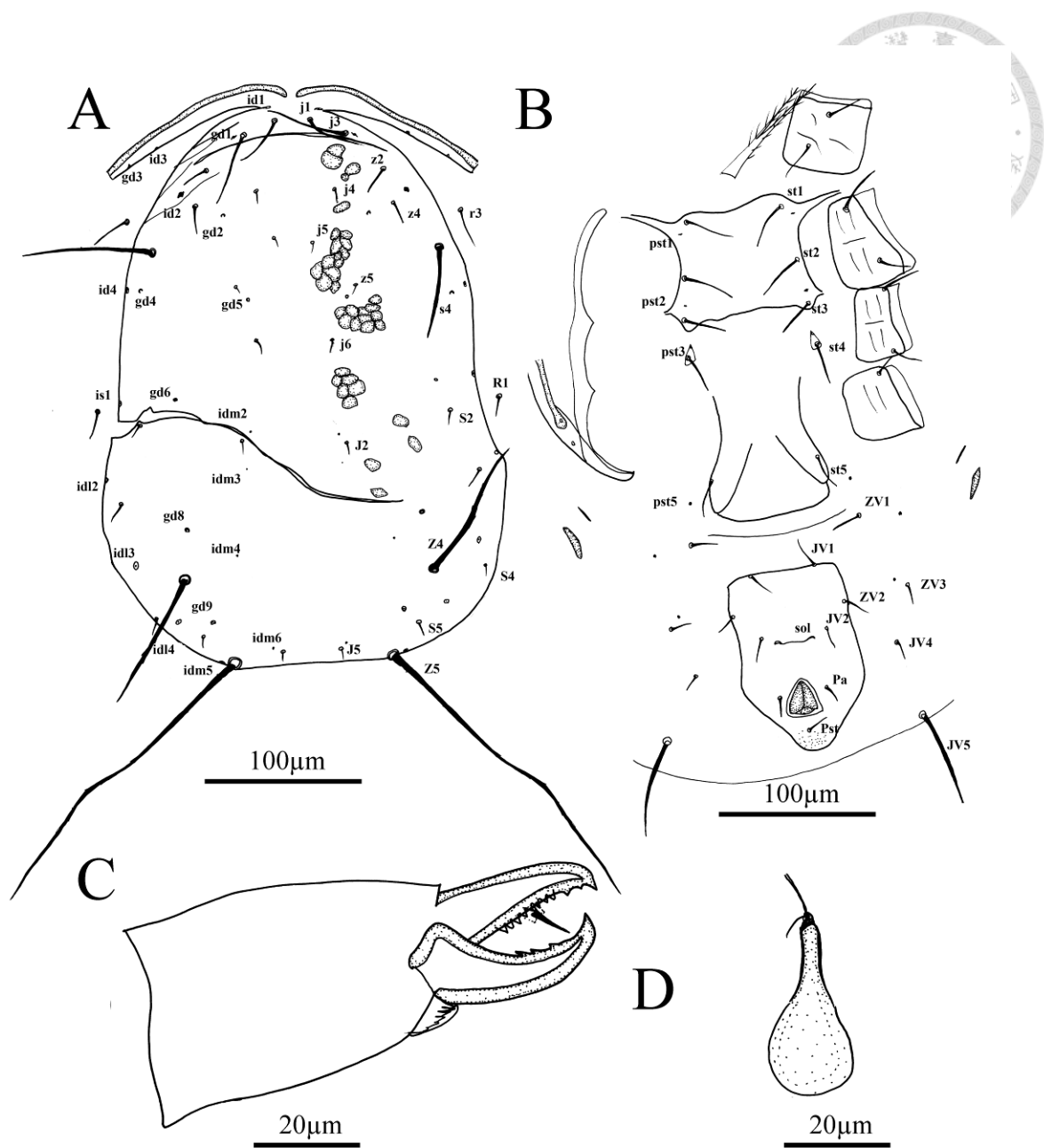


FIGURE 65. *Amblyseius alpinia* Tseng, 1983, Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

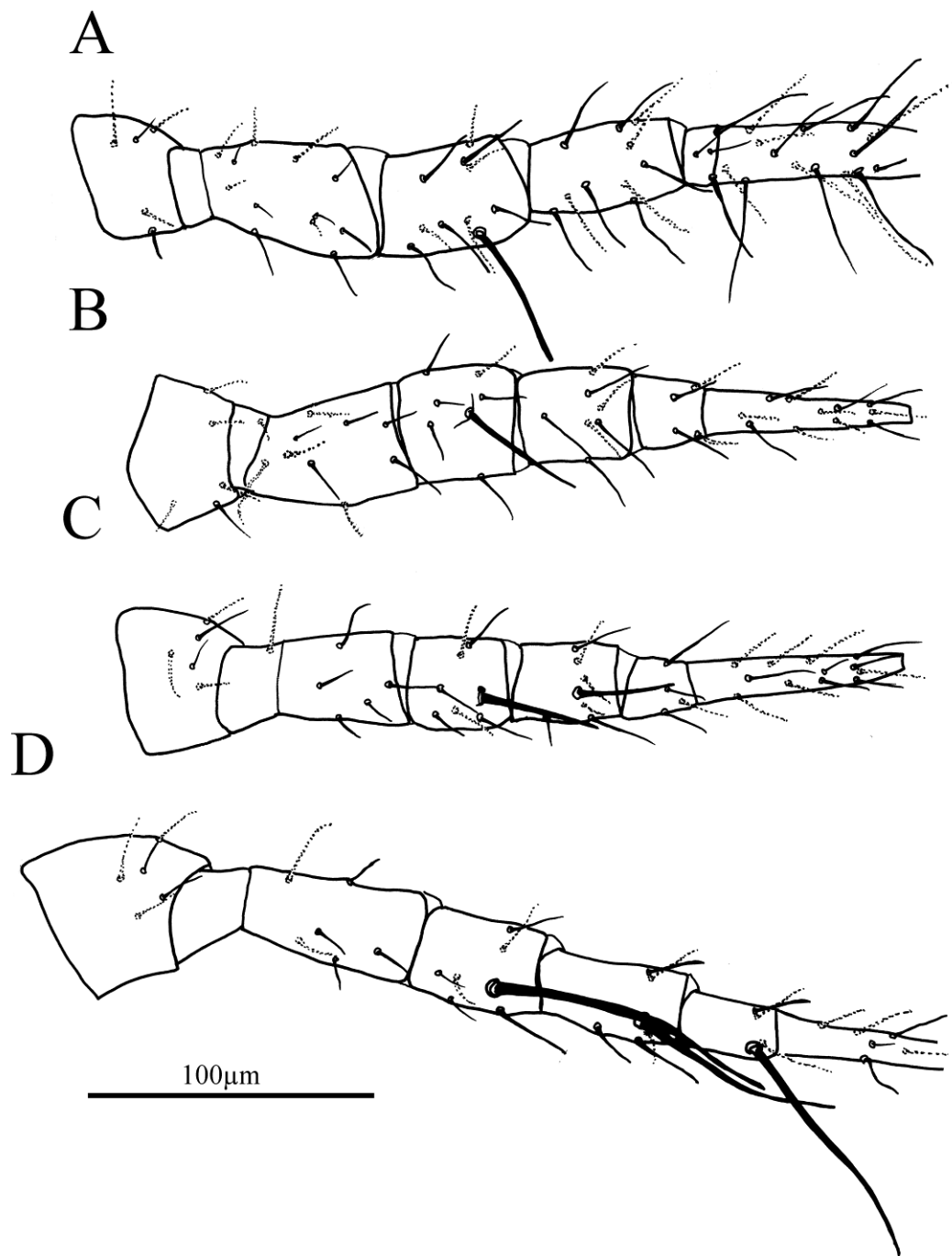


FIGURE 66. *Amblyseius alpinia* Tseng, 1983, Female, legs A. leg I anterior view, B. leg II dorsal view, C. leg III anterodorsal view, D. leg IV anterior view.

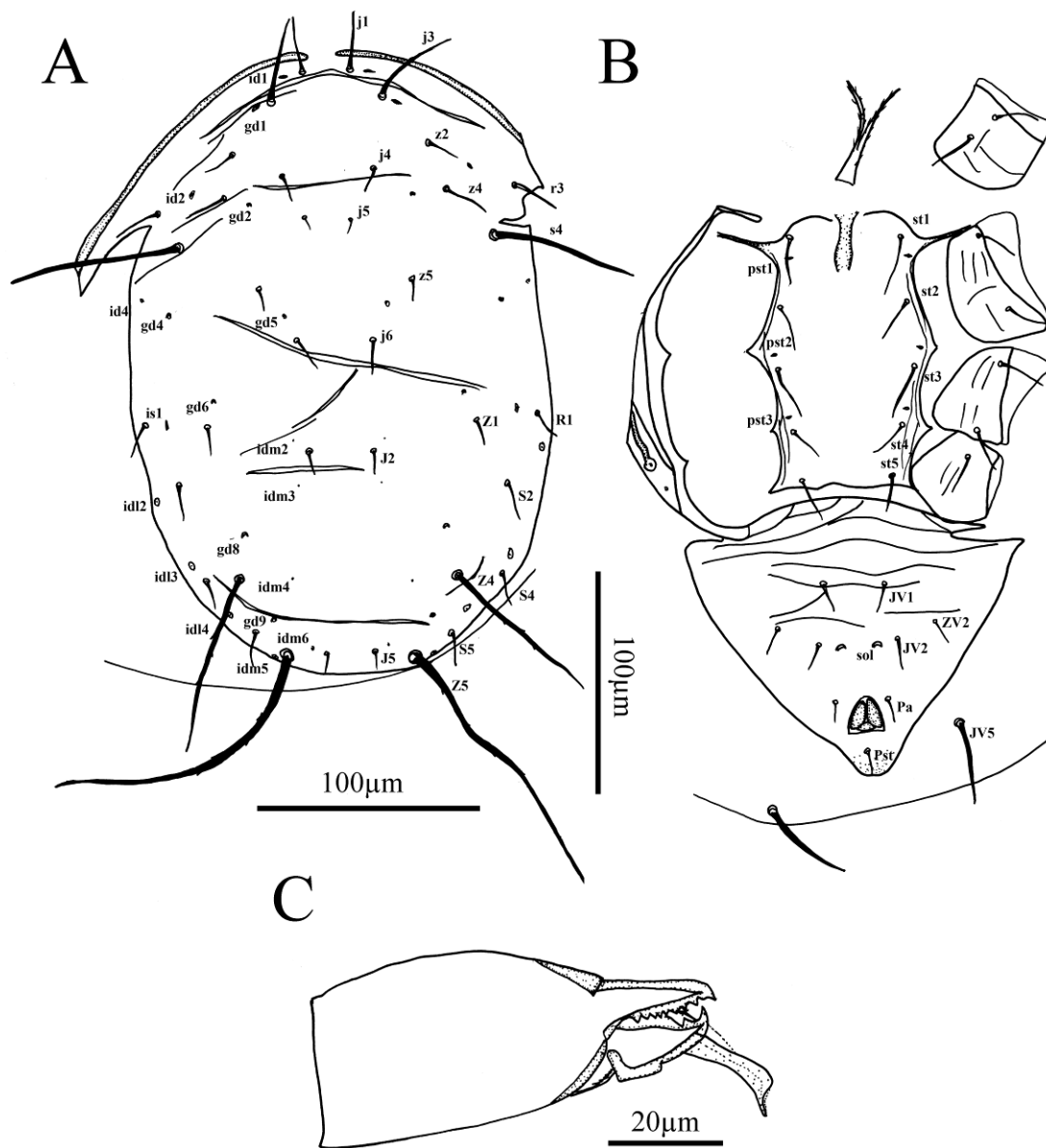


FIGURE 67. *Amblyseius alpinia* Tseng, 1983, Male, A. dorsal shield; B. ventral idiosoma; C. chelicera and spermatodactyl.

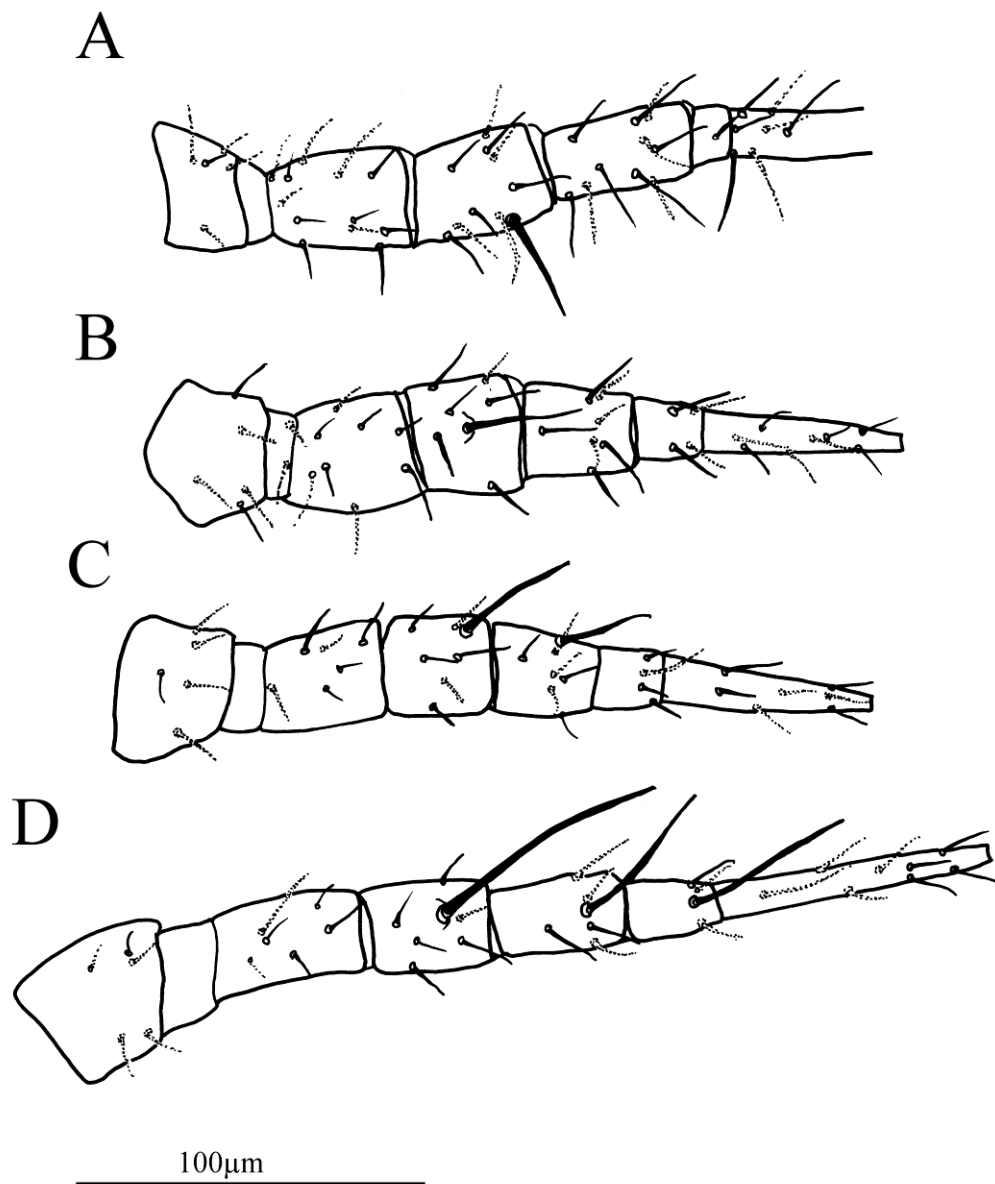


FIGURE 68. *Amblyseius alpinia* Tseng, 1983, Male, A. leg I anterior view, B. leg II dorsal view, C. leg III posterior view, D. leg IV dorsal view.

***Amblyseius bellatulus* Tseng, 1983**

純潔鈍綏蟎



(Figures 69–72)

Amblyseius (*Amblyseius*) *bellatulus* Tseng, 1983: 38.

Female (n=10)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield lightly sclerotized, smooth, laterally reticulated **382** 384 (353–449) long, **202** 212 (192–250) wide at level of *s*4, **228** 228 (212–276) wide at level of *S*4; seven pairs of solenostomes (*gd*1, *gd*2, *gd*4, *gd*5, *gd*6, *gd*8, *gd*9), thirteen pairs of lyrifissures (*id*1, *id*1a, *id*2, *id*4, *id*m2, *id*m3, *id*m4, *id*m5, *id*m6, *is*1, *id*l2, *id*l3, *id*l4); length of dorsal setae: *j*1 **23** 28 (23–32), *j*3 **34** 40 (34–46), *j*4 **5** 7 (5–13), *j*5 **4** 5 (4–7), *j*6 **6** 7 (4–8), *J*2 **4** 7 (4–9), *J*5 **5** 6 (4–9), *z*2 **11** 10 (8–11), *z*4 **11** 11 (8–13), *z*5 **5** 6 (4–8), *Z*1 **8** 8 (7–10), *Z*4 **52** 52 (47–57), *Z*5 **119** 136 (117–158), *s*4 **46** 49 (43–61), *S*2 **10** 11 (9–13), *S*4 **5** 8 (5–11), *S*5 **6** 7 (6–9), *r*3 **21** 19 (17–21), *R*1 **13** 10 (8–13). Setae *j*1, *j*3, *s*4 longer and smooth; *Z*4, *Z*5 greatly elongated, slightly serrated; other minute.

Peritreme. Peritreme extending to *j*1, peritremal shield smooth, lightly sclerotized, with one pair of solenostome (*gd*3), with one pair of lyrifissure (*id*3)..

Venter. Sternal shield smooth, posterior margin almost straight, wider than long, **66** 69 (62–73) long, **87** 94 (84–114) wide at *st*3 level, with three pairs of setae *st*1 **25** 27 (24–29), *st*2 **24** 24 (21–26), *st*3 **23** 23 (17–26) and two pairs of lyrifissures (*pst*1, *pst*2). Exopodal shield at coxae II–IV. Metasternal platelets tear-shaped, with a pair metasternal setae, *st*4 **22** 19 (14–22), and one pair of lyrifissures (*pst*3). Genital shield smooth, *st*5 **23** 22 (16–26), **77** 78 (73–96) wide. Distances between *st*1–*st*1 **59** 58 (53–73), *st*2–*st*2 **63** 63 (59–75), *st*3–*st*3 **78** 74 (67–80), *st*1–*st*3 **63** 64 (61–74), *st*5–*st*5 **59** 64 (58–73). Ventrianal shield smooth, almost pentagonal, with slightly waist at *JV*2

level; **121** 131 (121–151) long, **100** 98 (90–117) wide at level of ZV2 and **86** 90 (84–103) wide at level of anus; with three pairs of pre-anal setae, *JV1* **13** 15 (11–18), *JV2* **10** 13 (10–18), *ZV2* **9** 11 (9–14), solenostome *gv3* crescentic, *Pa* **19** 15 (12–19), *Pst* **19** 18 (14–22) on shield. Setae *JV4* **11** 10 (7–11), *JV5* **45** 51 (45–61), *ZV1* **15** 16 (12–19), *ZV3* **9** 10 (9–11) on interscutal membrane. All ventral setae smooth. Two pairs of metapodal plates **18** 20 (18–23) long, **4** 6 (4–7) wide, **12** 15 (12–17) long, **2** 2 (1–3) wide.

Calyx of spermatheca funnel-shaped **10** 11 (10–14) long, **10** 12 (10–13) wide, and atrium well distinct with neck, embolus not visible, with a thin major duct.

Chelicera. Movable digit **30** 29 (24–32) long, with three teeth; fixed digit **26** 27 (24–28) long, anterior half with two teeth, posterior half with eight teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* II (pd2) **27** 29 (26–33), *Sge* III (ad2) **30** 31 (27–37), *Sge* IV (ad2) **50** 50 (40–59), *Sti* IV (ad) **45** 46 (40–51), *St* IV (d) **73** 73 (66–84).

Male (n=2)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3,4:ZV-3.

Dorsum. Dorsal shield smooth, laterally reticulated; 264 (248–280) long, 178 (161–195) wide at level of *s4*, 138 (127–149) wide at level of *S4*, with seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), thirteen pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 20 (20–2), *j3* 28 (28–29), *j4* 5.4 (5–6), *j5* 5 (4–5), *j6* 5 (4–6), *J2* 5 (5–5), *J5* 5 (4–6), *z2* 10

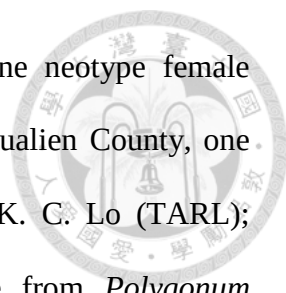
(10–11), *z4* 9 (8–10), *z5* 4 (4–4), *Z1* 9 (8–9), *Z4* 35 (35–35), *Z5* 81 (77–85), *s4* 34 (34–34), *S2* 9 (9–9), *S4* 7 (7–7), *S5* 6 (6–6), *r3* 15 (15–16), *R1* 9 (7–11). Setae *j1*, *j3*, *s4* longer and smooth; *Z4*, *Z5* greatly elongated, slightly serrated; other minute. Setae *r3* and *R1* inserted on dorsal shield.

Peritreme. Peritreme extending to *j1* level; peritremal shield lightly sclerotized, with one pair of solenostome (*gd3*).

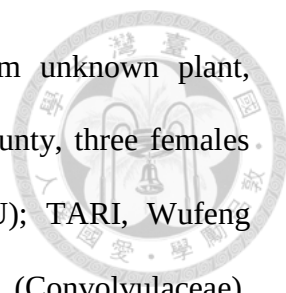
Venter. Sternogenital shield smooth, lateral slightly reticulated, posterior margin almost straight, longer than wide 116 (110–123) long, 64 (55–73) wide at level *st2*, with five pairs of setae *st1* 18 (16–19), *st2* 18 (16–20), *st3* 16 (13–19), *st4* 14 (11–17), *st5* 14 (13–14), three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Exopodal shield at coxae II–IV. Distance between *st1-st1* 42 (40–43), *st2-st2* 49 (46–52), *st3-st3* 50 (47–54), *st4-st4* 38 (36–40), *st5-st5* 30 (27–33), *st1-st5* 102 (97–106). Exopodal shield at coxae II–IV. Ventrianal shield subtriangular, slightly reticulated, 108 (103–114) long, 137 (129–144) wide at level of anterior corner and 61 (61–62) wide at level of anus, fused with peritremal shield cingulum; with three pairs of pre-anal setae, *JV1* 9 (9–9), *JV2* 10 (10–10), *ZV2* 8 (8–8), solenostome *gv3* crescentic, *Pa* 11 (11–11), *Pst* 11 (11–11) on shield; *JV5* 20 (17–22) on interscutal membrane. All ventral setae smooth.

Chelicera. Movable digit 21 (21–22) long, with one tooth; fixed digit 22 (20–24), with 8 teeth, *pilus dentilis*. Spermatodactyl U-shaped, shaft 34 (30–37) long, heel rounded, foot 18 (17–19) long, with rounded toe and lateral thorn-like projection.

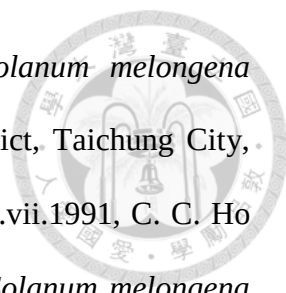
Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* II (ad2) 20 (20–20), *Sge* III (ad2) 20 (20–20), *Sge* IV (ad2) 29 (28–30), *Sti* IV (ad) 26 (25–26), *St* IV (d) 56 (56–56).



Specimens examined. TARI, Wufeng District, Taichung, one neotype female from *Toona sinensis* (Meliaceae), 17.xii.2001, C. C. Ho (NTU). Hualien County, one female from rice leaf sheath *Oryza sativa* (Poaceae), 2.xi.1977, K. C. Lo (TARL); Wanfeng Village, Wufeng District, Taichung City, one female from *Polygonum perfoliatum* (Polygonaceae), 3.ii.1978, C. C. Ho (TARI); Wanfeng Village, Wufeng District, Taichung City, one female from *Bothriochloa ischaemum* (Poaceae), 15.ii.1978, C. C. Ho (TARI); Wanfeng Village, Wufeng District, Taichung City, one female from mushroom, 15.xii.1981, K. C. Lo (TARI); TARI, Wufeng District, Taichung City, two females from *Zea mays* (Poaceae), 18.x.1985, C. C. Ho (TARL); TARI, Wufeng District, Taichung City, 17 females 1 male from *Ageratum conyzoides* (Asteraceae), 22.xi.1985, C. C. Ho (TARI); NPIA, two females from *Ageratum conyzoides* (Asteraceae), 22.xi.1985, C. C. Ho (TARL); Erlin Township, Changhua County, one female from *Vigna unguiculata* (Fabaceae), 14.xii.1986, S. M. Yu (NPUST); Mingjian Township, Nantou County, two females from *Ampelopsis brevipedunculata* (Vitaceae), 24.xii.1985, C. C. Ho (NTU); TARI, Wufeng District, Taichung City, one female from *Zea mays* (Poaceae), 4.vii.1987, C. C. Ho (TARI); Baihe District, Tainan City, one female from *Sambucus formosana* (Caprifoliaceae), 23.vi.1988, S. M. Yu (NMNS); TARI, Wufeng District, Taichung City, one female from *Ageratum houstonianum* (Asteraceae), 12.x.1988, S. M. Yu (NMNS); TARI, Wufeng District, Taichung City, two females from *Alternanthera sessilis* (Amaranthaceae), 17.x.1988, S. M. Yu (NPUST); TARI, Wufeng District, Taichung City, one female from *Eclipta prostrata* (Asteraceae), 17.x.1988, S. M. Yu (NMNS); TARI, Wufeng District, Taichung City, nine females from *Polygonum perfoliatum* (Polygonaceae), 17.x.1988, S. M. Yu (NCHU); TARI, Wufeng District, Taichung City, two females (MZLQ-7644, 7645) from *Arachis hypogaea* (Fabaceae), 17.x.1988, S. M. Yu (ESALQ-USP); TARI,



Wufeng District, Taichung City, one female (MZLQ-7643) from unknown plant, 18.x.1988, S. M. Yu (ESALQUSP); Caotun Township, Nantou County, three females from *Psidium guajava* (Myrtaceae), 27.x.1988, S. M. Yu (NTU); TARI, Wufeng District, Taichung City, two females from *Ipomoea acuminata* (Convolvulaceae), 27.x.1988, S. M. Yu (NTU); TARI, Wufeng District, Taichung City, one female (88-Am-0638) from *Ipomoea acuminata* (Convolvulaceae), 27.x.1988, S. M. Yu (TARI); TARI, Wufeng District, Taichung City, three females from *Zingiber officinale* (Zingiberaceae), 2.xi.1988, S. M. Yu (TARL); Caotun Township, Nantou County, 11 females from *Psidium guajava* (Myrtaceae), 2.xi.1988, S. M. Yu (NPUST); TARI, Wufeng District, Taichung City, two females from *Ageratum houstonianum* (Asteraceae), 16.xi.1988, S. M. Yu (NTU); TARI, Wufeng District, Taichung City, two females from *Ipomoea acuminata* (Convolvulaceae), 24.xi.1988, S. M. Yu (NTU); TARI, Wufeng District, Taichung City, one female from *Rorippa indica* (Brassicaceae), 30.xi.1988, S. M. Yu (TARL); TARI, Wufeng District, Taichung City, two females one male from *Oryza sativa* (Poaceae), 2.xii.1988, S. M. Yu (NCHU); TARI, Wufeng District, Taichung City, one female from *Ziziphus mauritiana* (Rhamnaceae), 7.xii.1988, C. C. Ho (TARI); Sanxiantai, Chenggong Township, Taitung County, one male from *Calophyllum inophyllum* (Calophyllaceae), 4.iv.1989, C. C. Ho (TARL); TARI, Wufeng District, Taichung City, one female from *Solanum melongena* (Solanaceae), 25.vi.1991, C. C. Ho (NMNS); TARI, Wufeng District, Taichung City, two females from *Solanum melongena* (Solanaceae), 4.vi.1991, C. C. Ho (TARI); TARI, Wufeng District, Taichung City, one female from *Solanum melongena* (Solanaceae), 11.vi.1991, C. C. Ho (NMNS); TARI, Wufeng District, Taichung City, three females rear from unknown plant, 3.vii.1991, C. C. Ho (TARI); TARI, Wufeng District, Taichung City, one female from *Solanum melongena* (Solanaceae), 4.vii.1991, C. C. Ho (NPUST);



TARI, Wufeng District, Taichung City, three females from *Solanum melongena* (Solanaceae), 6.vii.1991, C. C. Ho (NMNS); TARI, Wufeng District, Taichung City, nine females two males from *Solanum melongena* (Solanaceae), 16.vii.1991, C. C. Ho (NTU); TARI, Wufeng District, Taichung City, one female from *Solanum melongena* (Solanaceae), 23.vii.1991, C. C. Ho (NTU); TARI, Wufeng District, Taichung City, one female rear from unknown plant, 6.xi.1993, C. C. Ho (NTU); Lucao Township, Chiayi County, one female from *Lagenaria siceraria* (Cucurbitaceae) soil, 14.viii.2001, C. C. Ho (NTU); Dayuan District, Taoyuan City, one female from *Allium fistulosum* (Amaryllidaceae) soil, 25.x.2001, C. C. Ho (NTU).

Distribution. Asia: Taiwan (Tseng, 1983; Liao *et al.*, 2017b).

Remarks. Tseng (1983) reported this species based on holotype female from *Morus alba* in Nantou. Because of specimens of Tseng were lost, Liao *et al.* (2017) designated the neotype of *A. bellatulus*, and provided a detailed redescription. In the redescription, some differences between neotype and holotype were provided, such leg chaetotaxy, and solenostomes.

A. bellatulus were observed on various plants, although these mites mostly inhabit weeds, they also inhabit some economically valuable plants (e.g., corn plants, egg plants, and guava). Ho & Chen (2001) reported that *A. bellatulus* could prey on melon thrips (*Thrips palmi*) in the field. Therefore, *A. bellatulus* need further experiments for confirmation of the biocontrol potential.

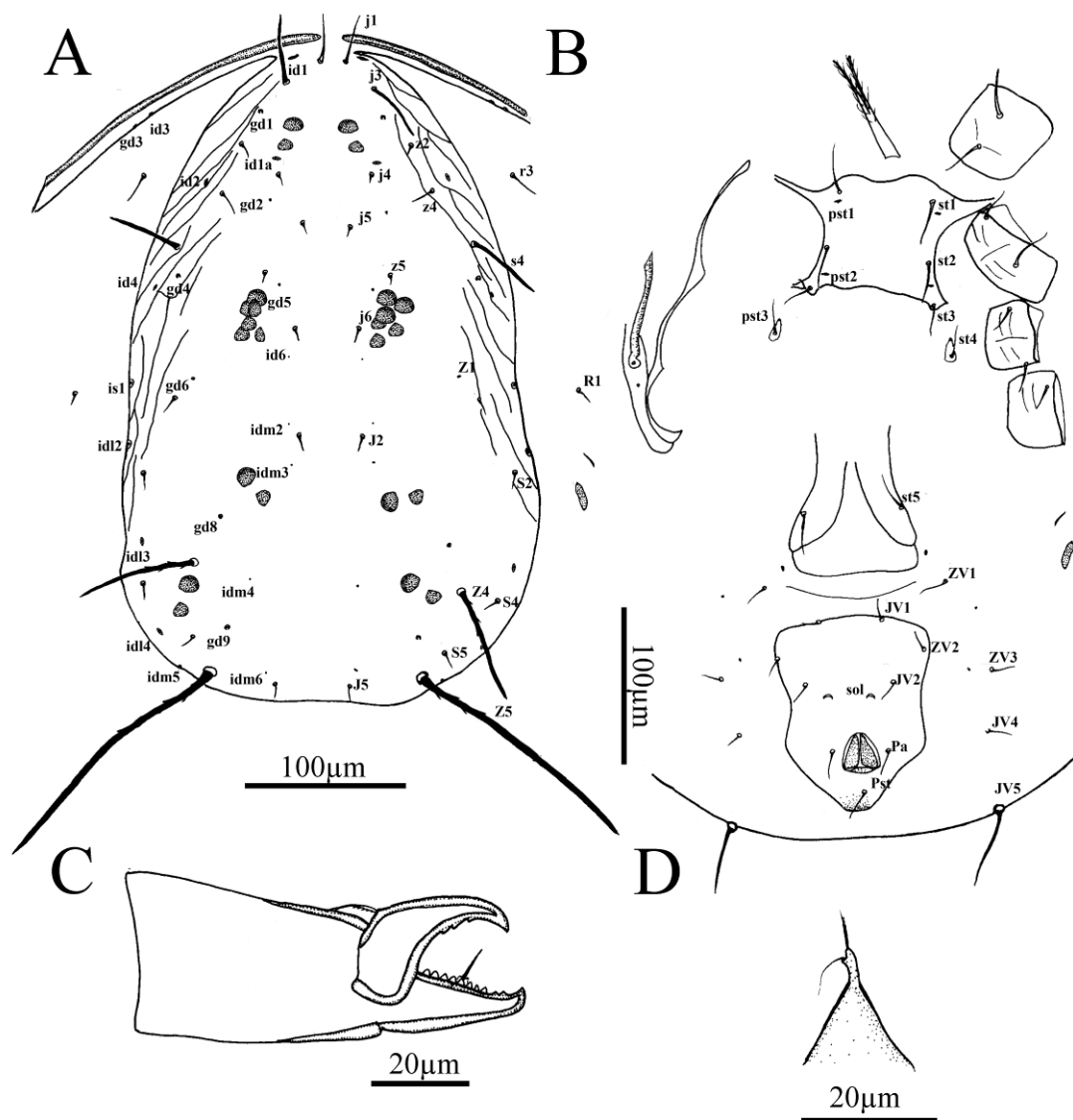


FIGURE 69. *Amblyseius bellatulus* Tseng, 1983, Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

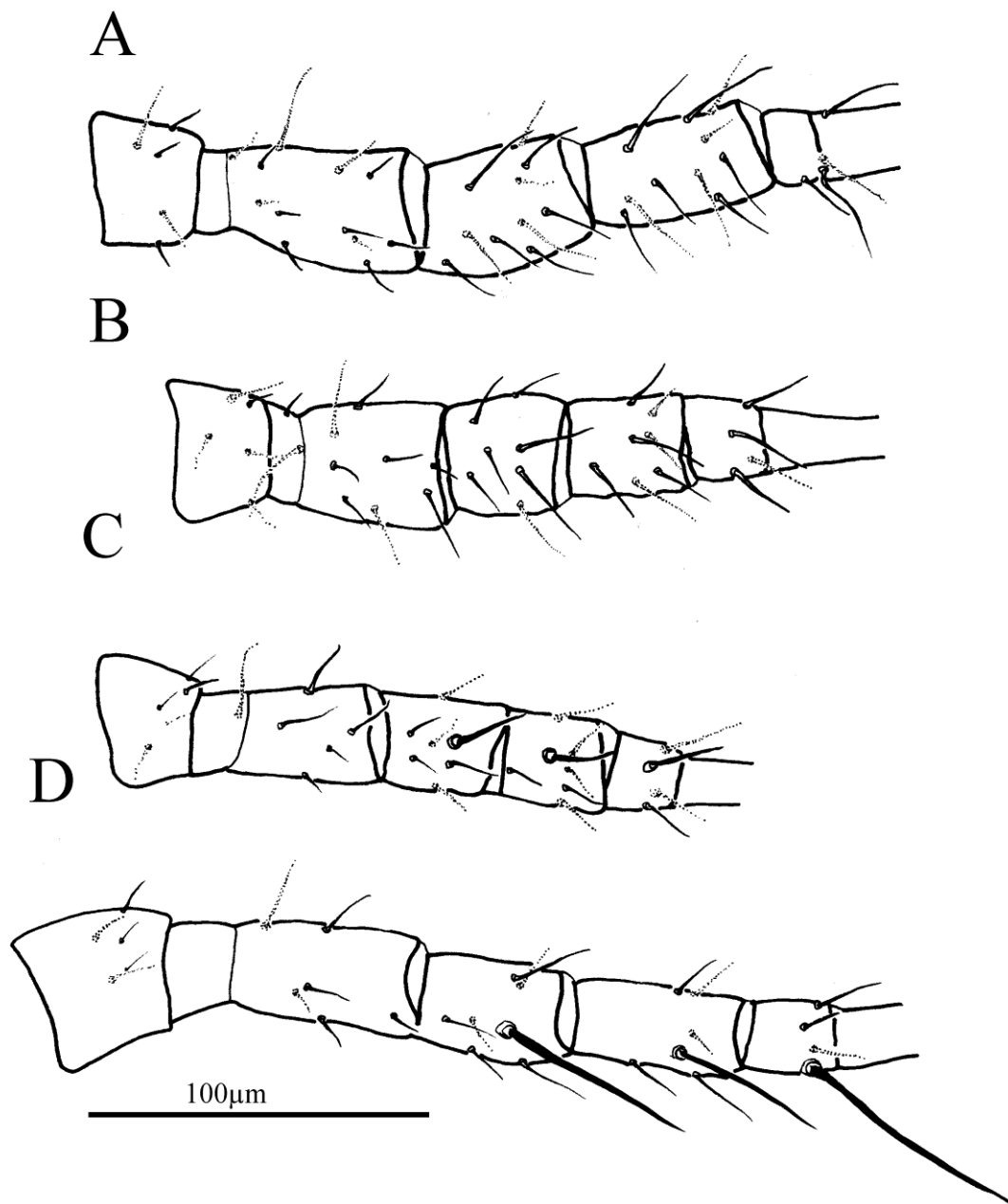


FIGURE 70. *Amblyseius bellatulus* Tseng, 1983, Female, legs A. leg I anterior view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV anterior view.

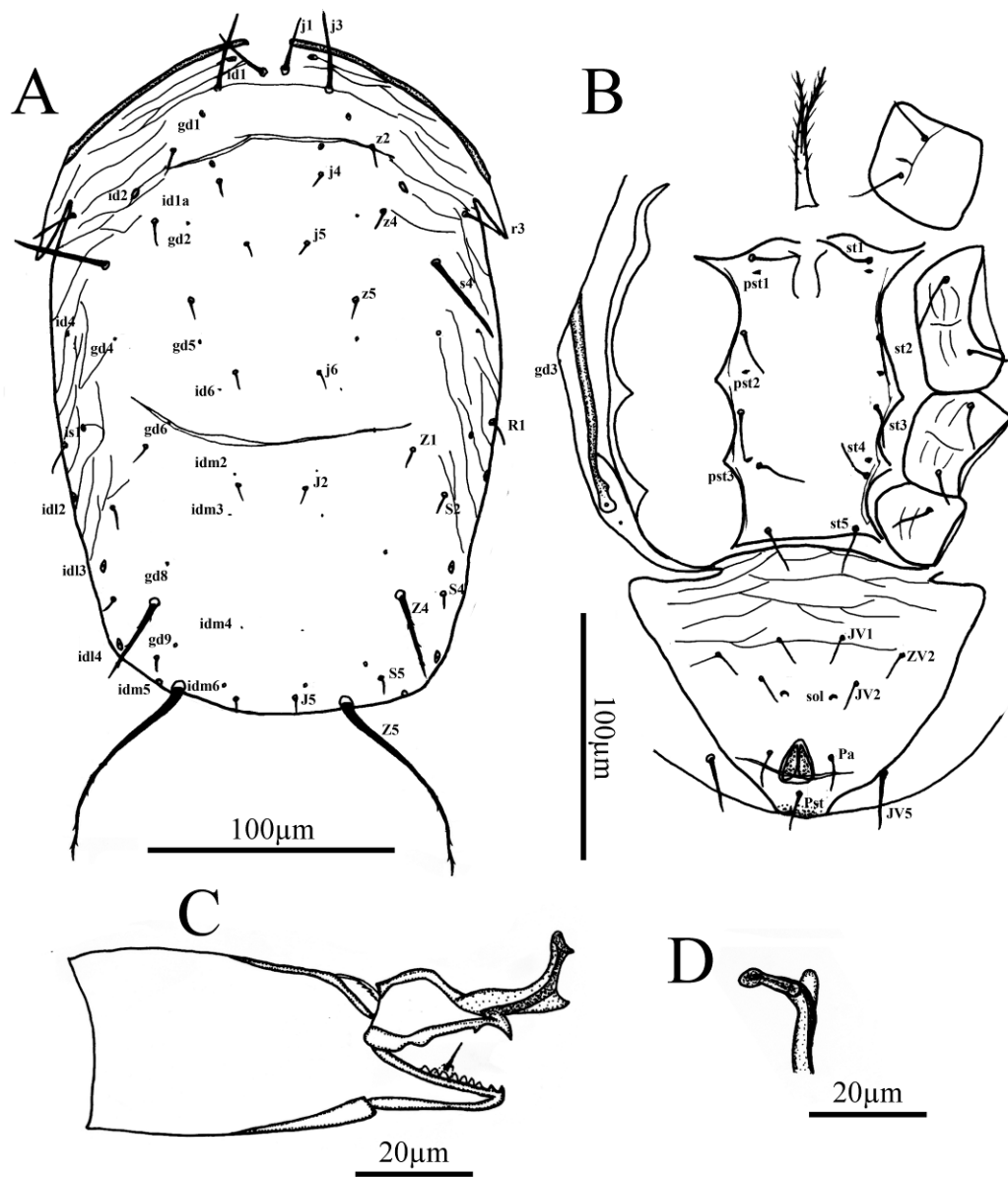


FIGURE 71. *Amblyseius bellatulus* Tseng, 1983, Male, A. dorsal shield; B. ventral idiosoma; C. chelicera and spermatodactyl.

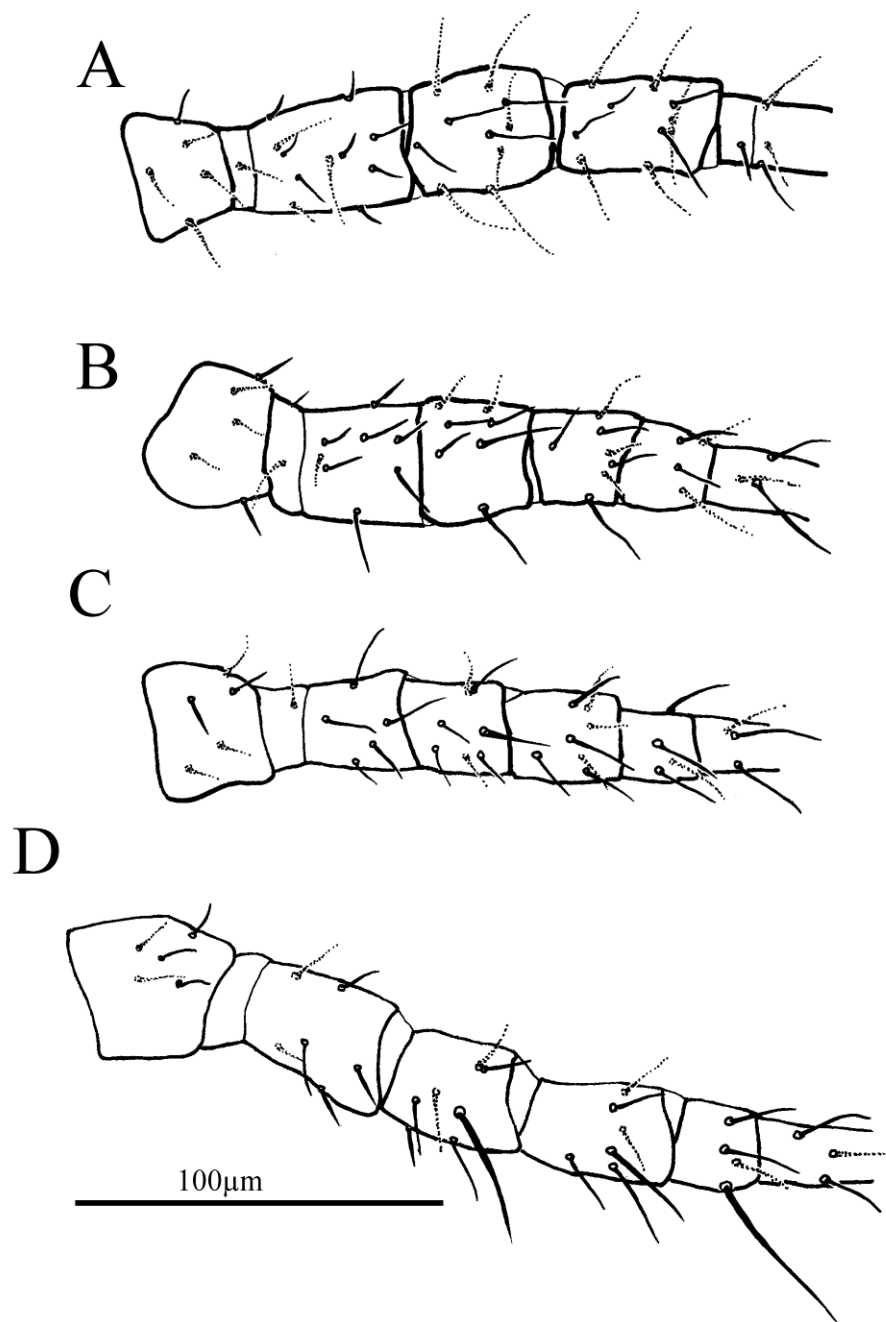


FIGURE 72. *Amblyseius bellatulus* Tseng, 1983, Male, A. leg I dorsal view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV anterior view.

***Amblyseius eharai* Amitai & Swirski, 1981**

江原鈍綏蟎



(Figures 73–76)

Amblyseius eharai Amitai & Swirski, 1981: 60.

Amblyseius (*Amblyseius*) *eharai*.—Ryu, 1993: 101.

Female (n=10)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield lightly sclerotized, smooth, 367 (332–392) long, 252 (224–270) wide at level of *s4*, 223 (196–252) wide at level of *S4*; seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), thirteen pairs of lyrifissures (*id1*, *id2*, *id4*, *id6*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of dorsal setae: *j1* 36 (33–39), *j3* 49 (35–55), *j4* 4 (3–6), *j5* 4 (3–7), *j6* 5 (3–8), *J2* 7 (4–10), *J5* 6 (3–9), *z2* 10 (7–16), *z4* 7 (4–10), *z5* 5 (2–7), *Z1* 7 (5–11), *Z4* 115 (96–127), *Z5* 303 (253–345), *s4* 102 (94–121), *S2* 8 (6–11), *S4* 7 (4–10), *S5* 8 (5–10), *r3* 10 (7–14), *R1* 8 (7–11). Setae *j1*, *j3*, *s4* longer and smooth; *Z4*, *Z5* greatly elongated, slightly serrated; other minute.

Peritreme. Peritreme extending beyond to *j1* level, peritremal shield smooth, lightly sclerotized, with one pair of solenostome (*gd3*), with one pair of lyrifissure (*id3*).

Venter. Sternal shield smooth, posterior margin almost with median projection, wider than long, 72 (60–79) long, 91 (76–104) wide at *st3* level, with three pairs of setae *st1* 37 (30–41), *st2* 31 (27–36), *st3* 32 (24–39) and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae II–IV. Metasternal platelets tear-shaped, with a pair metasternal setae, *st4* 27 (21–34), and one pair of lyrifissures (*pst3*). Genital shield smooth, *st5* 26 (19–31), 75 (60–85) wide. Distances between *st1*–*st1* 64 (60–69), *st2*–*st2* 72 (63–76), *st3*–*st3* 78 (68–85), *st1*–*st3* 70 (62–76), *st5*–*st5* 66 (53–74). Ventrianal shield smooth, vase-shaped; 116 (104–126) long, 56 (54–59) wide at level of *ZV2* and 69

(63–75) wide at level of anus; with three pairs of pre-anal setae, *JV1* 22 (16–25), *JV2* 20 (18–23), *ZV2* 16 (10–20), solenostome *gv3* crescentic, *Pa* 18 (15–23), *Pst* 17 (14–21) on shield. Setae *JV4* 10 (6–13), *JV5* 74 (57–85), *ZV1* 17 (13–23), *ZV3* 11 (8–15) on interscutal membrane. All ventral setae smooth. Two pairs of metapodal plates 21 (18–24) long, 5 (2–8) wide, 12 (8–16) long, 3 (1–4) wide.

Spermatheca. Calyx of spermatheca elongate, tubular, wider toward vehicle, 25 (17–31) long, 4 (3–5) wide, atrium larger, minor and major ducts visible.

Chelicera. Movable digit 31 (29–33) long, with three teeth; fixed digit 30 (25–33) long, anterior half with two teeth, posterior half with nine teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* I (pd2) 52 (45–57), *Sge* II (pd2) 42 (38–58), *Sge* III (ad2) 53 (45–61), *Sti* III (ad) 42 (35–51), *St* III (ad) 35 (30–39), *Sge* IV (ad2) 146 (130–161), *Sti* IV (ad) 114 (89–127), *St* IV (d) 76 (57–88).

Male (n=4)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3,4:ZV-3.

Dorsum. Dorsal shield smooth; 270 (263–280) long, 188 (175–195) wide at level of *s4*, 145 (140–149) wide at level of *S4*, seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), thirteen pairs of lyrifissures (*id1*, *id2*, *id4*, *id6*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 31 (24–46), *j3* 39 (38–42), *j4* 4 (3–6), *j5* 4 (3–5), *j6* 5 (4–7), *J2* 5 (3–7), *J5* 7 (4–9), *z2* 7 (5–10), *z4* 5 (3–6), *z5* 5 (3–8), *Z1* 7 (6–8), *Z4* 75 (68–81), *Z5* 215 (199–229), *s4* 74 (63–88), *S2* 8 (7–9), *S4* 7 (6–8), *S5* 6 (5–7), *r3* 9 (7–12), *R1* 9 (8–9). Setae *j1*, *j3*, *s4* longer and smooth; *Z4*, *Z5* greatly elongated, slightly serrated; other minute. Setae *r3* and *R1* inserted on dorsal shield.

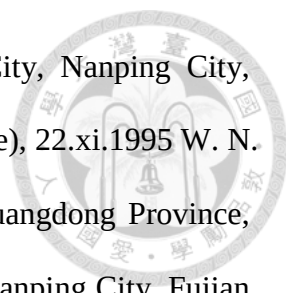
Peritreme. Peritreme extending to *j1* level; peritremal shield lightly sclerotized.

Venter. Sternogenital shield smooth, lateral slightly reticulated, posterior margin almost straight, longer than wide 118 (111–123) long, 74 (60–80) wide at level *st2*, with five pairs of setae *st1* 24 (20–28), *st2* 20 (17–22), *st3* 17 (16–20), *st4* 16 (15–17), *st5* 14 (12–18), three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Exopodal shield at coxae II–IV. Distance between *st1-st1* 51 (49–53), *st2-st2* 54 (49–56), *st3-st3* 57 (56–61), *st4-st4* 38 (36–40), *st5-st5* 31 (28–33), *st1-st5* 111 (109–112). Ventrianal shield subtriangular, with slightly reticulated, 111 (109–114) long, 145 (136–151) wide at level of anterior corner and 48 (40–54) wide at level of anus, fused with peritremal shield cingulum; with three pairs of pre-anal setae, *JV1* 14 (10–18), *JV2* 14 (12–16), *ZV2* 11 (10–12), solenostome *gv3* crescentic, *Pa* 11 (8–12), *Pst* 12 (11–12) on shield; *JV5* 38 (34–43) on interscutal membrane. All ventral setae smooth.

Chelicera. Movable digit 20 (19–24) long, with one tooth; fixed digit 20 (18–21), with two teeth on anterior half, five teeth on posterior half, with *pilus dentilis*. Spermatodactyl U-shaped, shaft 15 (13–16) long, heel rounded, foot 10 (9–11) long, with rounded toe and lateral thorn-like projection.

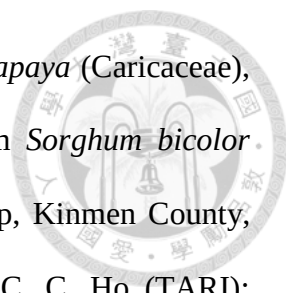
Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* I (pd2) 38 (37–39), *Sge* II (pd2) 33 (30–37), *Sge* III (ad2) 38 (35–45), *Sti* III (ad) 31 (28–33), *St* III (d) 27 (23–28), *Sge* IV (ad2) 79 (74–88), *Sti* IV (ad) 63 (60–64), *St* IV (d) 57 (51–65).

Specimens examined. CHINA: Mt. Baiyun, Baiyun District, Guangzhou City, Guangdong Province, one female from *Lespedeza formosa* (Fabaceae), 23-24.vii.2001, J. Z. Lin (GIABR); Huidong County, Huizhou City, Guangdong Province, 12 females

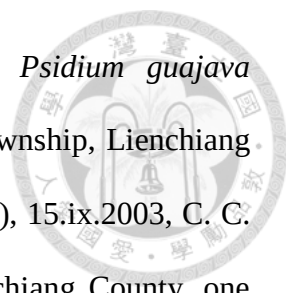


from unknown plant, 4.x.1988, W. N. Wu (GIABR); Shaowu City, Nanping City, Fujian Province, one female from dried leaf of *Oryza sativa* (Poaceae), 22.xi.1995 W. N. Wu (GIABR); Mt. Zhaichang, Huidong County, Huizhou City, Guangdong Province, one female shrub, 16.ix.1988, W. N. Wu (GIABR); Shaowu City, Nanping City, Fujian Province, one male from tree bark of *Cunninghamia lanceolata* (Cupressaceae), 19.xi.1995 W. N. Wu (GIABR); Mt. Zhaichang, Huidong County, Huizhou City, Guangdong Province, three females shrub, 17.ix.1988, W. N. Wu (GIABR); Fuzhou City, Fujian Province, three females from *Camellia sinensis* (Theaceae), 24.v.1996, W. N. Wu (GIABR); Zhouning County, Ningde City, Fujian Province, one female from *Camellia sinensis* (Theaceae), 20.xi.1995, W. N. Wu (GIABR); Fujian Agriculture And Forestry University, Fuzhou City, Fujian Province, three females from *Camellia sinensis* (Theaceae), 25.v.1996, W. N. Wu (GIABR); Fujian Agriculture And Forestry University, Fuzhou City, Fujian Province, two females from *Eriobotrya japonica* (Rosaceae), 13.ii.1998, W. N. Wu (GIABR); Shaowu City, Nanping City, Fujian Province, one female from *Laurus nobilis* (Lauraceae), 19.xi.1995 W. N. Wu (GIABR); Shaowu City, Nanping City, Fujian Province, one female from tree bark of *Pinus sp.* (Pinaceae), 19.xi.1995 W. N. Wu (GIABR); Guangzhou City, Guangdong Province, seven females from *Citrus reticulata* (Rutaceae), vii.1981, W. N. Wu (GIABR); Shaowu City, Nanping City, Fujian Province, one female from litter, 19.xi.1995 W. N. Wu (GIABR); Chebaling National Nature Reserve, Shaoguan City, Guangdong Province, two females one male from *Cunninghamia lanceolata* (Cupressaceae), 1991, W. N. Wu (GIABR); Yangzhou City, Jiangsu Province, six females (no. 1215-1, 2, 3, 4, 5, 6) from *Morus sp.* (Moraceae), 2013.?.?, S. M. Liu (NTU).

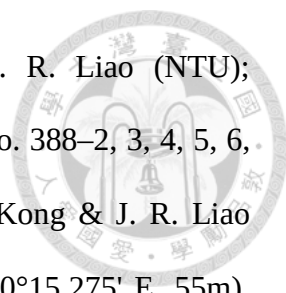
SOUTH KOREA: Unknown, eight females (no. 000485) from *Diospyros kaki* (Ebenaceae), 13.x.2004, C. C. Ho (TARI).



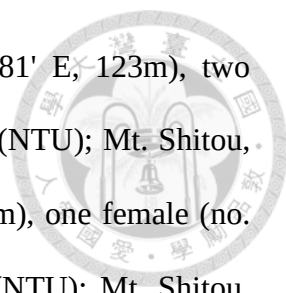
TAIWAN: Dashu Dist., Kaohsiung City, one female from *Carica papaya* (Caricaceae), 8.xii.1992, C. C. Ho (TARI); Kinmen County, two females from *Sorghum bicolor* (Poaceae), 15.vii.1996, C. C. Ho (TARI); Xibao, Jinning Township, Kinmen County, one female from *Ipomoea indica* (Convolvulaceae), 15.vii.1996, C. C. Ho (TARI); Fuwo Village, Nangan Township, Lienchiang County, one female from unknown plant, 14.ix.2000, C. C. Ho (TARL); Mt. Bishan, Beigan Township, Lienchiang County, one female from *Achyranthes aspera* (Amaranthaceae), 15.ix.2000, W. H. Chen (TARL); Qiaozi Village, Beigan Township, Lienchiang County, one female from *Bidens pilosa* (Asteraceae), 15.ix.2000, C. C. Ho (TARL); Shanlong, Nangan Township, Lienchiang County, one female (TAL090K233) from *Lagenaria siceraria* (Cucurbitaceae), 25.vii.2001, C. C. Ho (TARL); Shangcun, Beigan Township, Lienchiang County, one female one male (TAL090K130, 31) from *Melia azedarach* (Meliaceae), 26.vii.2001, C. C. Ho (TARL); Banli, Beigan Township, Lienchiang County, two females (TAL090K195) from *Solanum melongena* (Solanaceae), 26.vii.2001, C. C. Ho (TARL); Banli, Beigan Township, Lienchiang County, two females (TAL090K195) from *Solanum melongena* (Solanaceae), 26.vii.2001, C. C. Ho (TARL); Yanxiu, Dongyin Township, Lienchiang County, two female (TAL091F009) from soil of *Ricinus communis* (Euphorbiaceae), 4.vi.2002, C. C. Ho (TARL); Fuwo Village, Nangan Township, Lienchiang County, one female (TAL091F041) from soil of *Eriobotrya japonica* (Rosaceae), 4.vi.2002, C. C. Ho (TARL); Fuxing Village, Nangan Township, Lienchiang County, two females (TAL091F044, 49) from soil, 5.vi.2002, C. C. Ho (TARL); Qingshui, Nangan Township, Lienchiang County, one female (TAL092N196) from *Vitis vinifera* (Vitaceae), 15.ix.2003, C. C. Ho (TARL); Qingfan Village, Juguang Township, Lienchiang County, two females (TAL092N116, 17) from *Ficus erecta* var. *beecheiana* (Moraceae), 15.ix.2003, C. C. Ho (TARL); Nangan Township, Lienchiang



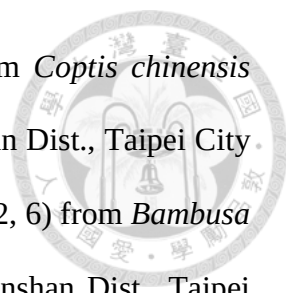
County, two females one male (TAL092N229, 30, 31) from *Psidium guajava* (Myrtaceae), 15.ix.2003, C. C. Ho (TARL); Miaoyuan, Nangan Township, Lienchiang County, one female (TAL092N168) from *Pyrus pyrifolia* (Rosaceae), 15.ix.2003, C. C. Ho (TARL); Matsu Senior High School, Nangan Township, Lienchiang County, one female (TAL092N173) from unknown plant, 15.ix.2003, C. C. Ho (TARL); Matsu Senior High School, Nangan Township, Lienchiang County, one female (TAL092N181) from unknown plant, 15.ix.2003, C. C. Ho (TARL); Puli Township, Nantou County, one female from *Bambusa oldhamii* (Poaceae), 26.viii.2009, H. T. Fang & J. R. Liao (NTU); Xindian Dist., New Taipei City, one female from *Musa x paradisiaca* (Musaceae), 1.ix.2009, J. R. Liao (NTU); Wufeng Dist., Hsinchu County, one female from *Rhus javanica* Linn. var. *roxburghiana* (Anacardiaceae), 20.i.2010, Y. H. Chiang & J. R. Liao (NTU); Zhitan Elementary School, Xindian Dist., New Taipei City, five females two males from *Morus* sp. (Moraceae), 27.i.2010, J. R. Liao (NTU); Zhitan, Xindian Dist., New Taipei City, one female one male from *Ficus irisana* (Moraceae), 27.i.2010, J. R. Liao (NTU); Zhitan, Xindian Dist., New Taipei City, two females one male from *Morus* sp. (Moraceae), 27.i.2010, J. R. Liao (NTU); Daping Village, Longqi Dist., Tainan City (22°55.647' N, 120°23.514' E, 60 m), three females from *Bambusa oldhamii* (Poaceae), 21.ii.2010, J. R. Liao (NTU); Xihu Township, Miaoli County (24°32.489' N, 120°44.981' E, 62 m), six females one male (no. 370–1, 2, 3, 4, 5, 6, 7) from *Morus* sp. (Moraceae), 11.iii.2010, Y. H. Chiang (NTU); Xihu Township, Miaoli County (24°31.944' N, 120°45.432' E, 92m), three females two males (no. 380–8, 9, 10, 11, 12) from *Humulus scandens* (Cannabaceae), 11.iii.2010, Y. H. Chiang (NTU); Chaishan, Gushan Dist., Kaohsiung City, five females one male (no. 386–1, 2, 3, 4, 5, 7) from *Lantana camara* (Verbenaceae), 11.iii.2010, S. W. Kong & J. R. Liao (NTU); Chaishan, Gushan Dist., Kaohsiung City, two females one male (no. 387–1, 2, 3) from



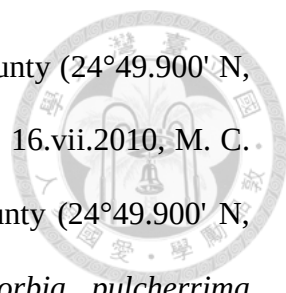
Solanum erianthum (Solanaceae), 11.iii.2010, S. W. Kong & J. R. Liao (NTU); Chaishan, Gushan Dist., Kaohsiung City, four females two males (no. 388–2, 3, 4, 5, 6, 7) from *Macaranga tanarius* (Euphorbiaceae), 11.iii.2010, S. W. Kong & J. R. Liao (NTU); Xiziwan, Gushan Dist., Kaohsiung City (22°38.539' N, 120°15.275' E, 55m), four females from *Millettia pinnata* (Fabaceae), 11.iii.2010, S. W. Kong & J. R. Liao (NTU); Banju Branch, Taitung District Agricultural Research and Extension Station, Beinan Township, Taitung County (22°49.759' N, 121°04.634' E, 310m), two females one male (no.403–3, 4, 5) from *Ageratum houstonianum* (Asteraceae), 31.iii.2010, Y. T. Hsu & J. R. Liao (NTU); Banju Branch, Taitung District Agricultural Research and Extension Station, Beinan Township, Taitung County (22°49.759' N, 121°04.634' E, 310m), four females one male (no. 404–4, 5, 6, 7, 8) from *Crassocephalum crepidioides* (Asteraceae), 31.iii.2010, Y. T. Hsu & J. R. Liao (NTU); Banju Branch, Taitung District Agricultural Research and Extension Station, Beinan Township, Taitung County (22°49.759' N, 121°04.634' E, 310m), 13 females 2 males (no. 410–1, 2, 3, 4, 5, 6, 9, 12, 13, 14, 15, 16, 19, 20, 21, 22, 23) from *Annona x atemoya* (Annonaceae), 31.iii.2010, Y. T. Hsu & J. R. Liao (NTU); Banju Branch, Taitung District Agricultural Research and Extension Station, Beinan Township, Taitung County (22°49.759' N, 121°04.634' E, 310m), four females (no.413–4, 5, 6, 7) from *Dendrocnide meyeniana* (Urticaceae), 31.iii.2010, Y. T. Hsu & J. R. Liao (NTU); Banju Branch, Taitung District Agricultural Research and Extension Station, Beinan Township, Taitung County (22°49.759' N, 121°04.634' E, 310m), two females (no.414–1, 2) from *Machilus kusanoi* (Lauraceae), 31.iii.2010, Y. T. Hsu & J. R. Liao (NTU); Banju Branch, Taitung District Agricultural Research and Extension Station, Beinan Township, Taitung County (22°49.759' N, 121°04.634' E, 310m), three females two males (no. 511–6, 7, 8, 9, 10) from *Mangifera indica* (Anacardiaceae), 31.iii.2010, Y. T. Hsu & J. R. Liao (NTU); Mt.



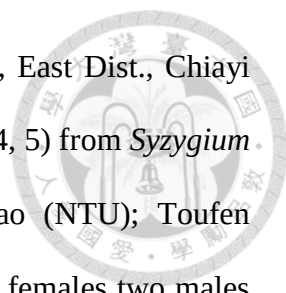
Shitou, Xindian Dist., New Taipei City (24°57.671' N, 121°32.481' E, 123m), two females (no. 474–4, 6) from unknown plant, 17.iv.2010, J. R. Liao (NTU); Mt. Shitou, Xindian Dist., New Taipei City (24°57.671' N, 121°32.481' E, 123m), one female (no. 475–1) from *Arenga tremula* (Arecaceae), 17.iv.2010, J. R. Liao (NTU); Mt. Shitou, Xindian Dist., New Taipei City (24°57.568' N, 121°32.564' E, 155m), one female (no. 479–12) from *Prunus campanulata* Maxim. cv. "Polypetalous" (Rosaceae), 17.iv.2010, J. R. Liao (NTU); Mt. Shitou, Xindian Dist., New Taipei City (24°57.466' N, 121°32.649' E, 208m), one female (no. 481–1) from unknown plant, 17.iv.2010, J. R. Liao (NTU); Mt. Shitou, Xindian Dist., New Taipei City (24°57.466' N, 121°32.649' E, 208m), four females (no. 482-3, 4, 5, 6) from *Bischofia javanica* (Euphorbiaceae), 17.iv.2010, J. R. Liao (NTU); Mt. Shitou, Xindian Dist., New Taipei City (24°57.466' N, 121°32.649' E, 208m), four females one male (no. 483–1, 2, 3, 4, 5) from *Ficus fistulosa* (Moraceae), 17.iv.2010, J. R. Liao (NTU); Sanwan Township, Miaoli County (24°39.916' N, 120°57.901' E, 79m), two females (no. 486-1, 2) from *Clematis grata* (Ranunculaceae), 19.iv.2010, Y. H. Chiang & J. R. Liao (NTU); Sanwan Township, Miaoli County (24°38.780' N, 120°58.197' E, 119m), five females (no. 509–3, 4, 6, 7, 8) from *Bischofia javanica* (Euphorbiaceae), 19.iv.2010, Y. H. Chiang & J. R. Liao (NTU); Qingshi Road, Wufeng Township, Hsinchu County (24°33.789' N, 121°06.772' E, 924m), two females one male (no. 519–1, 4, 5) from *Morus* sp. (Moraceae), 3.v.2010, Y. H. Chiang & J. R. Liao (NTU); Qingshi Road, Wufeng Township, Hsinchu County (24°33.789' N, 121°06.772' E, 924m), one female (no. 521–1) from *Turpinia formosana* (Staphyleaceae), 3.v.2010, Y. H. Chiang & J. R. Liao (NTU); Sinwu Dist., Taoyuan City (25°00.031' N, 121°05.119' E, 58m), one female one male (no. 562–1, 2) from *Phyllostachys makinoi* (Poaceae), 24.v.2010, Y. H. Chiang & J. R. Liao (NTU); Laoquan St., Wenshan Dist., Taipei City (24°58.745' N, 121°34.045'



E, 22m), three females three males (no. 568–1, 2, 3, 4, 5, 6) from *Coptis chinensis* (Ranunculaceae), 8.vi.2010, J. R. Liao (NTU); Laoquan St., Wenshan Dist., Taipei City (24°58.745' N, 121°34.045' E, 22m), one female one male (no. 571–2, 6) from *Bambusa oldhamii* (Poaceae), 8.vi.2010, J. R. Liao (NTU); Laoquan St., Wenshan Dist., Taipei City (24°58.745' N, 121°34.045' E, 22m), five females two male (no. 572–1, 2, 3, 4, 5, 6) from *Debregeasia orientalis* (Urticaceae), 8.vi.2010, J. R. Liao (NTU); Maokong, Wenshan Dist., Taipei City (24°58.062' N, 121°35.332' E, 313m), one female two male (no. 578–1, 2, 3) from unknown plant, 9.vi.2010, A. K. Dubey & J. R. Liao (NTU); Maokong, Wenshan Dist., Taipei City (24°58.062' N, 121°35.332' E, 313m), one female two male (no. 584-2, 4, 5) from *Bambusa oldhamii* (Poaceae), 9.vi.2010, A. K. Dubey & J. R. Liao (NTU); Sandimen Township, Pingtung County (22°43.878' N, 120°40.038' E, 878m), three females two males (no. 589–1, 2, 3, 4, 5) from *Dimocarpus longan* (Sapindaceae), 13.vi.2010, Y. H. Chiang & J. R. Liao (NTU); Laiyi Township, Pingtung County (22°31.628' N, 120°39.930' E, 139m), three females (no. 591–2, 3, 4) from *Mangifera indica* (Anacardiaceae), 13.vi.2010, Y. H. Chiang & J. R. Liao (NTU); Manzhou Township, Pingtung County (22°00.734' N, 120°50.234' E, 26m), one female (no. 605–5) from *Morus* sp. (Moraceae), 14.vi.2010, Y. H. Chiang & J. R. Liao (NTU); Lianhuachi, Yuchi Township, Nantou County, one female (no. 635–1) from *Litsea acuminata* (Lauraceae), 28.vi.2010, S. F. Lin & J. R. Liao (NTU); Lianhuachi, Yuchi Township, Nantou County, two females (no. 640–2, 4) from *Ageratum houstonianum* (Asteraceae), 28.vi.2010, S. F. Lin & J. R. Liao (NTU); Hengshan Township, Hsinchu County (24°42.977' N, 121°11.422' E, 491m), two females (no. 669–3, 5) from *Morus* sp. (Moraceae), 12.vii.2010, Y. H. Chiang & J. R. Liao (NTU); Hengshan Township, Hsinchu County (24°42.977' N, 121°11.422' E, 491m), two females (no. 673-1, 3) from *Ageratum houstonianum* (Asteraceae), 12.vii.2010, Y. H.



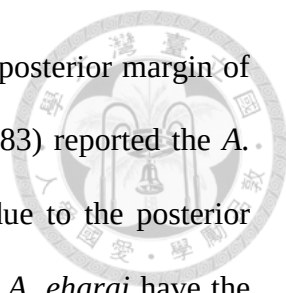
Chiang & J. R. Liao (NTU); Wufengqi, Jiaoxi Township, Yilan County (24°49.900' N, 121°44.837' E, 108m), one female (no. 676–1) from unknown plant, 16.vii.2010, M. C. Chiu & J. R. Liao (NTU); Wufengqi, Jiaoxi Township, Yilan County (24°49.900' N, 121°44.837' E, 108m), one female (no. 682–6) from *Euphorbia pulcherrima* (Euphorbiaceae), 16.vii.2010, M. C. Chiu & J. R. Liao (NTU); Paomagudao, Jiaoxi Township, Yilan County (24°49.656' N, 121°45.928' E, 36m), two females (no. 684-7, 9) from *Trema orientalis* (Cannabaceae), 16.vii.2010, M. C. Chiu & J. R. Liao (NTU); Paomagudao, Jiaoxi Township, Yilan County (24°49.656' N, 121°45.928' E, 36m), three female two males (no. 686–2, 3, 10, 11, 12) from *Machilus zuihoensis* (Lauraceae), 16.vii.2010, M. C. Chiu & J. R. Liao (NTU); Paomagudao, Jiaoxi Township, Yilan County (24°49.656' N, 121°45.928' E, 36m), one female (no. 689-6) from *Phyllostachys makinoi* (Poaceae), 16.vii.2010, M. C. Chiu & J. R. Liao (NTU); Baibao River Forest Road, Xiulin Township, Hualien County (23°53.576' N, 121°29.996' E, 168m), two females one male from *Ageratum houstonianum* (Asteraceae), 2.viii.2010, S. F. Lin & J. R. Liao (NTU); Fenghuang Waterfall, Fenglin Township, Hualien County (23°45.402' N, 121°25.525' E, 208m), one female two males (no. 728–1, 2, 4) from *Vernicia fordii* (Euphorbiaceae), 2.viii.2010, S. F. Lin & J. R. Liao (NTU); Zhudong Township, Hsinchu County (24°42.299' N, 121°05.800' E, 188m), one female (no. 752–12) from *Boehmeria nivea* (Urticaceae), 13.viii.2010, C. T. Chen & J. R. Liao (NTU); Qilan Forest Recreation Area, Datong Township, Yilan County (24°34.861' N, 121°29.687' E, 393m), one female (no. 852–6) from *Morus* sp. (Moraceae), 30.viii.2010, J. F. Hsieh & J. R. Liao (NTU); Yizhu Township, Chiayi County (23°22.858' N, 120°15.409' E, 3m), one female (no. 867–1) from *Morus* sp. (Moraceae), 14.iv.2010, J. F. Hsieh & J. R. Liao (NTU); Yizhu Township, Chiayi County (23°22.858' N, 120°15.409' E, 3m), one female (no. 868–3) from *Cordia dichotoma* (Boraginaceae),



14.iv.2010, J. F. Hsieh & J. R. Liao (NTU); Chiayi Branch, TARI, East Dist., Chiayi City (23°29.109' N, 120°28.199' E, 55m), three females (no. 873–3, 4, 5) from *Syzygium samarangense* (Myrtaceae), 14.iv.2010, J. F. Hsieh & J. R. Liao (NTU); Toufen Township, Miaoli County (23°29.109' N, 120°28.199' E, 55m), two females two males (no. 879–3, 6, 8, 9) from *Poria cocos* (Polyporaceae), 13.x.2010, J. R. Liao (NTU); Mt. Jiali, Nanzhuang Township, Miaoli County (24°31.651' N, 121°01.599' E, 1326m), one female (no. 893–5) from *Bridelia balansae* (Euphorbiaceae), 13.x.2010, J. R. Liao (NTU); Mt. Shitou, Emei Township, Hsinchu County (24°39.277' N, 121°01.539' E, 595m), one female (no. 896–2) from *Litsea* sp. (Lauraceae), 13.x.2010, J. R. Liao (NTU); Sanwan Township, Miaoli County (24°38.876' N, 120°59.732' E, 142m), one female (no. 899–8) from *Ageratum houstonianum* (Asteraceae), 13.x.2010, J. R. Liao (NTU); Sanwan Township, Miaoli County (24°38.876' N, 120°59.732' E, 142m), three females two males (no. 900–1, 2, 3, 4, 6) from *Morus* sp. (Moraceae), 13.x.2010, J. R. Liao (NTU); Erlun Township, Yunlin County (23°46.480' N, 120°21.713' E, 15m), one female one male (no. 903–5, 9) from *Morus* sp. (Moraceae), 24.x.2010, J. F. Hsieh & C. T. Chen (NTU); Simaxian, Tai'an Township, Miaoli County (24°24.679' N, 120°56.725' E, 852m), five females (no. 909–1, 2, 3, 4, 5) from *Morus* sp. (Moraceae), 31.x.2010, W. C. Yang & J. R. Liao (NTU).

Distribution. Asia: China (Guangdong (Wu *et al.* 1991), Hainan (Wu & Ou 2002), Hong Kong (Amitai & Swirski 1981), Wuling mountain Region (Wu & Lan 1992)), Japan (Amitai & Swirski 1981; Ehara & Amano 1998), Malaysia (Ehara 2002a), South Korea (Ryu 1993), Taiwan (Ho *et al.* 2003; Liao *et al.* 2013), Thailand (Oliveira *et al.* 2012).

Remarks. Amitai & Swirski (1981) described this species based on series materials in Hong Kong, Philippines, and also Japan. *A. largoensis* and closely species



were also redefined in their article. *A. eharai* was characterized by posterior margin of sternal shield with median projection, calyx shorter. McMurtry (1983) reported the *A. deleoni* in Amitai & Swirski (1981) was probably *A. herbicolus* due to the posterior margin of sternal shield straight. Amitai & Swirski (1981) reported *A. eharai* have the movable digit with four teeth, fixed digit with ten teeth; and the present study reported that *A. eharai* have movable digit with three teeth, fixed digit with eleven teeth. The tooth number of movable digit is considered as a stable character in some groups of phytoseiid (Döker *et al.* 2018b). In Taiwan, three species (e.g. *A. eharai*, *A. largoensis*, *A. herbicolus*) belonged to *largoensis* species group were easily misidentified. The present study provided the differences: 1. *A. largoensis* could be identified by parallel tubular calyx of spermatheca; 2. *A. herbicolus* could be diagnosed by posterior margin of sternal shield straight and also movable digit with 4 teeth; 3. *A. eharai* could be identified by posterior margin of sternal shield with medium projection, movable digit with 3 teeth. During the survey, *A. eharai* was observed in whole Taiwan and also surrounding islands. It is the most common phytoseiid species in Taiwan. Besides, this species occurred in farm when spider mite population is lower, but when spider mites become major pests, *A. eharai* population will be down, and difficult to be found. Although this species was tested for biocontrol potential in China, but it is probably a natural enemy in initial stages of spider mite in natural condition.

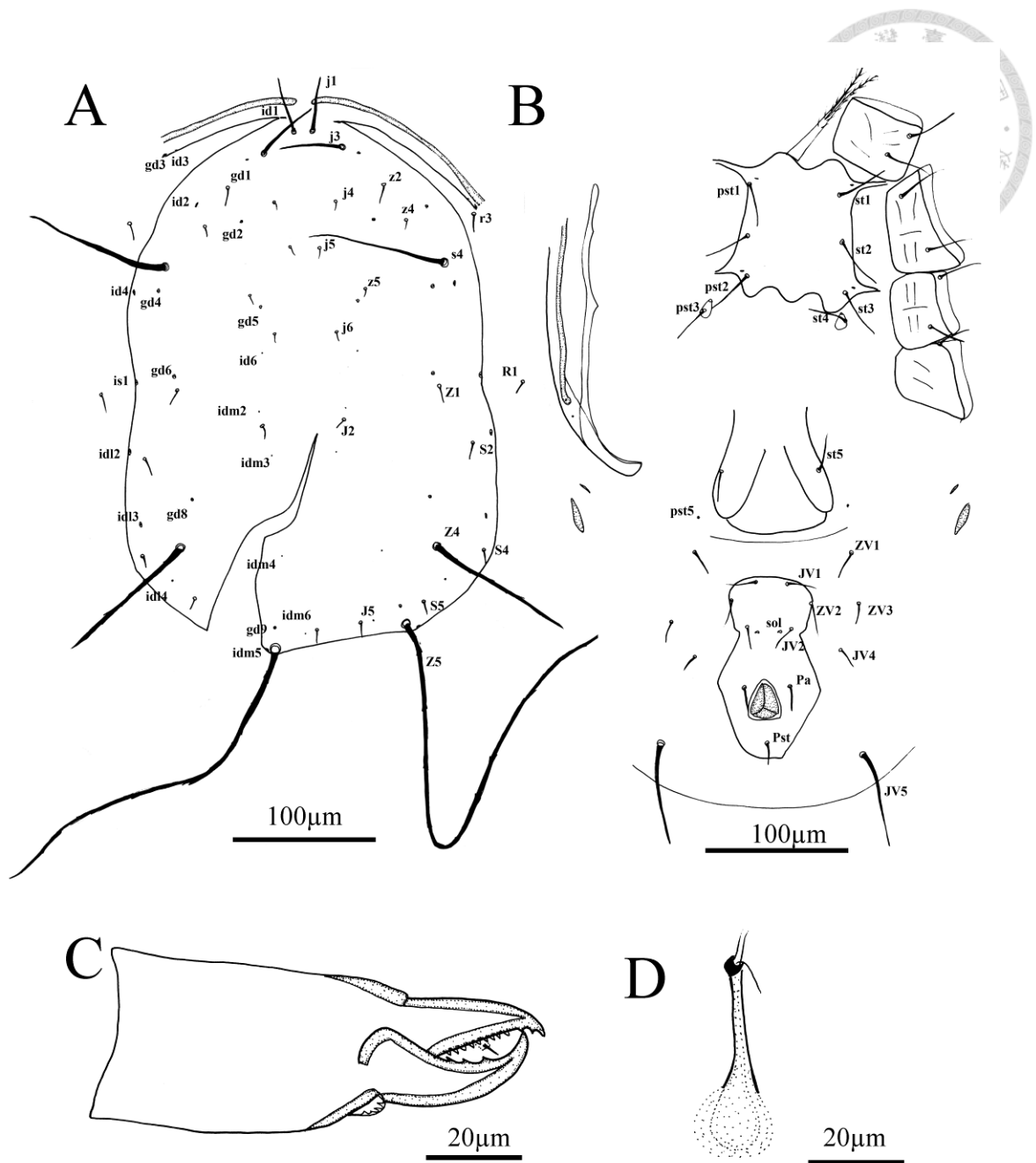


FIGURE 73. *Amblyseius eharai* Amitai & Swirski, 1981, Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

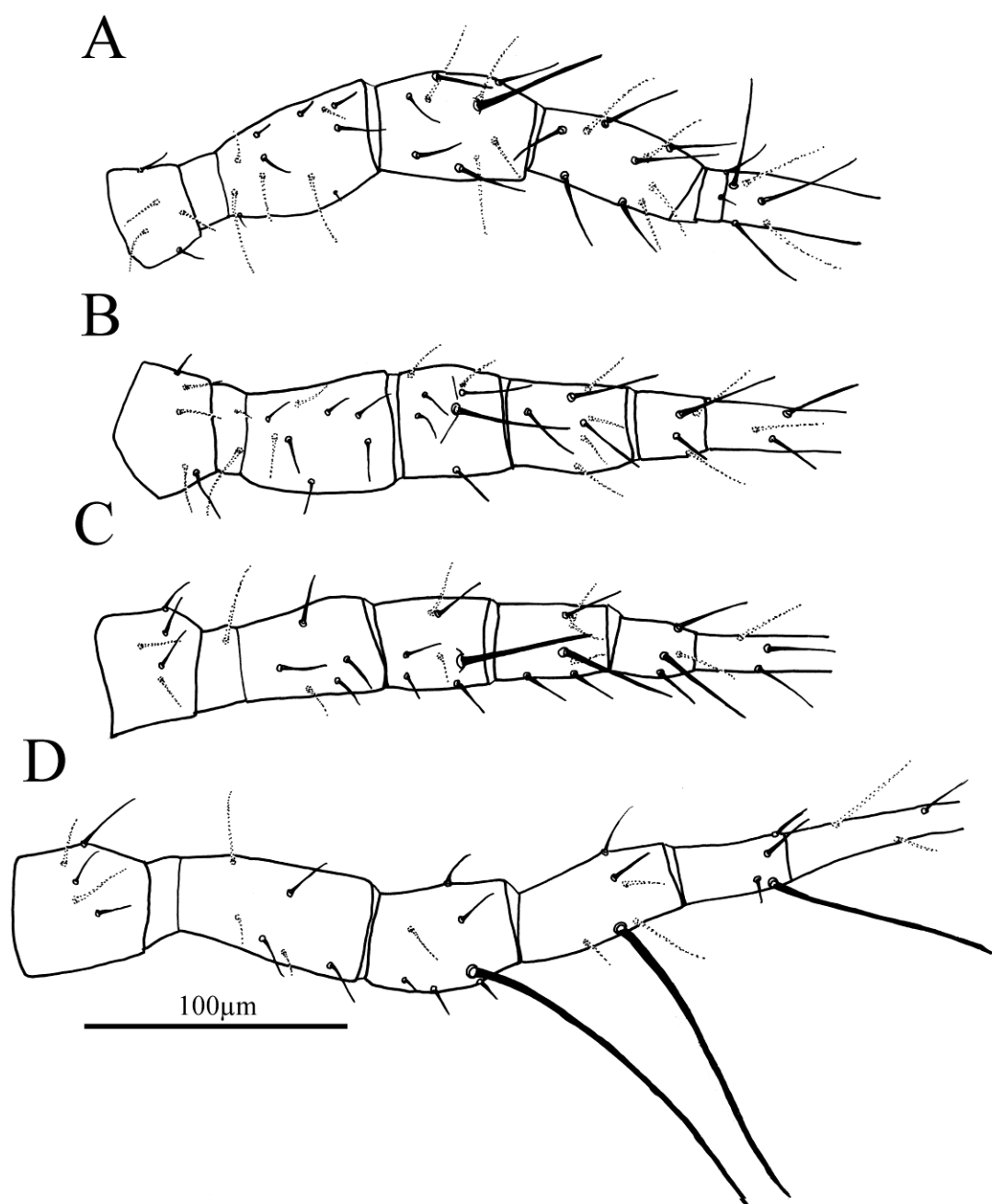


FIGURE 74. *Amblyseius eharai* Amitai & Swirski, 1981, Female, legs A. leg I posterodorsal view, B. leg II dorsal view, C. leg III anterodorsal view, D. leg IV anterior view.

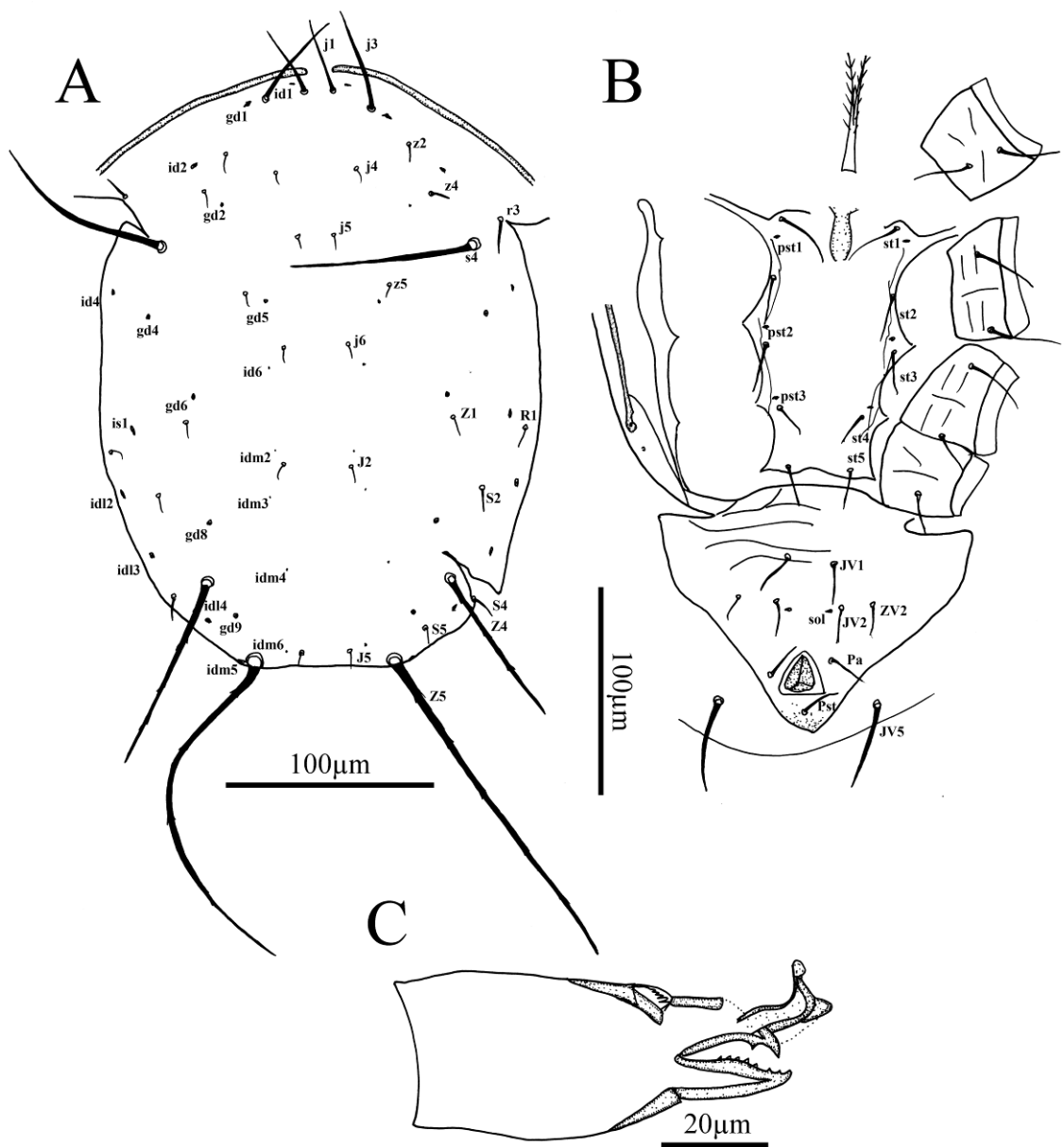


FIGURE 75. *Amblyseius eharai* Amitai & Swirski, 1981, Male, A. dorsal shield; B. ventral idiosoma; C. chelicera and spermatodactyl.

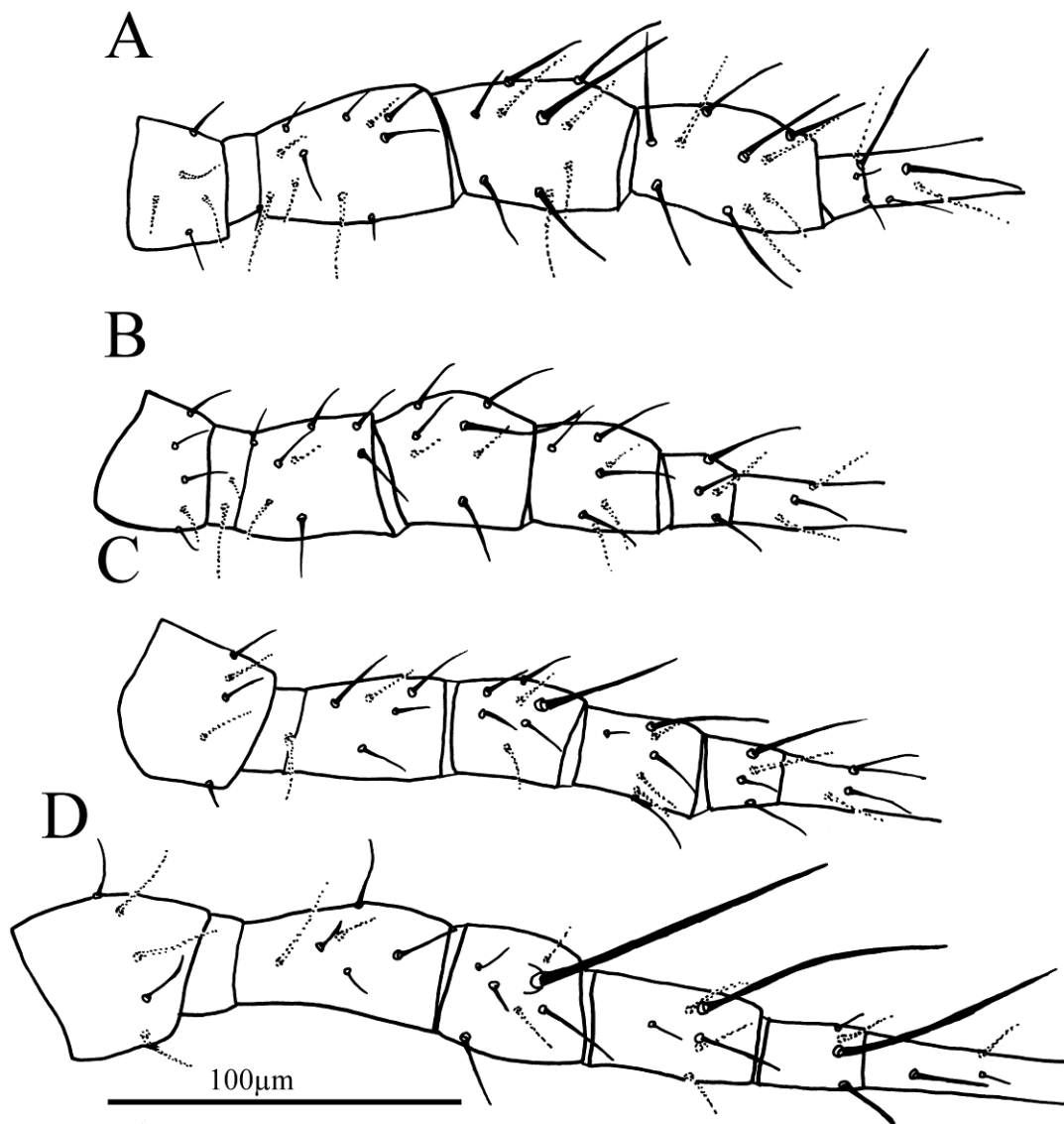


FIGURE 76. *Amblyseius eharai* Amitai & Swirski, 1981, Male, A. leg I posterior view, B. leg II posterior view, C. leg III posterior view, D. leg IV dorsal view.

***Amblyseius herbicolus* (Chant, 1959b)**

長尾鈍綏蟎



(Figures 77–80)

Typhlodromus (*Amblyseius*) *herbicolus* Chant, 1959b: 84.

Amblyseius (*Amblyseius*) *herbicolus*.—Muma, 1961: 287.

Typhlodromus herbicolus.—Hirschmann, 1962: 23.

Amblyseius amitae (Bhattacharyya, 1968): 677.—(Synonymy according to Denmark & Muma 1989)

Amblyseius deleoni Muma & Denmark, 1970: 68.—(Synonymy according to Daneshvar & Denmark 1982)

Amblyseius giganticus Gupta, 1981: 33.—(Synonymy according to Gupta 1986)

Amblyseius impactus Chaudhri, 1968: 553.—(Synonymy according to Daneshvar & Denmark 1982)

Female (n=10)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield lightly sclerotized, smooth, 347 (319–369) long, 237 (213–263) wide at level of *s4*, 202 (180–222) wide at level of *S4*; seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), fifteen pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *id6*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *idx*, *is1*, *idl2*, *idl3*, *idl4*); length of dorsal setae: *j1* 32 (26–37), *j3* 39 (31–51), *j4* 5 (3–8), *j5* 5 (3–8), *j6* 5 (3–11), *J2* 5 (3–8), *J5* 6 (4–8), *z2* 7 (4–9), *z4* 7 (5–9), *z5* 5 (3–7), *Z1* 6 (4–8), *Z4* 96 (85–107), *Z5* 240 (200–288), *s4* 90 (82–101), *S2* 8 (6–10), *S4* 7 (5–10), *S5* 6 (5–9), *r3* 8 (5–14), *R1* 8 (6–9). Setae *j1*, *j3*, *s4* longer and smooth; *Z4*, *Z5* greatly elongated, slightly serrated; other minute.

Peritreme. Peritreme extending beyond to *j1* level, peritremal shield smooth, lightly sclerotized, with one pair of solenostome (*gd3*) and one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, posterior margin straight, wider than long, 69 (62–77) long, 89 (81–101) wide at *st3* level, with three pairs of setae *st1* 32 (28–35), *st2* 25 (21–30), *st3* 24 (16–29) and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae I–IV. Metasternal platelets tear-shaped, with a pair metasternal setae, *st4* 24 (21–32), and one pair of lyrifissures (*pst3*). Genital shield smooth, *st5* 23 22 (16–26), 67 (61–77) wide. Distances between *st1-st1* 62 (55–70), *st2-st2* 69 (65–74), *st3-st3* 70 (66–75), *st1-st3* 64 (57–69), *st5-st5* 21 (14–26). Ventrianal shield smooth, vase-shaped; 107 (99–114) long, 49 (44–55) wide at level of ZV2 and 65 (57–75) wide at level of anus; with three pairs of pre-anal setae, *JV1* 17 (13–20), *JV2* 16 (7–20), *ZV2* 13 (11–15), solenostome *gv3* crescentic, *Pa* 15 (12–20), *Pst* 15 (11–17) on shield. Setae *JV4* 8 (6–10), *JV5* 56 (48–68), *ZV1* 14 (12–17), *ZV3* 8 (6–11) on interscutal membrane. All ventral setae smooth. Two pairs of metapodal plates 19 (15–27) long, 6 (4–9) wide, 11 (8–14) long, 2 (1–3) wide.

Spermatheca. Calyx elongated, tubular, wider toward vehicle, 28 (24–34) long, 6 (4–9) wide, atrium larger, major duct long, minor duct visible.

Chelicera. Movable digit 30 (28–33) long, with four teeth; fixed digit 29 (26–32) long, anterior half with two teeth, posterior half with twelve teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* I (pd2) 43 (39–59), *Sge* II (pd2) 35 (30–41), *Sge* III (ad2) 41 (36–54), *Sti* III (ad) 32 (28–37), *St* III (d) 28 (22–32), *Sge* IV (ad2) 112 (94–129), *Sti* IV (ad) 79 (70–86), *St* IV (d) 66 (60–70).

Male (n=5)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3,4:ZV-3.

Dorsum. Dorsal shield smooth, laterally reticulated; 266 (240–298) long, 191 (175–206) wide at level of *s4*, 149 (138–162) wide at level of *S4*, with seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), fifteen pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *id6*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *idx*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 24 (18–29), *j3* 41 (32–47), *j4* 7 (5–9), *j5* 5 (4–7), *j6* 6 (4–7), *J2* 6 (5–8), *J5* 6 (4–7), *z2* 8 (5–11), *z4* 8 (5–9), *z5* 5 (2–7), *Z1* 6 (5–7), *Z4* 86 (79–100), *Z5* 212 (181–227), *s4* 74 (62–83), *S2* 7 (5–9), *S4* 7 (6–9), *S5* 7 (6–8), *r3* 11 (8–13), *R1* 7 (6–8). Setae *j1*, *j3*, *s4* longer and smooth; *Z4*, *Z5* greatly elongated, slightly serrated; other minute. Setae *r3* and *R1* inserted on dorsal shield.

Peritreme. Peritreme extending to *j1* level; peritremal shield lightly sclerotized, with one pair of solenostome (*gd3*).

Venter. Sternogenital shield smooth, lateral slightly reticulated, posterior margin almost straight, longer than wide 123 (117–132) long, 74 (69–78) wide at level *st2*, with five pairs of setae *st1* 24 (15–29), *st2* 20 (15–24), *st3* 19 (16–20), *st4* 14 (11–17), *st5* 13 (10–17), three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Exopodal shield at coxae II–IV. Distance between *st1-st1* 52 (50–54), *st2-st2* 55 (50–59), *st3-st3* 55 (48–61), *st4-st4* 40 (37–42), *st5-st5* 35 (32–37), *st1-st5* 112 (99–121). Exopodal shield at coxae II–IV. Ventrianal shield subtriangular, slightly reticulated, 109 (104–114) long, 143 (131–154) wide at level of anterior corner and 50 (43–57) wide at level of anus, fused with peritremal shield cingulum; with three pairs of pre-anal setae, *JV1* 13 (10–16), *JV2* 12 (10–16), *ZV2* 10 (8–12), solenostome *gv3* crescentic, *Pa* 12 (9–14), *Pst* 11 (9–15) on shield; *JV5* 39 (35–43) on interscutal membrane. All ventral setae smooth.

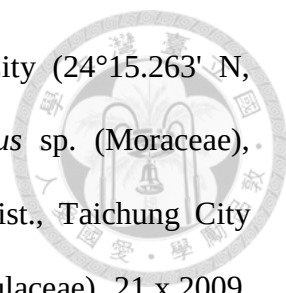
Chelicera. Movable digit 20 (19–23) long, with one tooth; fixed digit 21 (20–22), with two teeth on anterior half, seven teeth on posterior half, with *pilus dentilis*. Spermatodactyl U-shaped, shaft 16 (14–18) long, heel rounded, foot 10 (10–11) long,

with rounded toe and lateral thorn-like projection.

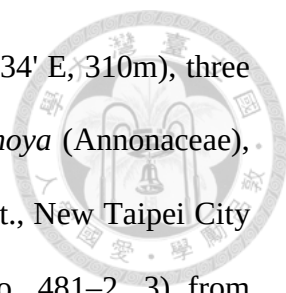
Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* I (pd2) 38 (35–41), *Sge* II (pd2) 32 (29–37), *Sge* III (ad2) 39 (35–42), *Sti* III (ad) 31 (30–32), *St* III (d) 25 (21–28), *Sge* IV (ad2) 85 (72–93), *Sti* IV (ad) 64 (60–66), *St* IV (d) 58 (45–69).

Specimens examined. CHINA: Mt. Qingcheng, Dujiangyan City, Chengdu City, Sichuan Province, one female from unknown plant, 19.vi.1979, W. N. Wu (GIABR); Tengchong City (1900m), Baoshan City, Yunnan Province, two females from unknown plant, 24.vi.1981, W. N. Wu (GIABR); Bawangling National Forest Park, Changjiang Li Autonomous County, Hainan Province, one female from unknown plant, unknown time, W. N. Wu (GIABR); Baoguosi, Emeishan City, Leshan City, Sichuan Province, three females from unknown plant, 5.vi.1979, W. N. Wu (GIABR); Chebaling National Nature Reserve, Shaoguan City, Guangdong Province, one female from shrub, unknown time, W. N. Wu (GIABR); Xinglong town, Wanning City, Hainan Province, three females from unknown plant, 2.x.1980, W. N. Wu (GIABR); Mt. Baiyun, Baiyun District, Guangzhou City, Guangdong Province, one female from *Lespedeza formosa* (Fabaceae), 23-24.vii.2001, J. Z. Lin (GIABR); Mt. Baiyun, Baiyun District, Guangzhou City, Guangdong Province, one female from *Lespedeza formosa* (Fabaceae), 25-28.vii.2001, J. Z. Lin (GIABR).

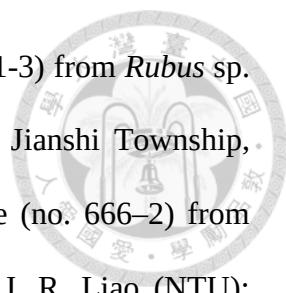
TAIWAN: Xitou, Lugu Township, Nantou County (23°41'26.42" N, 120°47'09.25" E, 867m), one female (no. 79–6) from *Morus* sp. (Moraceae), 11.ix.2009, C. H. Hsieh & J. R. Liao (NTU); Lishan, Heping Dist., Taichung City (24°15.263' N, 121°15.057' E, 1989m), two females (no. 170–1, 5) from *Ulmus uyematsui* (Ulmaceae), 20.x.2009, C.



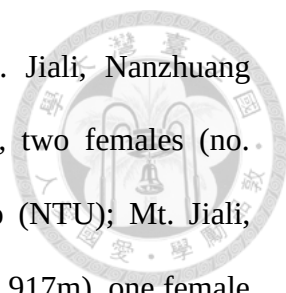
C. Ho & J. R. Liao (NTU); Lishan, Heping Dist., Taichung City (24°15.263' N, 121°15.057' E, 1989m), two females (no. 174–1, 3) from *Morus* sp. (Moraceae), 20.x.2009, C. C. Ho & J. R. Liao (NTU); Huanshan, Heping Dist., Taichung City (24°19.119' N, 121°17.1514' E, 1583m), *Carpinus kawakamii* (Betulaceae), 21.x.2009, C. C. Ho & J. R. Liao (NTU); Mt. Anma, Heping Dist., Taichung City (24°14.669' N, 120°55.556' E, 1363m), one female (no. 263–1) from ground litter, 5.xii.2009, C. H. Hsieh & J. R. Liao (NTU); Qingquan, Wufeng Township, Hsinchu County (24°34.272' N, 121°05.842' E, 680m), *Taiwania cryptomerioides* (Taxodiaceae), 20.i.2010, Y. H. Chiang & J. R. Liao (NTU); Dalu Road, Wufeng Township, Hsinchu County (24°32.770' N, 121°05.744' E, 977m), three females (no. 279–1, 2, 4) from *Morus* sp. (Moraceae), 20.i.2010, Y. H. Chiang & J. R. Liao (NTU); Qinshi Road, Wufeng Township, Hsinchu County (24°33.265' N, 121°06.784' E, 1069m), two females (no. 298–1, 2) from unknown plant, 20.i.2010, Y. H. Chiang & J. R. Liao (NTU); Shitan, Miaoli County (24°27.647' N, 121°54.124' E, 676m), one female (no. 301–1) from *Saurauia tristyla* (Actinidiaceae), 27.i.2010, Y. H. Chiang (NTU); Banju Branch, Taitung Distric Agricultural Research and Extension Station, Beinan Township, Taitung County (22°49.759' N, 121°04.634' E, 310m), one female (no. 403–4) from *Ageratum houstonianum* (Asteraceae), 31.iii.2010, Y. T. Hsu & J. R. Liao (NTU); Banju Branch, Taitung Distric Agricultural Research and Extension Station, Beinan Township, Taitung County (22°49.759' N, 121°04.634' E, 310m), one female (no. 404–5) from *Crassocephalum crepidioides* (Asteraceae), 31.iii.2010, Y. T. Hsu & J. R. Liao (NTU); Banju Branch, Taitung Distric Agricultural Research and Extension Station, Beinan Township, Taitung County (22°49.759' N, 121°04.634' E, 310m), one female three male (no. 406–5, 6, 7, 8) from *Boehmeria* sp. (Urticaceae), 31.iii.2010, Y. T. Hsu & J. R. Liao (NTU); Banju Branch, Taitung Distric Agricultural Research and Extension



Station, Beinan Township, Taitung County (22°49.759' N, 121°04.634' E, 310m), three females two males (no. 410–6, 12, 13, 14, 16) from *Annona x atemoya* (Annonaceae), 31.iii.2010, Y. T. Hsu & J. R. Liao (NTU); Mt. Shitou, Xindian Dist., New Taipei City (24°57.466' N, 121°32.649' E, 208m), one female one male (no. 481–2, 3) from unknown plant, 17.iv.2010, J. R. Liao (NTU); Sanwan Township, Miaoli County (24°38.780' N, 120°58.197' E, 119m), one female two males (no. 509–5, 9, 10) from *Bischofia javanica* (Euphorbiaceae), 19.iv.2010, Y. H. Chiang & J. R. Liao (NTU); Qinshi Road, Wufeng Dist., Hsinchu County (24°33.789' N, 121°06.771' E, 923m), four females (no. 518–1, 2, 3, 4) from *Polygonum chinense* (Polygonaceae), 3.v.2010, Y. H. Chiang & J. R. Liao (NTU); Qinshi Road, Wufeng Dist., Hsinchu County (24°33.789' N, 121°06.771' E, 923m), two females (no. 519–2, 3) from *Morus* sp. (Moraceae), 3.v.2010, Y. H. Chiang & J. R. Liao (NTU); Qinquan, Wufeng Township, Hsinchu County (24°34.525' N, 121°06.220' E, 537m), six females two males (no. 534–1, 2, 3, 4, 5, 6, 7, 8) from *Euphoria longan* (Sapindaceae), 3.v.2010, Y. H. Chiang & J. R. Liao (NTU); Taigang, Jianshi Township, Hsinchu County (24°36.575' N, 121°17.199' E, 1108m), two females (no. 548–1, 2) from *Phyllostachys makinoi* (Poaceae), 17.v.2010, Y. H. Chiang & J. R. Liao (NTU); Smangus, Jianshi Township, Hsinchu County (24°34'43" N, 121°20'02" E, 1571m), two females (no. 556–1, 2) from *Hydrangea* sp. (Hydrangeaceae), 17.v.2010, Y. H. Chiang & J. R. Liao (NTU); Laiyi Township, Pingtung County (22°31.628' N, 120°39.930' E, 139m), one female (no. 591–1) from *Mangifera indica* (Anacardiaceae), 13.vi.2010, Y. H. Chiang & J. R. Liao (NTU); Lianhuachi, Yuchi Township, Nantou County, two females (no. 640–5, 6) from *Ageratum houstonianum* (Asteraceae), 8.vi.2010, S. F. Lin & J. R. Liao (NTU); Lianhuachi, Yuchi Township, Nantou County, one female (no. 644–1) from *Crassocephalum crepidioides* (Asteraceae), 28.vi.2010, S. F. Lin & J. R. Liao (NTU);



Lianhuachi, Yuchi Township, Nantou County, one female (no. 644-1-3) from *Rubus* sp. (Rosaceae), 28.vi.2010, S. F. Lin & J. R. Liao (NTU); Meiyuan, Jianshi Township, Hsinchu County (24°42.872' N, 121°16.161' E, 696m), one female (no. 666-2) from *Callicarpa formosana* (Lamiaceae), 12.vii.2010, Y. H. Chiang & J. R. Liao (NTU); Neiwan, Henshan Township, Hsinchu County (24°42.977' N, 121°11.422' E, 491m), one female (no. 673-1) from *Ageratum houstonianum* (Asteraceae), 14.vii.2010, Y. H. Chiang & J. R. Liao (NTU); Jinping Road, Jianshi Township, Hsinchu County (24°40.254' N, 121°16.040' E, 898m), three females (no. 802-1, 3, 4) from *Machilus zuihoensis* (Lauraceae), 24.viii.2010, Y. J. Tsao & J. R. Liao (NTU); Zhenxibao, Jianshi Township, Hsinchu County (24°34.476' N, 121°18.673' E, 1719m), one female (no. 809-1) from *Bidens pilosa* (Asteraceae), 24.viii.2010, Y. J. Tsao & J. R. Liao (NTU); Baling, Fuxing Dist., Taoyuan City (24°40.515' N, 121°24.001' E, 881m), four females (no. 823-2, 5, 6, 7) from *Morus* sp. (Moraceae), 28.viii.2010, J. F. Hsieh & J. R. Liao (NTU); Mt. Lala, Fuxing Dist., Taoyuan City (24°41.463' N, 121°24.717' E, 1207m), one female (no. 832-10) from *Broussonetia papyrifera* (Moraceae), 28.viii.2010, J. F. Hsieh & J. R. Liao (NTU); Sanguang, Fuxing Dist., Taoyuan City (24°41.494' N, 121°22.522' E, 658m), three females (no. 836-3, 4, 5) from *Morus* sp. (Moraceae), 28.viii.2010, J. F. Hsieh & J. R. Liao (NTU); Fuxing Dist., Taoyuan City, four females from *Callicarpa formosana* (Lamiaceae), 29.viii.2010, J. F. Hsieh & J. R. Liao (NTU); Sileng, Fuxing Dist., Taoyuan City (24°39.036' N, 121°25.572' E, 1152m), two females (no. 843-1, 3) from *Oreocnide pedunculata* (Urticaceae), 29.viii.2010, J. F. Hsieh & J. R. Liao (NTU); Sileng, Fuxing Dist., Taoyuan City (24°39.036' N, 121°25.572' E, 1152m), one female (no. 844-2) from *Prunus* sp. (Rosaceae), 29.viii.2010, J. F. Hsieh & J. R. Liao (NTU); Sileng, Fuxing Dist., Taoyuan City (24°39.036' N, 121°25.572' E, 1152m), one female (no. 846-3) from *Morus* sp.



(Moraceae), 29.viii.2010, J. F. Hsieh & J. R. Liao (NTU); Mt. Jiali, Nanzhuang Township, Miaoli County (24°31.651' N, 121°01.599' E, 1326m), two females (no. 888–1, 2) from *Prunus persica* (Rosaceae), 13.x.2010, J. R. Liao (NTU); Mt. Jiali, Nanzhuang Township, Miaoli County (24°32.349' N, 121°01.482' E, 917m), one female (no. 892-6) from *Callicarpa formosana* (Lamiaceae), 1♀, 13.x.2010, J. R. Liao (NTU); Mt. Jiali, Nanzhuang Township, Miaoli County (24°32.349' N, 121°01.482' E, 917m), one female (no. 893–1) from *Bridelia balansae* (Euphorbiaceae), 13.x.2010, J. R. Liao (NTU).

Distribution. Africa: Benin (Zannou *et al.* 2007), Canary Islands (Ferragut & Peña-Estévez 2003), Dr Congo (Zannou *et al.* 2007), Kenya (El-Banhawy & Knapp 2009), Malawi (Zannou *et al.* 2005), Rwanda (Zannou *et al.* 2007), Senegal (Kade *et al.* 2011), South Africa (Ueckermann & Loots 1988). Asia: China (Fujian (Lin *et al.* 2000); Wuling Mountain Region (Wu & Lan 1992a)), India (Gupta, 1986), Iran (Daneshvar & Denmark 1982), Malaysia (Ehara 2002a), Papua New Guinea (McMurtry & Moraes 1985), Philippines (Moraes *et al.* 1989b), Singapore (Corpuz-Raros 1995b), Taiwan (Lo 1986), Thailand (Oliveira *et al.* 2012), Turkey (Akyazi *et al.* 2016). Central America: Costa Rica (Denmark *et al.* 1999), Dominican Republic (Ferragut *et al.* 2011), El Salvador (Denmark *et al.* 1999), Guatemala (McMurtry 1983), Honduras (Denmark *et al.* 1999). Europe: Spain (Miñarro *et al.* 2002). North America: USA (Chant 1959b). South America: Argentina (Furtado *et al.* 2007), Brazil (Moraes *et al.* 1990), Colombia (Moraes & Mesa 1988), Peru (Guanilo *et al.* 2008c), Venezuela: (Aponte & McMurtry 1993). Oceania: Australia (Waite & Gerson 1994), Hawaii (Tenorio *et al.* 1985).

Remarks. Chant (1959b) reported that species from intercepted specimens from Portugal. The original description provided simple description and illustration. Muma & Denmark (1970) mentioned that previous *A. largoensis* should have two different

species, *A. largoensis* and *A. deleoni*. Daneshvar & Denmark (1982) provided *A. deleoni* is junior synonym of *A. herbicolus*. Schicha (1981) provided the first detailed description and illustration of *A. herbicolus* under *A. delenoi*. McMurtry (1983) reported that probably many records of *A. largoensis* refer to *A. herbicolus*. This species is characterized by longer spermatheca and posterior margin of sternal shield straight.

This species have been reported that showed biological control potential for broad mite (*Polyphagotarsonemus latus*) (Rodriguez-Cruz *et al.* 2013) and also for thrips (Lam *et al.* 2019). In Taiwan, this species is a common species on various plants in whole Taiwan, from flat ground area to high mountain area (Lishan, 2500m). This species usually occurs in the initial stage of pest in the field in my experience. Besides, one collection data was observed three species (*A. eharai*, *A. herbicolus*, *A. largoensi*) coexist together—“Laiyi Township, Pingtung County (22°31.628' N, 120°39.930' E, 139m), one female (no. 591–1) from *Mangifera indica* (Anacardiaceae), 13.vi.2010, Y. H. Chiang & J. R. Liao (NTU)”.

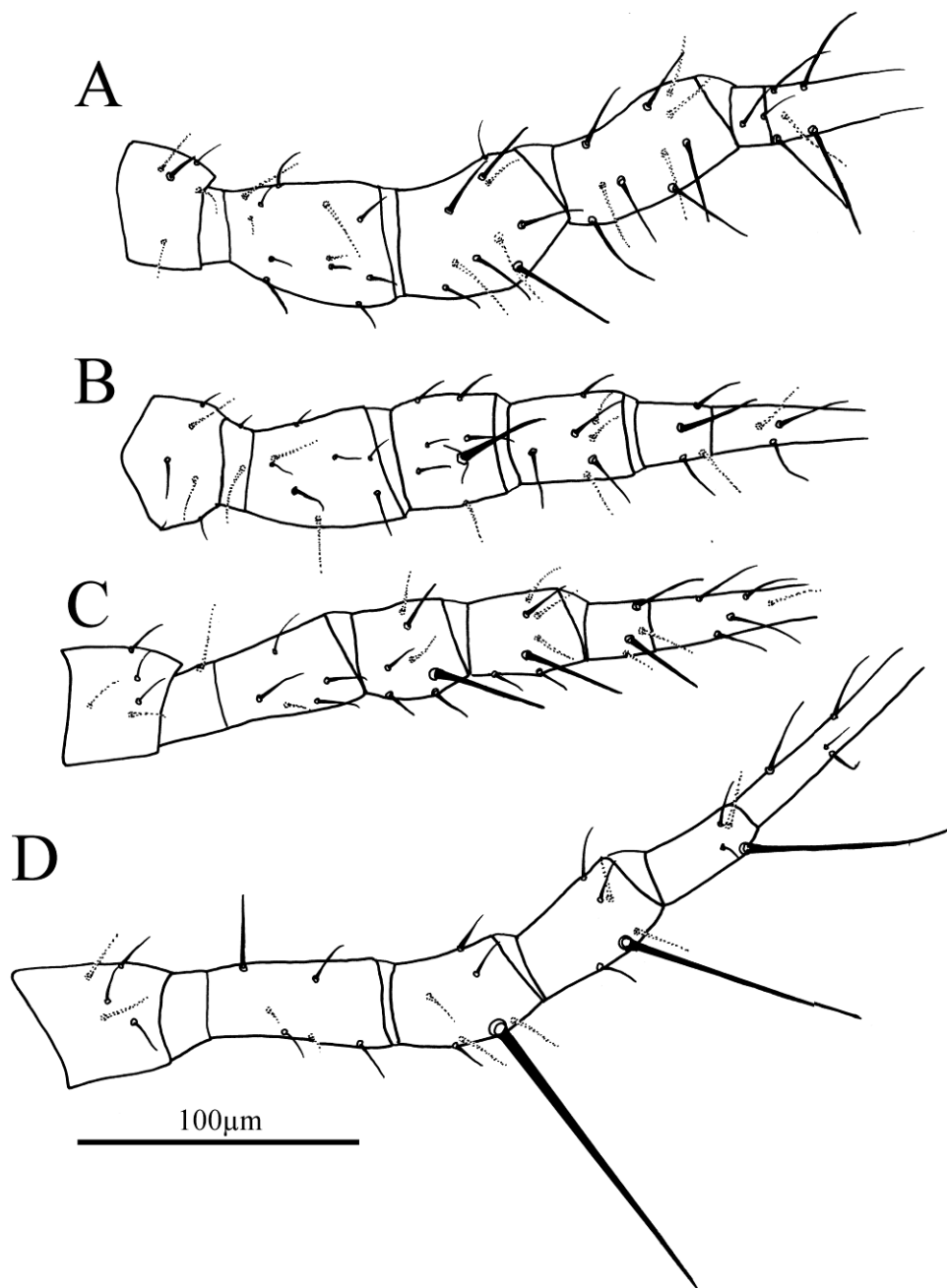


FIGURE 78. *Amblyseius herbicolus* (Chant, 1959b), Female, legs A. leg I anterior view, B. leg II dorsal view, C. leg III anterior view, D. leg IV anterior view.

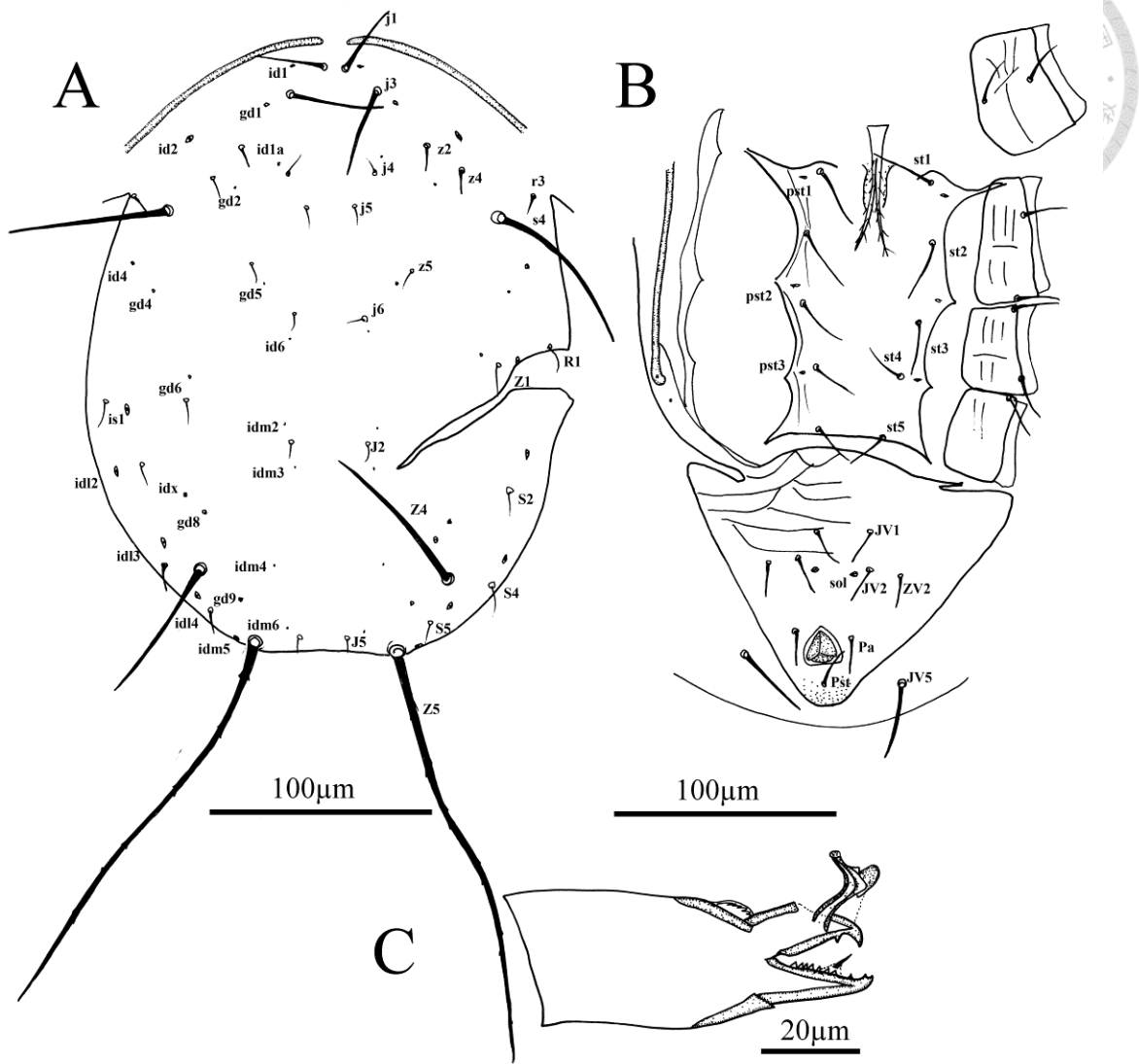


FIGURE 79. *Amblyseius herbicolus* (Chant, 1959b), Male, A. dorsal shield; B. ventral idiosoma; C. chelicera and spermatodactyl.

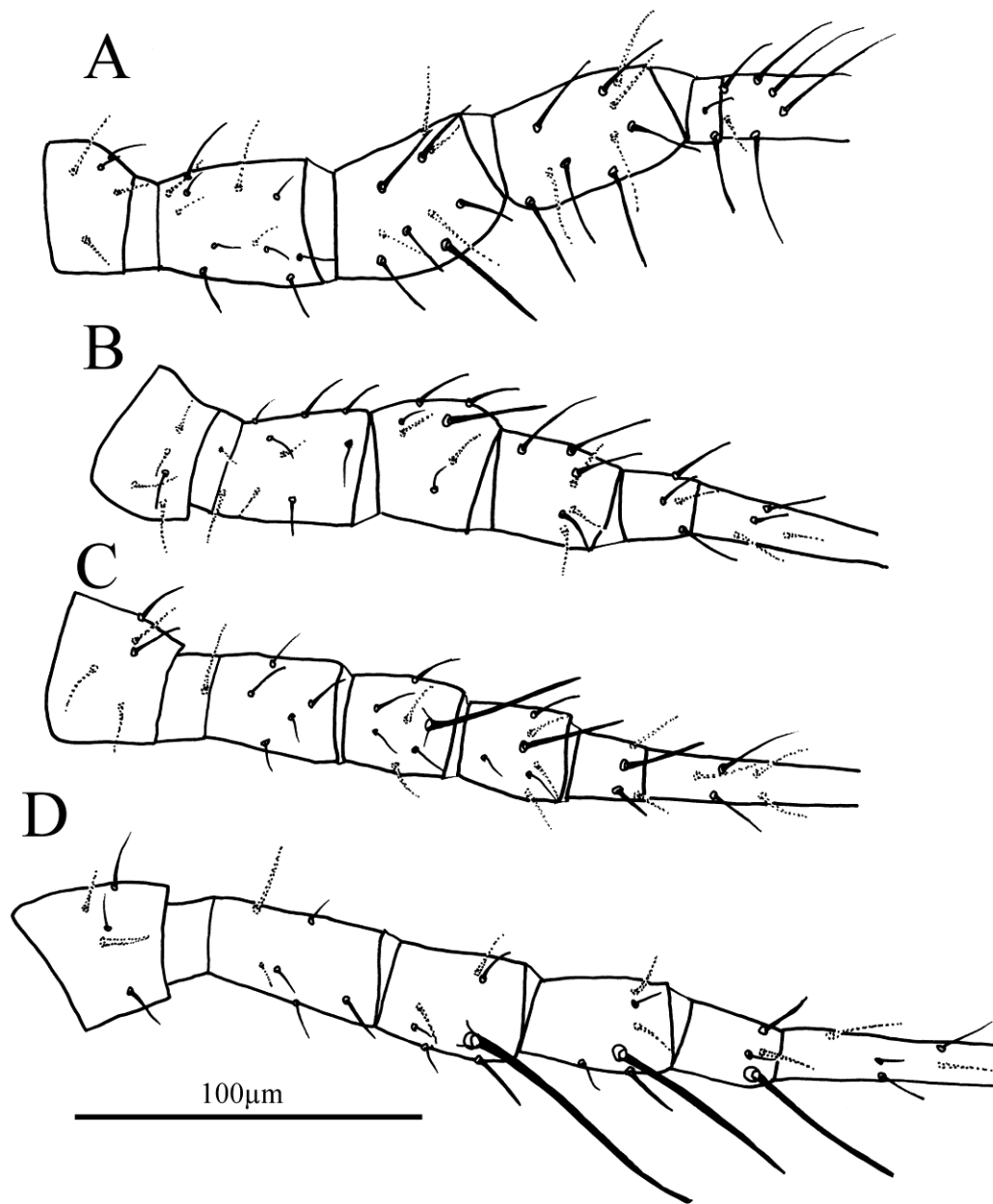


FIGURE 80. *Amblyseius herbicolus* (Chant, 1959b), Male, A. leg I anterior view, B. leg II posterior view, C. leg III dorsal view, D. leg IV anterior view.

***Amblyseius largoensis* (Muma, 1955)**

拉哥鈍綏蟎



(Figures 81–84)

Amblyseiopsis largoensis Muma, 1955: 266.

Typhlodromus (*Amblyseius*) *largoensis*.—Chant, 1959: 96.

Amblyseius (*Amblyseiulus*) *largoensis*.—Muma, 1961: 287.

Typhlodromus largoensis.—Hirschmann, 1962: 17.

Amblyseius (*Amblyseius*) *largoensis*.—Ehara, 1966a: 22.

Amblyseius amitae (Bhattacharyya, 1968): 677. (Synonymy according to Gupta 1986)

Amblyseius amtalaensis Gupta, 1977: 53. (Synonymy according to Gupta 1986)

Amblyseius sakalava Blommers, 1976: 96. (Synonymy according to Ueckermann & Loots 1988)

Amblyseius magnoliae Muma, 1961: 289. (Synonymy according to Denmark & Evans 2011)

Female (n=10)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield lightly sclerotized, smooth, 356 (329–386) long, 245 (228–266) wide at level of *s*₄, 220 (192–241) wide at level of *S*₄; seven pairs of solenostomes (*gd*₁, *gd*₂, *gd*₄, *gd*₅, *gd*₆, *gd*₈, *gd*₉), thirteen pairs of lyrifissures (*id*₁, *id*₂, *id*₄, *id*₆, *idm*₂, *idm*₃, *idm*₄, *idm*₅, *idm*₆, *is*₁, *idl*₂, *idl*₃, *idl*₄); length of dorsal setae: *j*₁ 32 (27–37), *j*₃ 48 (37–58), *j*₄ 5 (4–7), *j*₅ 6 (4–9), *j*₆ 7 (3–11), *J*₂ 7 (5–9), *J*₅ 7 (4–9), *z*₂ 8 (5–11), *z*₄ 8 (6–9), *z*₅ 5 (4–10), *Z*₁ 7 (5–9), *Z*₄ 95 (87–113), *Z*₅ 261 (235–284), *s*₄ 89 (82–99), *S*₂ 9 (8–10), *S*₄ 8 (5–11), *S*₅ 8 (5–11), *r*₃ 10 (8–12), *R*₁ 8 (7–10). Setae *j*₁, *j*₃, *s*₄ longer and smooth; *Z*₄, *Z*₅ greatly elongated, slightly serrated; other minute.

Peritreme. Peritreme extending beyond to *j*₁ level, peritremal shield smooth,

lightly sclerotized, with one pair of solenostome (*gd3*), with one pair of lyrifissure (*id3*).

Venter. Sternal shield smooth, posterior margin straight, wider than long, 67 (60–77) long, 85 (74–98) wide at *st3* level, with three pairs of setae *st1* 30 (24–35), *st2* 26 (18–33), *st3* 24 (19–31) and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae I–IV. Metasternal platelets tear-shaped, with a pair metasternal setae, *st4* 21 (12–26), and one pair of lyrifissures (*pst3*). Genital shield smooth, *st5* 21 (16–27), 71 (59–79) wide. Distances between *st1-st1* 61 (57–68), *st2-st2* 66 (61–71), *st3-st3* 70 (67–77), *st1-st3* 63 (56–70), *st5-st5* 66 (60–73). Ventrianal shield smooth, vase-shaped; 111 (101–123) long, 49 (45–54) wide at level of ZV2 and 70 (60–78) wide at level of anus; with three pairs of pre-anal setae, *JV1* 18 (14–22), *JV2* 17 (15–19), *ZV2* 14 (10–18), solenostome *gv3* crescentic, *Pa* 15 (9–20), *Pst* 16 (13–19) on shield. Setae *JV4* 10 (8–13), *JV5* 65 (52–75), *ZV1* 15 (11–19), *ZV3* 10 (7–14) on interscutal membrane. All ventral setae smooth. Two pairs of metapodal plates 19 (14–24) long, 6 (5–7) wide, 12 (8–16) long, 2 (2–3) wide.

Spermatheca. Calyx of spermatheca elongate, tubular, parallel, 23 (19–27) long, 4 (3–5) wide, atrium larger, minor and major ducts visible.

Chelicera. Movable digit 28 (25–34) long, with three teeth; fixed digit 27 (24–31) long, anterior half with two teeth, posterior half with eight teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* I (pd2) 44 (36–58), *Sge* II (pd2) 38 (32–46), *Sge* III (ad2) 47 (39–53), *Sti* III (ad) 39 (35–42), *St* III (ad) 31 (25–35), *Sge* IV (ad2) 116 (105–127), *Sti* IV (ad) 94 (82–102), *St* IV (d) 65 (58–78).

Male (n=2)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3,4:ZV-3.

Dorsum. Dorsal shield smooth; 285 (263–307) long, 198 (195–201) wide at level of *s4*, 170 (166–175) wide at level of *S4*, seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), thirteen pairs of lyrifissures (*id1*, *id2*, *id4*, *id6*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 29 (22–37), *j3* 45 (40–51), *j4* 5 (5–6), *j5* 5 (4–6), *j6* 4 (3–4), *J2* 5 (5–5), *J5* 6 (5–6), *z2* 9 (8–9), *z4* 8 (8–9), *z5* 6 (5–7), *Z1* 7 (6–7), *Z4* 71 (69–73), *Z5* 185 (162–208), *s4* 67 (67–67), *S2* 7 (6–8), *S4* 6 (5–7), *S5* 6 (5–7), *r3* 7 (7–8), *R1* 8 (6–10). Setae *j1*, *j3*, *s4* longer and smooth; *Z4*, *Z5* greatly elongated, slightly serrated; other minute. Setae *r3* and *R1* inserted on dorsal shield.

Peritreme. Peritreme extending to *j1* level; peritremal shield lightly sclerotized.

Venter. Sternogenital shield smooth, lateral slightly reticulated, posterior margin almost straight, longer than wide 121 (115–126) long, 74 (69–78) wide at level *st2*, with five pairs of setae *st1* 25 (23–28), *st2* 19 (19–20), *st3* 18 (16–20), *st4* 16 (13–19), *st5* 14 (12–15), three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Exopodal shield at coxae I–IV. Distance between *st1-st1* 51 (50–51), *st2-st2* 51 (50–52), *st3-st3* 51 (49–52), *st4-st4* 38 (34–41), *st5-st5* 35 (34–36), *st1-st5* 111 (107–116). Exopodal shield at coxae II–IV. Ventrianal shield subtriangular, with slightly reticulated, 113 (105–122) long, 149 (141–157) wide at level of anterior corner and 62 (52–73) wide at level of anus, fused with peritremal shield cingulum; with three pairs of pre-anal setae, *JV1* 10 (10–11), *JV2* 10 (10–11), *ZV2* 11 (10–11), solenostome *gv3* crescentic, *Pa* 12 (12–13), *Pst* 11 (9–14) on shield; *JV5* 35 (28–42) on interscutal membrane. All ventral setae smooth.

Chelicera. Movable digit 20 (20–20) long, with one tooth; fixed digit 21 (21–22), with one tooth on anterior half, seven teeth on posterior half, with *pilus dentilis*. Spermatodactyl U-shaped, shaft 17 (17–18) long, heel rounded, foot 11 (10–11) long, with rounded toe and lateral thorn-like projection.

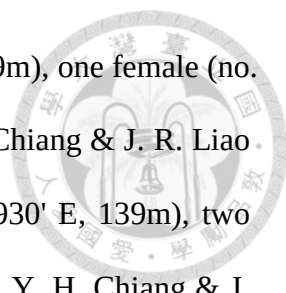
Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* I (pd2) 34 (30–337), *Sge* II (pd2) 30 (27–33), *Sge* III (ad2) 37 (30–43), *Sti* III (ad) 31 (27–35), *St* III (ad) 27 (25–28) *Sge* IV (ad2) 79 (74–84), *Sti* IV (ad) 63 (52–73), *St* IV (d) 53 (47–58).

Specimens examined. CAMBODIA: Angkor Wat, one female (HAL101B159) from *Mangifera indica* (Anacardiaceae), 11.v.2012, C. C. Ho (TARL).

PHILIPPINES: Camiguin Island, two females (LACR 4681, Aca 3325) from *Cocos nucifera* (Arecaceae), 9.xi.1995, Philippines coconut authority staff (UPLB-MNH); Kanhuraw Hill, Tacloban City, Leyte, three females (LACR 5336, Aca 3320) from *Pachira aquatic* (Malvaceae), 2.iii.2003, L. M. Calleja (UPLB-MNH); Pintor, Gamu City, Isabela Province, Luzon, one female one male (LACR 4876, Aca 3269) from *Vigna unguiculata* (Fabaceae), 5.v.2001, L. A. Corpuz-Raros (UPLB-MNH).

CHINA: Haikou City, Hainan Province, two females from *Acalypha hainanensis* (Euphorbiaceae), 6.iv.1974, W. N. Wu (GIABR); Jianfengling National Forest Park, Ledong Li Autonomous County, Hainan Province, one female from *Alstonia scholaris* (Apocynaceae), 6.iv.1974, W. N. Wu (GIABR); Dianbai District, Maoming City, Guangdong Province, four females two males from *Dimocarpus longan* (Sapindaceae), x.1984, W. N. Wu (GIABR).

TAIWAN: Xiulin Township, Hualien County (24°11'57.19" N, 121°29'38.6" E, 636m), three females (no. 7–6, 7, 8) from *Boehmeria nivea* (Urticaceae), 6.viii.2009, Y. H. Chiang & H. T. Fang (NTU); Ciaotou Sugar Refinery, Gushan Dist., Kaohsiung City (22°45'27.68" N, 120°18'50.8" E, 14m), four females (no. 9–10, 11, 14, 15) from *Tabebuia chrysanth*a (Bignoniaceae), 7.viii.2009, Y. H. Chiang & H. T. Fang (NTU);

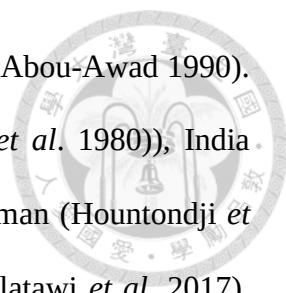


Laiyi Township, Pingtung County (22°31.628' N, 120°39.930' E, 139m), one female (no. 591–5) from *Mangifera indica* (Anacardiaceae), 13.vii.2010, Y. H. Chiang & J. R. Liao (NTU); Laiyi Township, Pingtung County (22°31.628' N, 120°39.930' E, 139m), two females (no. 593–1, 2) from *Areca catechu* (Arecaceae), 13.vi.2010, Y. H. Chiang & J. R. Liao (NTU); Nanzhou Sugar Refinery, Nanzhou Township, Pingtung County (22°29.668' N, 120°30.798' E, 4m), three females two males (no. 597–1, 2, 3, 4, 5) from *Millettia pinnata* (Fabaceae), 13.vi.2010, Y. H. Chiang & J. R. Liao (NTU); Manzhou Township, Pingtung County (22°00.734' N, 120°50.234' E, 26m), four females one male (no. 608–2, 3, 4, 5, 6) from *Cocos nucifera* (Arecaceae), 14.vi.2010, Y. H. Chiang & J. R. Liao (NTU); Xigang Dist., Tainan City (23°07.146' N, 120°12.620' E, 9m), one female one male (no. 859–2, 3) from *Annona squamosa* (Annonaceae), 13.ix.2010, J. F. Hsieh & J. R. Liao (NTU); Yanshui Dist., Tainan City (23°16.523' N, 120°13.399' E, 13m), one female one male (no. 865–6, 11) from *Morus* sp. (Moraceae), 13.ix.2010, J. F. Hsieh & J. R. Liao (NTU); Yizhu Township, Chiayi County (23°22.746' N, 120°15.064' E, 15m), two females (no. 866–2, 5) from *Mangifera indica* (Anacardiaceae), 14.ix.2010, J. F. Hsieh & J. R. Liao (NTU); Chiayi Branch, TARI, East Dist., Chiayi City (23°29.109' N, 120°28.199' E, 55m), one female one male (no. 873–1, 2) from *Syzygium samarangense* (Myrtaceae), 14.ix.2010, J. F. Hsieh & J. R. Liao (NTU).

THAILAND: Chalong Bay, Phuket, one female (HAL101B007) from *Trachycarpus fortune* (Arecaceae), 11.v.2012, C. C. Ho (TARL).

USA: Unknown, one female (HAL100B062) from *Persea americana* (Lauraceae), 19.v.2011, C. C. Ho (TARL).

Distribution. Africa: Angola (Carmona 1968), Benin (Zannou *et al.* 2007), Ivory Coast (Moraes *et al.* 1989a), Kenya (Swirski & Ragusa 1978), Mozambique (Rodrigues



1968), Sierra Leone (Zannou *et al.* 2007), Tanzania (El-Banhawy & Abou-Awad 1990). Asia: China (Guangdong (Waite & Gerson 1994), Hainan (Chen *et al.* 1980)), India (Gupta 1978b); Iran (Daneshvar 1980), Malaysia (Ehara 2002a), Oman (Hountondji *et al.* 2010), Philippines (Corpuz & Rimando 1966), Saudi Arabia (Alatawi *et al.* 2017), Singapore (Corpuz-Raros 1995b), Sri Lanka (Moraes *et al.* 2004b), Taiwan (Ehara 1970), Thailand (Ehara & Bhandhufalck 1977), Turkey (Çobanoğlu 1989). Central America: Cuba (Rodriguez *et al.* 1981a), Dominican Republic (Ferragut *et al.* 2011), Guatemala (Chant 1959b), Mexico (Chant 1959b). Europe: Georgia (Wainstein & Vartapetov 1973). North America: USA (Muma 1955), Jamaica (Denmark & Muma 1978), Puerto Rico (De Leon 1965). Oceania: Australia (Collyer 1980), Fiji (Collyer 1980), Hawaii (Prasad 1968b), New Caledonia (Schicha 1981b), New Zealand (Collyer 1964b), Papua New Guinea (Schicha & Gutierrez 1985), Vanuatu (Schicha 1981b). South America: Brazil (Ehara 1966b), Colombia (Moraes & Mesa 1988), Fernando de Noronha Archipelago (Vasconcelos *et al.* 2006), Guyana (De Leon 1966), Trinidad (De Leon 1967), Venezuela (Aponte & McMurtry 1993).

Remarks. Muma (1955) described this species from key lime leave in Florida. After that, many articles reported the distribution about this species. However, many misidentifications also exist in these researches, (e.g. Specimens reported by Ehara (1967b) reidentified as *A. deleari* by Ehara (1977) and as *A. eharai* by Ehara & Amano (1998). The present study reported that this species could be identified by the parallel tubular spermatheca.

During the survey, this species was distributed in southwest Taiwan, the tropical area. In some cases, this species were collected with *A. eharai* together. This species have been reported as an important predator for red palm mite (*Raoiella indica*) (Mendes *et al.* 2018).

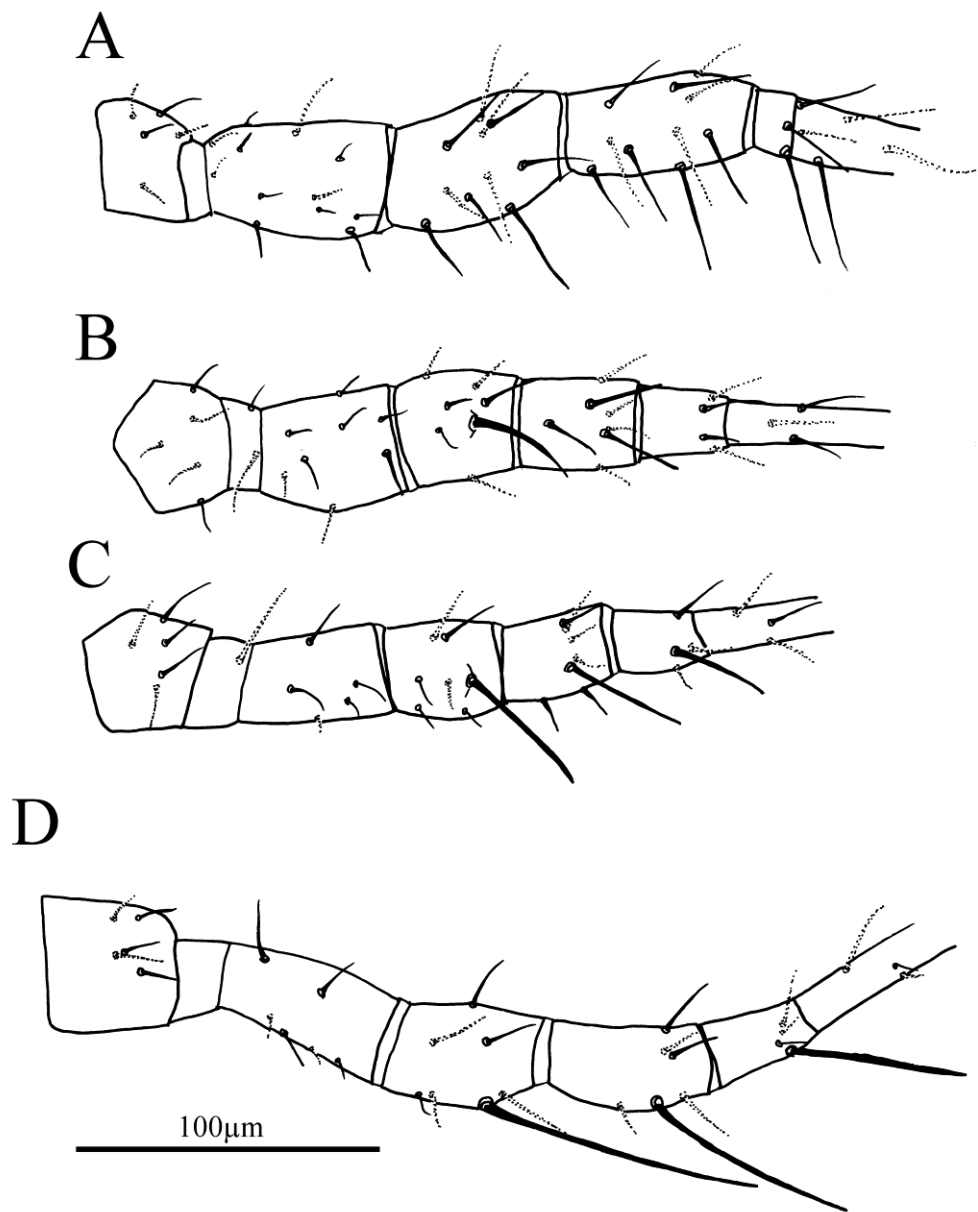


FIGURE 82. *Amblyseius largoensis* (Muma, 1955), Female, legs A. leg I anterior view, B. leg II dorsal view, C. leg III anterodorsal view, D. leg IV anterior view.

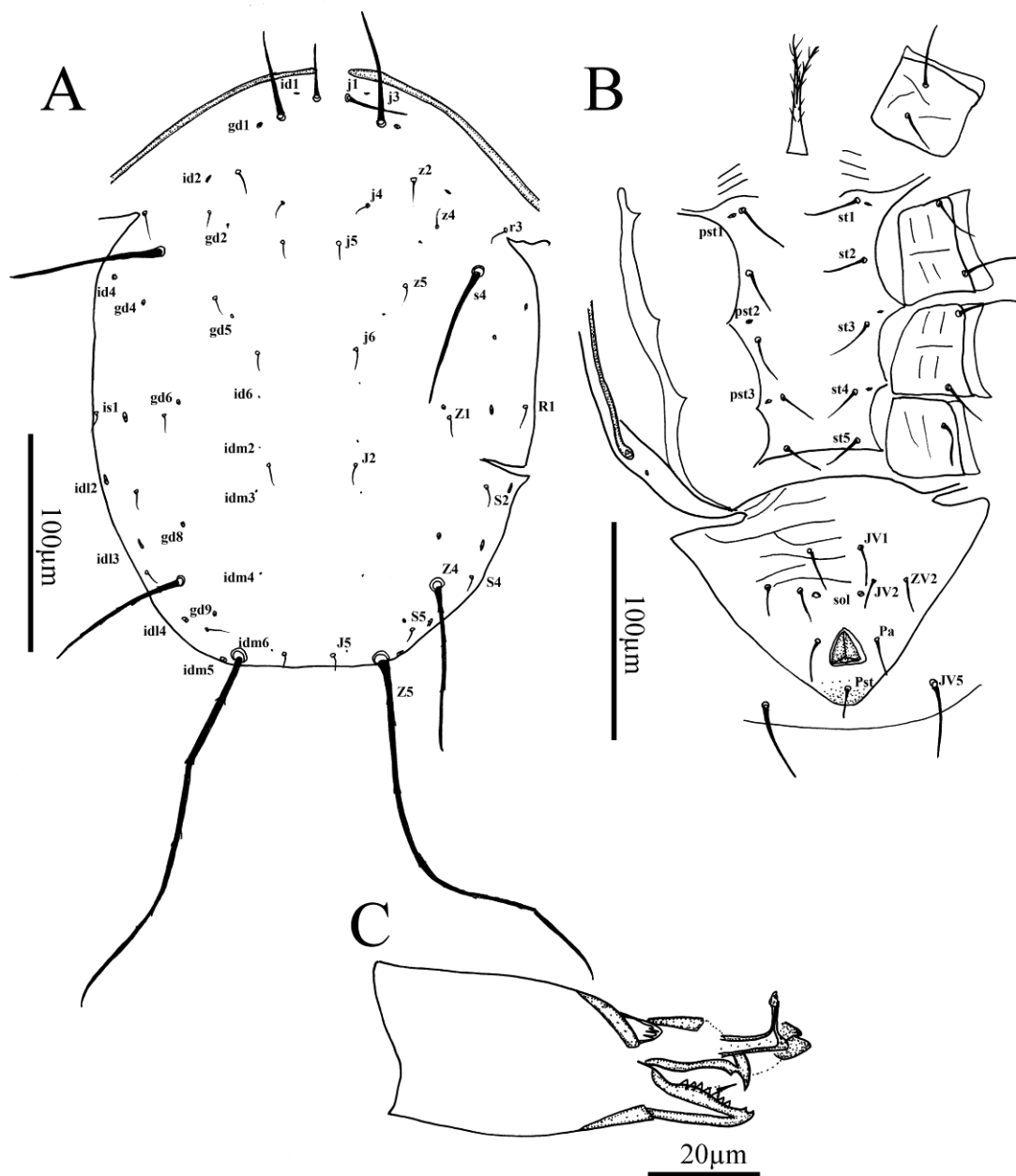


FIGURE 83. *Amblyseius largoensis* (Muma, 1955), Male, A. dorsal shield; B. ventral idiosoma; C. chelicera and spermatodactyl.

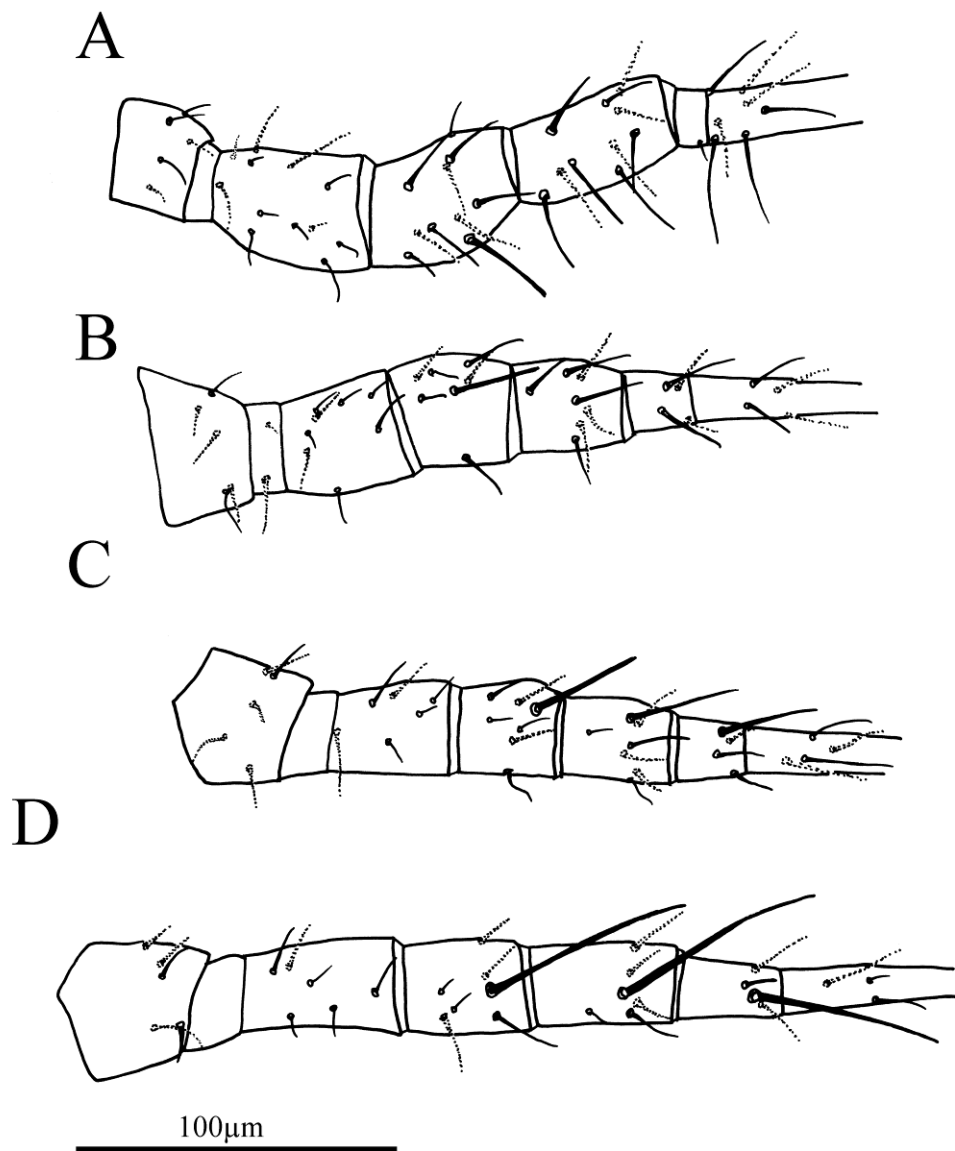


FIGURE 84. *Amblyseius largoensis* (Muma, 1955), Male, A. leg I anterior view, B. leg II posterior view, C. leg III posterior view, D. leg IV anterodorsal view.

Amblyseius pascalis Tseng, 1983

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(Figures 85–86)

Amblyseius (Amblyseius) pascalis Tseng, 1983: 36.

Female (n=2)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield lightly sclerotized, smooth, 396 (386–410) long, 223 (216–229) wide at level of *s4*, 224 (196–251) wide at level of *S4*; seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), thirteen pairs of lyrifissures (*id1*, *id2*, *id4*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *idx*, *is1*, *idl2*, *idl3*, *idl4*); length of dorsal setae: *j1* 34 (33–35), *j3* 48 (48–48), *j4* 9 (8–11), *j5* 6 (6–6), *j6* 6 (5–7), *J2* 8 (6–9), *J5* 8 (7–10), *z2* 8 (6–9), *z4* 7 (5–9), *z5* 6 (5–7), *Z1* 12 (10–14), *Z4* 96 (96–96), *Z5* 229 (225–232), *s4* 90 (90–90), *S2* 10 (10–10), *S4* 7 (7–7), *S5* 5 (5–5), *r3* 16 (13–18), *R1* 11 (10–13). Setae *j1*, *j3*, *s4* longer and smooth; *Z4*, *Z5* greatly elongated, slightly serrated; other minute.

Peritreme. Peritreme extending beyond to *j1* level, peritremal shield smooth, lightly sclerotized, with one pair of solenostome (*gd3*) and one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, posterior margin concave, wider than long, 75 (68–82) long, 106 (93–119) wide at *st3* level, with three pairs of setae *st1* 34 (33–34), *st2* 33 (31–35), *st3* 30 (28–32) and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae I–IV. Metasternal platelets tear-shaped, with a pair metasternal setae, *st4* 33 (32–33), and one pair of lyrifissures (*pst3*). Genital shield smooth, *st5* 24 (22–27), 90 (82–97) wide. Distances between *st1-st1* 68 (63–74), *st2-st2* 78 (72–84), *st3-st3* 86 (79–92), *st1-st3* 70 (65–74), *st5-st5* 73 (62–74). Ventrianal shield smooth, pentagonal, with slightly waist; 128 (123–133) long, 92 (91–93) wide at level of *ZV2* and 78 (71–86) wide at level of anus; with three pairs of pre-anal setae, *JV1* 18 (18–18), *JV2* 22 (22–22),

ZV2 18 (14–22), solenostome *gv3* crescentic, *Pa* 18 (16–20), *Pst* 17 (16–19) on shield. Setae *JV4* 13 (9–16), *JV5* 77 (77–78), *ZV1* 19 (16–21), *ZV3* 14 (11–16) on interscutal membrane. All ventral setae smooth. Two pairs of metapodal plates 21 (21–21) long, 6 (6–6) wide, 10 (10–10) long, 1 (1–1) wide.

Spermatheca. Calyx of spermatheca tubular, flaring distally, 17 (16–17) long, 4 (4–5) wide, atrium nodular, incorporate calyx, major duct and minor duct visible.

Chelicera. Movable digit 40 (37–44) long, with four teeth; fixed digit 34 (31–37) long, anterior half with two teeth, posterior half with eight teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* I (pd2) 48 (46–49), *Sge* II (pd2) 41 (40–43), *Sge* III (ad2) 57 (54–60), *Sti* III (ad) 51 (51–52), *Sge* IV (ad2) 111 (107–115), *Sti* IV (ad) 91 (89–94), *St* IV (d) 95 (95–95).

Specimens examined. CHINA: Guizhou Province, one female from shrub, 23.vi.1985, W. N. Wu (GIABR); Mt. Jinfo, Nanchuan City, Chongqing City, one female from weed, 25.vi.1985, W. N. Wu (GIABR).

Distribution. Asia: China (Wu *et al.* 1997c), Taiwan (Tseng 1983).

Remarks. Tseng (1983) described this species based on six female specimens from weeds and pear in Lishand, and Wuling Farm. These two places are mountain area in Taiwan, the altitude are about 2,000m. The investigation of present study were no finding, even in type locality. However, during the visiting to GIBAR, W. N. Wu provided several specimens of this species he collected in China. Therefore, present study described this species based on Chinese specimens.

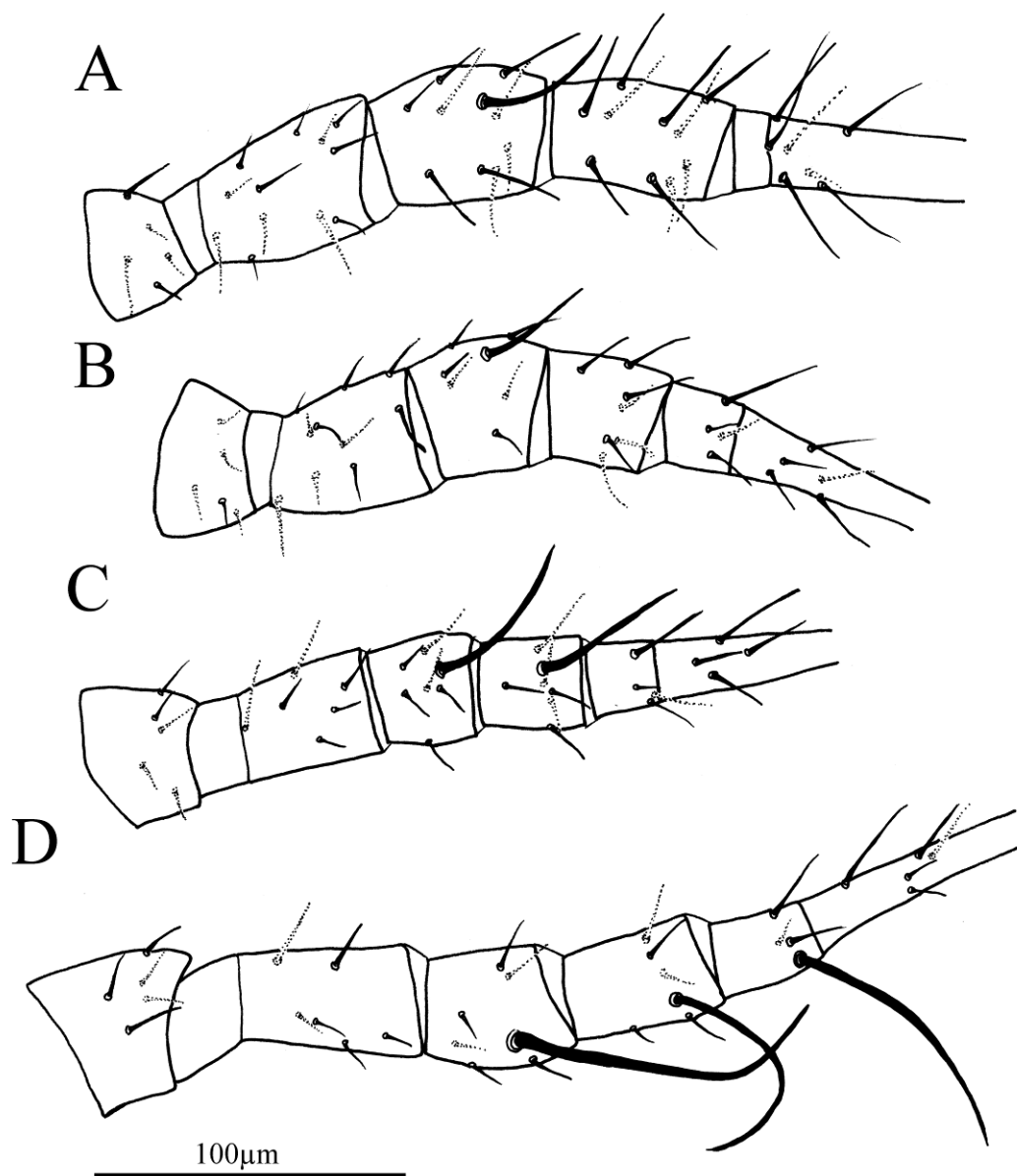


FIGURE 86. *Amblyseius pascalis* Tseng, 1983, Female, legs A. leg I posterior view, B. leg II posterior view, C. leg III dorsal view, D. leg IV anterior view.

Amblyseius trisetosus Tseng, 1983

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(Figure 87)

Amblyseius (Amblyseius) trisetosus Tseng, 1983: 49.

Female

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield well sclerotized, smooth, 317 long, 216 wide; length of dorsal setae: *j1* 14, *j3* 24, *j4* 4, *j5* 4, *j6* 4, *J2* 4, *J5* ?, *z2* 12, *z4* 10, *z5* 4, *Z1* 5, *Z4* 62, *Z5* 86, *s4* 48, *S2* 10, *S4* 7, *S5* 7, *r3* 12, *R1* 8. Setae *j1*, *j3*, *s4* longer and smooth; *Z4*, *Z5* longer, slightly serrated; other minute.

Peritreme. Peritreme extending to *j1* level.

Venter. Sternal shield slightly reticulated, posterior margin concave, wider than long, with three pairs of setae. Metasternal platelets tear-shaped, with a pair metasternal setae *st4*. Genital shield smooth, narrower than ventrianal shield, one pair of genital seta *st5*. Ventrianal shield pentagonal, with slightly reticulated 96 long, 94 wide; with three pairs of pre-anal setae, solenostome *gv3* crescentic. Setae *JV5* 53 on interscutal membrane. All ventral setae smooth. Two pairs of metapodal plates 17 long, 6 wide, 10 long, 4 wide.

Spermatheca. Calyx of spermatheca cup-shaped, 10 long 3 wide, and atrium, major duct visible.

Chelicera. Unknown.

Legs. Macrosetae: *Sge* IV 36, *Sti* IV 15, *St* IV 48.

Specimens examined. No specimens.

Distribution. Asia: Taiwan (Tseng 1983).

Remarks. Tseng (1983) described this species based on holotype female from

litter in Lushang, Nantou County. Because of specimen is lost (Liao *et al.* 2017b), investigation of this species is needed. The present study surveyed Taiwan and neighboring islands, also visited the type locality several times, but did not find this species. The type locality is famous scenic area in Taiwan; therefore, the landscape is tremendous change for development during these years. Besides, this place met several times of landslide, the environment is dramatically different.

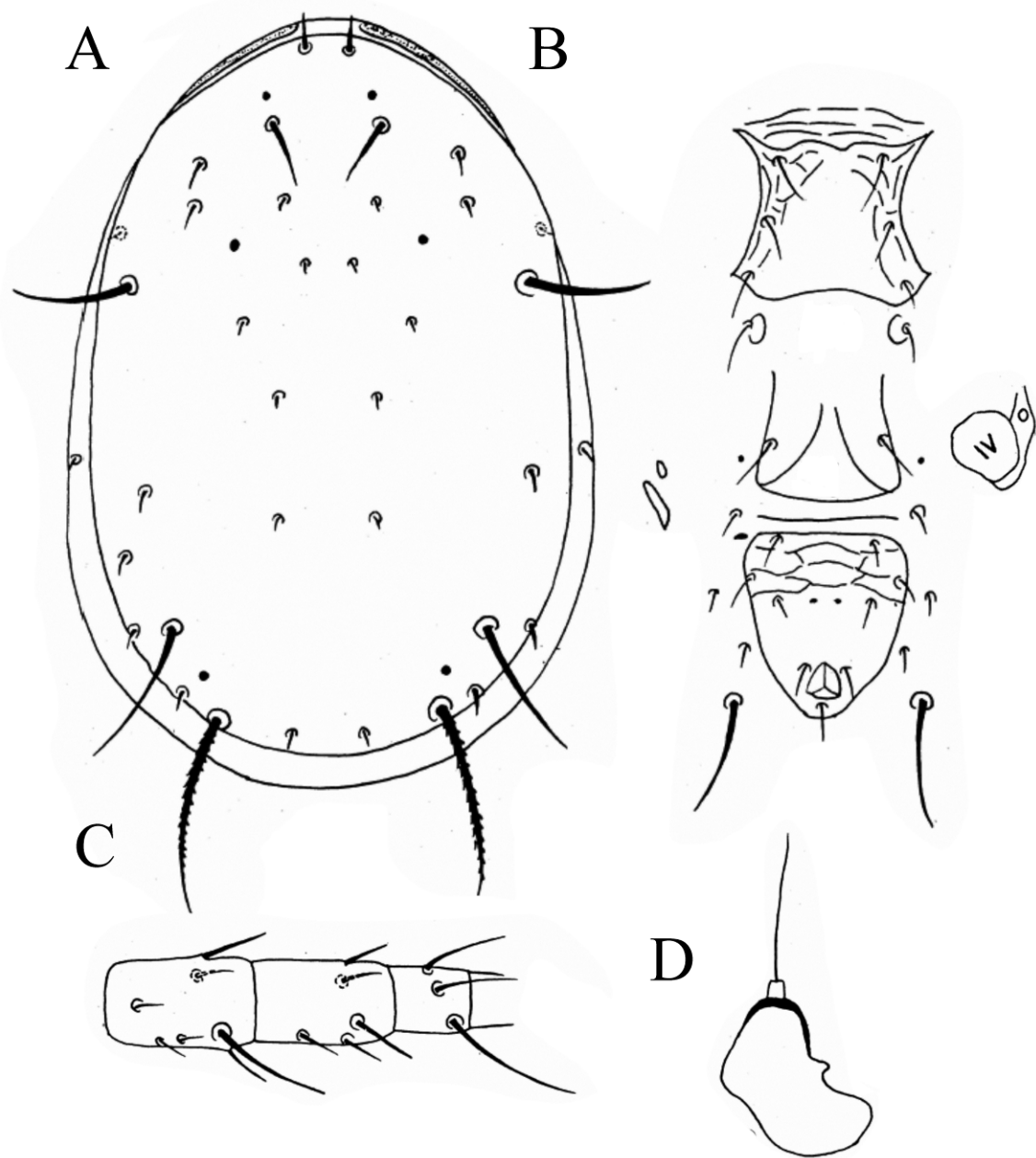


FIGURE 87. *Amblyseius trisetosus* Tseng, 1983, (after Tseng 1983), Female, A. dorsal shield, B. ventral idiosoma, C. leg IV, D. spermatheca.

Amblyseius tamatavensis Bloomers, 1974

塔瑪塔夫鈍綏蟎



(Figures 88–91)

Amblyseius tamatavensis Blommers, 1974: 144.

Amblyseius (*Amblyseius*) *maai* Tseng, 1976: 123.—(Synonymy according to Denmark & Muma 1989)

Amblyseius aegyptiacus Denmark & Matthyse, in Matthyse & Denmark 1981: 343.—(Synonymy according to Denmark & Muma 1989)

Female (n=10)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield lightly sclerotized, smooth, 365 (348–383) long, 230 (206–246) wide at level of *s4*, 210 (190–239) wide at level of *S4*; seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), twelve pairs of lyrifissures (*id1*, *id2*, *id4*, *id6*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of dorsal setae: *j1* 32 (28–37), *j3* 50 (48–52), *j4* 5 (4–7), *j5* 5 (3–8), *j6* 5 (3–8), *J2* 5 (3–8), *J5* 6 (4–8), *z2* 5 (4–7), *z4* 6 (4–8), *z5* 5 (4–8), *Z1* 6 (4–8), *Z4* 113 (95–125), *Z5* 233 (209–251), *s4* 85 (66–95), *S2* 5 (4–8), *S4* 5 (4–6), *S5* 6 (5–7), *r3* 9 (6–11), *R1* 8 (7–11). Setae *j1*, *j3*, *s4* longer and smooth; *Z4*, *Z5* greatly elongated, slightly serrated; other minute.

Peritreme. Peritreme extending beyond to *j1*, peritremal shield smooth, lightly sclerotized, with one pair of solenostome (*gd3*) and one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, posterior margin concave, wider than long, 65 (59–69) long, 98 (90–103) wide at *st3* level, with three pairs of setae *st1* 29 (25–34), *st2* 27 (19–34), *st3* 25 (21–29) and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae II–IV. Metasternal platelets tear-shaped, with a pair metasternal setae, *st4* 25 (21–29), and one pair of lyrifissures (*pst3*). Genital shield smooth, *st5* 21 (14–23), 84

(76–88) wide. Distances between *st1-st1* 62 (57–65), *st2-st2* 70 (64–76), *st3-st3* 79 (71–84), *st1-st3* 61 (57–63), *st5-st5* 78 (74–80). Ventrianal shield smooth, pentagonal with slightly waist; 118 (103–125) long, 96 (90–106) wide at level of ZV2 and 73 (59–86) wide at level of anus; with three pairs of pre-anal setae, *JV1* 14 (7–17), *JV2* 12 (8–15), *ZV2* 10 (7–14), solenostome *gv3* crescentic, *Pa* 15 (11–18), *Pst* 15 (11–18) on shield. Setae *JV4* 8 (5–12), *JV5* 82 (66–95), *ZV1* 11 (9–14), *ZV3* 8 (5–13) on interscutal membrane. All ventral setae smooth. Two pairs of metapodal plates 21 (19–25) long, 6 (4–8) wide, 12 (10–15) long, 2 (1–3) wide.

Spermatheca. Calyx tubular and elongated, flaring distally, usually bended, 18 (14–22) long, 3 (3–4) wide, atrium nodular incorporated within calyx, major duct long, minor duct visible.

Chelicera. Movable digit 35 (33–39) long, with four teeth; fixed digit 33 (28–37) long, anterior half with two teeth, posterior half with eleven teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* I (pd2) 39 (35–46), *Sge* II (pd2) 38 (31–42), *Sge* III (ad2) 54 (48–57), *Sti* III (ad) 41 (35–46), *Sge* IV (ad2) 111 (98–120), *Sti* IV (ad) 76 (66–84), *St* IV (d) 66 (57–73).

Male (n=2)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3,4:ZV-3.

Dorsum. Dorsal shield smooth, laterally reticulated; 254 (252–256) long, 174 (173–174) wide at level of *s4*, 160 (157–162) wide at level of *S4*, with seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), ten pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *is1*, *idl1*, *idl3*, *idl4*, *idm5*, *idm6*); length of setae: *j1* 25 (24–26), *j3* 40 (39–41), *j4* 5

(3–7), *j5* 5 (3–6), *j6* 6 (5–7), *J2* 4 (3–5), *J5* 5 (5–6), *z2* 5 (5–6), *z4* 6 (6–6), *z5* 5 (5–6), *Z1* 10 (6–14), *Z4* 79 (78–79), *Z5* 170 (167–173), *s4* 63 (62–65), *S2* 8 (7–9), *S4* 7 (5–10), *S5* 6 (6–7), *r3* 9 (7–11), *R1* 9 (8–11). Setae *j1*, *j3*, *s4* longer and smooth; *Z4*, *Z5* greatly elongated, slightly serrated; other minute. Setae *r3* and *R1* inserted on dorsal shield.

Peritreme. Peritreme extending beyond seta *j1* level; peritremal shield lightly sclerotized, with one pair of solenostome (*gd3*).

Venter. Sternogenital shield smooth, lateral slightly reticulated, posterior margin almost straight, longer than wide 135 (129–140) long, 77 (72–82) wide at level *st2*, with five pairs of setae *st1* 16 (16–16), *st2* 16 (13–20), *st3* 14 (13–15), *st4* 12 (11–12), *st5* 12 (12–12), three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Exopodal shield at coxae II–IV. Distance between *st1-st1* 52 (50–53), *st2-st2* 65 (58–71), *st3-st3* 53 (52–54), *st4-st4* 46 (44–49), *st5-st5* 41 (37–44), *st1-st5* 112 (109–115). Ventrianal shield subtriangular, slightly reticulated, 110 (101–118) long, 151 (149–153) wide at level of anterior corner and 49 (47–51) wide at level of anus, fused with peritremal shield cingulum; with three pairs of pre-anal setae, *JV1* 11 (10–11), *JV2* 13 (12–13), *ZV2* 12 (10–14), solenostome *gv3* crescentic, *Pa* 9 (8–10), *Pst* 10 (8–13) on shield; *JV5* 29 (24–34) on interscutal membrane. All ventral setae smooth.

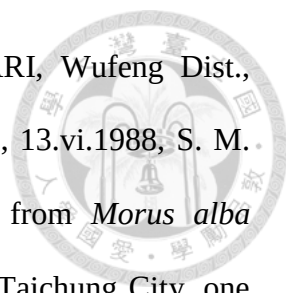
Chelicera. Movable digit 19 (18–20) long, with one tooth; fixed digit 24 (23–25), with two teeth on anterior half, eight teeth on posterior half, with *pilus dentilis*. Spermatodactyl L-shaped, shaft 20 (18–22) long, heel rounded, foot 21 (21–22) long, with rounded toe and lateral thorn-like projection.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* I (pd2) 32 (28–36), *Sge* II (pd2) 28 (26–31), *Sge*

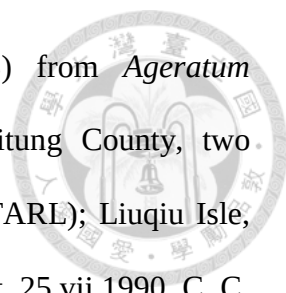
III (ad2) 35 (32–37), *Sti* III (ad) 33 (32–35), *Sge* IV (ad2) 63 (61–66), *Sti* IV (ad) 45 (42–47), *St* IV (d) 56 (50–61).

Specimens examined. PHILIPPINES: Laguna, Calamba, Luzon, one female (LACR 5242) from *Osteospermum* sp. (Asteraceae), 1.ii.2003, R. C. Garcia (UPLB-MNH); Pintor, Gamu Municipality, Isabella Province, Luzon, one female (LACR 5921, Aca 7323) from *Psidium guajava* (Myrtaceae), 29.iv.2013, L.A. Corpuz-Raros (UPLB-MNH); Pintor, Gamu Municipality, Isabella Province, Luzon, one female (LACR 5919, Aca 7324) from *Platycladus orientalis* (Cupressaceae), 2.iii.2013, L.A. Corpuz-Raros (UPLB-MNH); Pintor, Gamu Municipality, Isabella Province, Luzon, one male (LACR 5919, Aca 7324) from *Platycladus orientalis* (Cupressaceae), 2.iii.2013, L.A. Corpuz-Raros (UPLB-MNH); Pintor, Gamu Municipality, Isabella Province, Luzon, one female (LACR 5919, Aca 7324) from *Platycladus orientalis* (Cupressaceae), 2.iii.2013, L.A. Corpuz-Raros (UPLB-MNH); Tacloban City, Leyte, one female (LACR 5346, Aca 3722) from *Vanda* sp. (Orchidaceae), 1.iii.2003, L. M. Calleja (UPLB-MNH); Pintor, Gamu Municipality, Isabella Province, Luzon, four females from unknown weeds, 2.iii.2013, J. C. B. Naredor & J. Alvarez (UPLB-MNH).

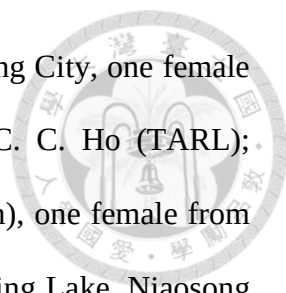
TAIWAN: NCHU, South Dist., Taichung City, one female from *Ixeris laevigata* (Asteraceae), 12.x.1985, C. C. Ho (TARL); Chuxiang, Lugu Township, Nantou County, three females from *Camellia sinensis* (Theaceae), 13.xi.1987, C. C. Ho (TARL); Chuxiang, Lugu Township, Nantou County, two females from *Alternanthera nodiflora* (Amaranthaceae), 13.xi.1987, C. C. Ho (TARL); Chuxiang, Lugu Township, Nantou County, six females from *Camellia sinensis* (Theaceae), 27.xi.1987, C. C. Ho (TARL); Chuxiang, Lugu Township, Nantou County, seven females from *Camellia sinensis* (Theaceae), 24.xii.1987, C. C. Ho (TARL); TARI, Wufeng Dist., Taichung City, one



female from unknown plant, 24.ii.1988, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, three females from *Artemisia princeps* (Asteraceae), 13.vi.1988, S. M. Yu (TARL); Hualien Station, Hualien County, sixteen females from *Morus alba* (Moraceae), 28.vii.1988, C. C. Ho (TARL); TARI, Wufeng Dist., Taichung City, one female from *Malpighia emarginata* (Malpighiaceae), 14.x.1988, M. T. Lin (TARL); TARI, Wufeng Dist., Taichung City, one female from *Ziziphus mauritiana* (Rhamnaceae), 14.x.1988, M. T. Lin (TARL); TARI, Wufeng Dist., Taichung City, one female from *Erigeron canadensis* (Asteraceae), 14.x.1988, M. T. Lin (TARL); Fonghuanggu, Lugu Township, Nantou County, three females from soil of *Camellia sinensis* (Theaceae), 18.x.1988, C. C. Ho (TARL); TARI, Wufeng Dist., Taichung City, three females from *Artemisia princeps* (Asteraceae), 18.x.1988, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, three females (88-AM-0819, 24, 28) from *Cordyline terminalis* (Asparagaceae), 18.x.1988, S. M. YU (TARL); TARI, Wufeng Dist., Taichung City, six females from *Ziziphus mauritiana* (Rhamnaceae), 20.x.1988, M. T. Lin (TARL); TARI, Wufeng Dist., Taichung City, one female from *Platostoma palustre* (Lamiaceae), 24.x.1988, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, three females from *Ziziphus mauritiana* (Rhamnaceae), 27.x.1988, M. T. Lin (TARL); TARI, Wufeng Dist., Taichung City, one female from *Ageratum houstonianum* (Asteraceae), 2.xi.1988, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, one female from *Ziziphus mauritiana* (Rhamnaceae), 4.xi.1988, M. T. Lin (TARL); TARI, Wufeng Dist., Taichung City, two females (88-Am-0653, 55) from *Ziziphus mauritiana* (Rhamnaceae), 14.xi.1988, M. T. Lin (TARL); TARI, Wufeng Dist., Taichung City, two females from *Ziziphus mauritiana* (Rhamnaceae), 24.xi.1988, M. T. Lin (TARL); TARI, Wufeng Dist., Taichung City, two females from *Ampelopsis glandulosa* var. *brevipedunculata* (Vitaceae), 24.xi.1988, S. M. Yu (TARL); Meinong,



Beinan Township, Taitung County, one female (89-Am-0513) from *Ageratum houstonianum* (Asteraceae), 2.ii.1989, Y. J. Wang (TARL); Taitung County, two females from *Camellia sinensis* (Theaceae), 2.ii.1989, C. C. Ho (TARL); Liuqiu Isle, Liuqiu Township, Pingtung County, one female from unknown plant, 25.vii.1990, C. C. Ho (TARL); Zhongxingling, Xinshe Dist., Taichung City, one female from *Cucumis sativus* (Cucurbitaceae), 14.vii.1992, C. C. Ho (TARL); Pinglin, Guoxing Township, Nantou County, one female from *Strelitzia reginae* (Strelitziaceae), 4.viii.1992, C. C. Ho (TARL); Daqi, Guoxing Township, Nantou County, one female from *Areca catechu* (Arecaceae), 4.viii.1992, C. C. Ho (TARL); Beigangxi, Guoxing Township, Nantou County, one female from *Phaseolus vulgaris* (Fabaceae), 4.viii.1992, C. C. Ho (TARL); Dongxing, Xinshe Dist., Taichung City, four females from *Solanum melongena* (Solanaceae), 27.viii.1992, C. C. Ho (TARL); Zhongxingling, Xinshe Dist., Taichung City, four females from *Cucumis sativus* (Cucurbitaceae), 27.vii.1992, C. C. Ho (TARL); Zhongxingling, Xinshe Dist., Taichung City, three females from *Luffa cylindrica* (Cucurbitaceae), 27.vii.1992, C. C. Ho (TARL); Houli Dist., Taichung City, one female from *Vitis vinifera* (Vitaceae), 27.vii.1992, C. C. Ho (TARL); Mingjian Township, Nantou County, one female (TAL087B17) from *Camellia sinensis* (Theaceae), 5.v.1998, C. C. Ho (TARL); Mingjian Township, Nantou County, one female (HAL097B411) from *Mangifera indica* (Anacardiaceae), 26.v.2008, C. C. Ho (TARL); Qingfu Village, Dongshi Dist., Taichung City, one female (HAL097B682) from *Pyrus* sp. (Rosaceae), 20.x.2008, C. C. Ho (TARL); Heping Dist., Taichung City, one female (HAL097B685) from *Prunus persica* (Rosaceae), 20.x.2008, C. C. Ho (TARL); Datiekeng, Heping Dist., Taichung City, one female (HAL097B688) from *Prunus persica* (Rosaceae), 21.x.2008, C. C. Ho (TARL); Yunshui, Zhongpu Township, Chiayi County, one female (HAL097B802) from *Pueraria lobata* (Fabaceae),



20.xi.2008, C. C. Ho (TARL); Mt. Azhaowu, Wufeng Dist., Taichung City, one female (HAL097B760) from *Boehmeria nivea* (Urticaceae), 1.xii.2008, C. C. Ho (TARL); Neimen Dist., Kaohsiung City (22°53'56.0" N, 120°25'42.2" E, 85m), one female from *Acacia confusa* (Fabaceae), 24.vii.2012, C. C. Ho (TARL); Chengqing Lake, Niasong Dist., Kaohsiung City, one female from *Morus alba* (Moraceae), 27.xii.1985, C. C. Ho (TARI); Dashe Dist., Kaohsiung City, one female from *Euphoria longan* (Sapindaceae), 13.vi.1986, C. C. Ho (TARI); Dashe Dist., Kaohsiung City, one female from *Ziziphus mauritiana* (Rhamnaceae), 4.vii.1991, C. C. Ho (TARI); Zhongpu Township, Chiayi County, two females from *Cocos nucifera* (Arecaceae), 1.x.1992, C. C. Ho (TARI); TARI, Wufeng Dist., Taichung City, one female from *Salvia officinalis* (Lamiaceae), 2.ix.2004, C. H. Young (TARI); Fulong, Gongliao Dist., New Taipei City, one female from *Macaranga tanarius* (Euphorbiaceae), 30.vii.2009, Y. H. Chiang (NTU); Zhuolan Township, Miaoli County (24°20.432' N, 120°49.362' E), one female from *Prunus* sp. (Rosaceae), 5.xii.2009, on, J. R. Liao; Sanmin Villange, Fuxing Dist., Taoyuan City, two females (no. 861–1, 2) from *Euphorbia pulcherrima* (Euphorbiaceae), 10.ix.2010, Y. T. Shih; Zhuolan Township, Miaoli County (24°19.260' N, 120°49.152' E, 332m), one female (no. 902–3) from *Cucumis sativus* (Cucurbitaceae), 19.x.2010, C. T. Chen & J. R. Liao (NTU); Sandimen Township, Pingtung County (22°43.866' N, 120°40.057' E, 487m), one female (no. 937–1) from *Mallotus japonicus* (Euphorbiaceae), 20.xi.2010, J. R. Liao (NTU); Sandimen Township, Pingtung County (22°43.866' N, 120°40.057' E, 487m), three females (no. 938–6, 7, 8) from *Lantana camara* (Verbenaceae), 20.xi.2010, J. R. Liao (NTU).

THAILAND: Quarantine specimen, one female one male (HAL098B608) from *Piper nigrum* (Piperaceae), 30.xi.2009, Hsinchu Branch (TARL); Quarantine specimen, one female (HAL099B097) from *Aranthera* sp. (Orchidaceae), 6.i.2010, Hsinchu Branch

(TARL); Quarantine specimen, one male (HAL100B201) from *Piper betle* (Piperaceae), 27.x.2011, Hsinchu Branch (TARL); Quarantine specimen, one female (HAL101B018) from *Piper betle* (Piperaceae), 6.xii.2011, Hsinchu Branch (TARL).

Distribution. Africa Benin (Zannou *et al.* 2007), Burundi (Zannou *et al.* 2007), Cameroon (Zannou *et al.* 2007), Dr Congo (Zannou *et al.* 2007), Ghana (Zannou *et al.* 2007), Kenya (Moraes *et al.* 1989c), Madagascar Island (Blommers 1974), Malawi (Zannou *et al.* 2005); Mozambique (Zannou *et al.* 2005), Nigeria (Moraes *et al.* 1989a), Rwanda (Zannou *et al.* 2007), South Africa (Ueckermann & Loots 1988), Uganda (Zannou *et al.* 2007). Asia: Indonesia (Oomen 1982), Japan (Ehara & Amano 2002), Malaysia (Ehara 2002a), Philippines (Schicha & Corpuz-Raros 1992), Singapore (Corpuz-Raros 1995b); Sri Lanka (Moraes *et al.* 2004b), Thailand (Oliveira *et al.* 2012). Central America: Cuba (Moraes *et al.* 1991). North America: Dominican Republic (Abo-Shnaf *et al.* 2016). Ocenia: Australia (Schicha 1981a), Fiji (Gutierrez & Schicha 1984), Papua New Guinea (Schicha 1981a), Vanuatu (Schicha 1981a), Western Samoa (Schicha 1981a). South America: Brazill (Gondim Jr. & Moraes 2001), Venezuela (Quirós *et al.* 2005).

Remarks. Döker *et al.* (2018a) reported that the tooth number differences among several descriptions of *A. tamatavensis*. Bloomers (1974) first described three teeth on movable digit, thirteen teeth on fixed digit; Schicha (1981a) reported that the type specimens should have four teeth on movable digit; Zannou *et al.* (2007) reported the African specimens have three teeth on movable digit, thirteen teeth on fixed digit; Silva *et al.* (2016) reported four teeth on movable digit, twelve teeth on fixed digit; Malayisia and Philippines specimens have four teeth on movable digit, ten teeth on fixed digit (Schicha & Corpuz-Raros 1992; Ehara 2002a); Ueckermman & Loots (1998) reported the South African specimens have four teeth on movable digit, and ten to eleven teeth

on fixed digit; Döker *et al.* (2018a) reported four teeth on movable digit, and eleven teeth on fixed digit; the present study showed four teeth on movable digit, and thirteen teeth on fixed digit.

Döker *et al.* (2018a) reported this species could use to control pests (e.g. whitefly) on the habitat plants with trichomes. Ho & Chen (2001) reported this species have potential to become a good predator for *Thrips palmi*. Besides, they also found this species occurred in the fallen flowers in tea field, and tea flower pollens are suitable food for this species.

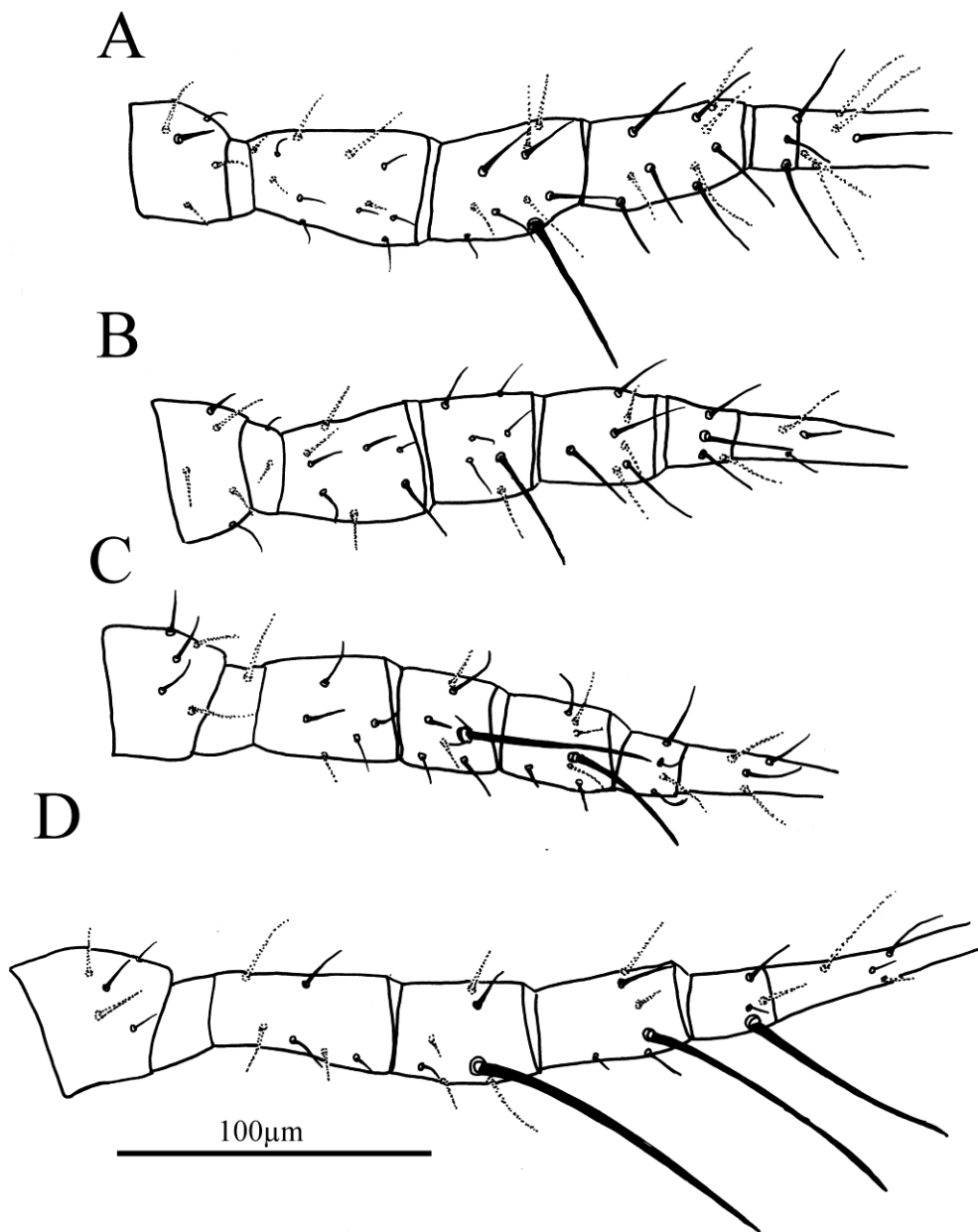


FIGURE 89. *Amblyseius tamatavensis* Bloomers, 1974, Female, legs A. leg I anterior view, B. leg II dorsal view, C. leg III anterodorsal view, D. leg IV anterior view.

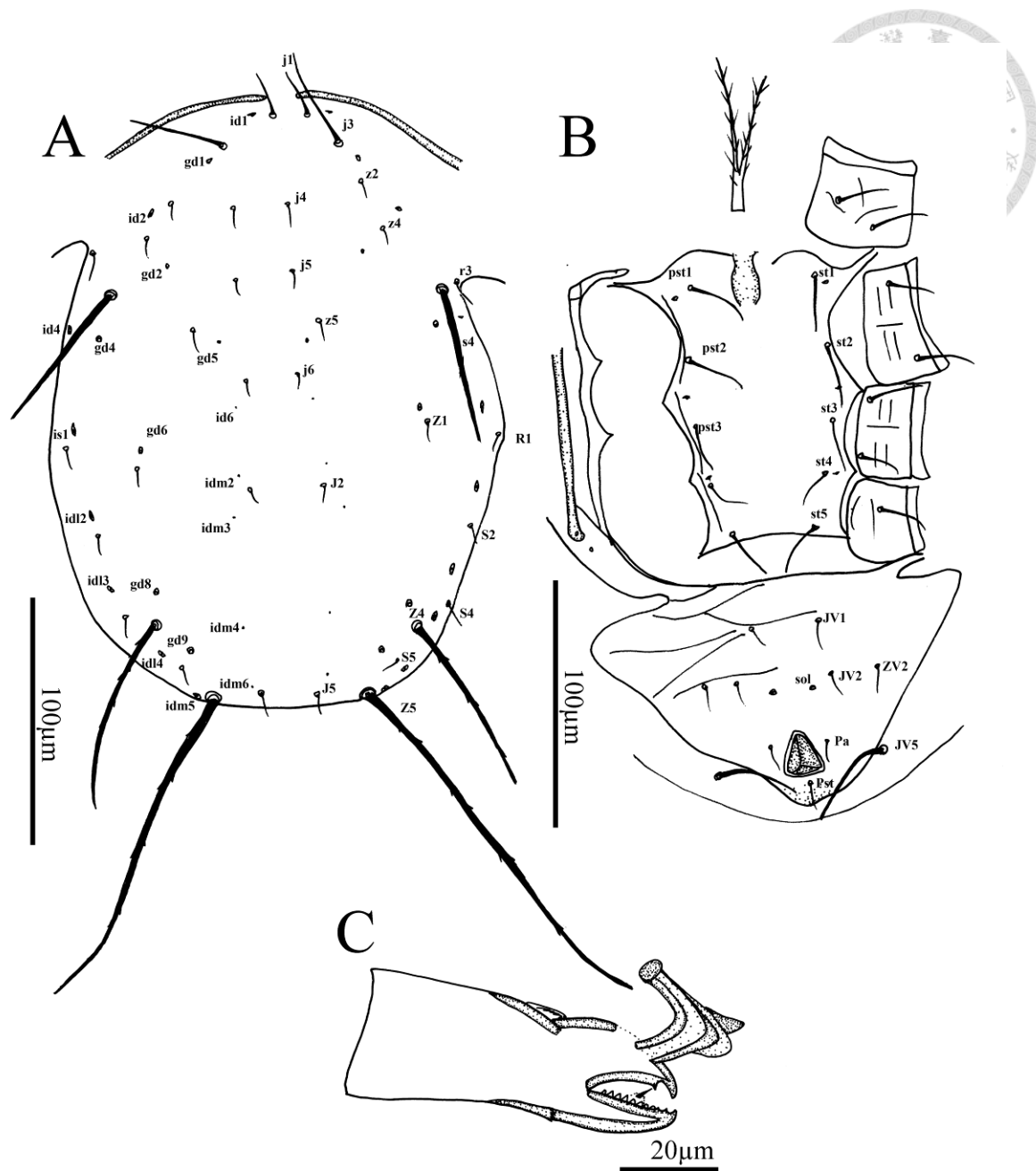


FIGURE 90. *Amblyseius tamatavensis* Bloomers, 1974, Male, A. dorsal shield; B. ventral idiosoma; C. chelicera and spermatodactyl.

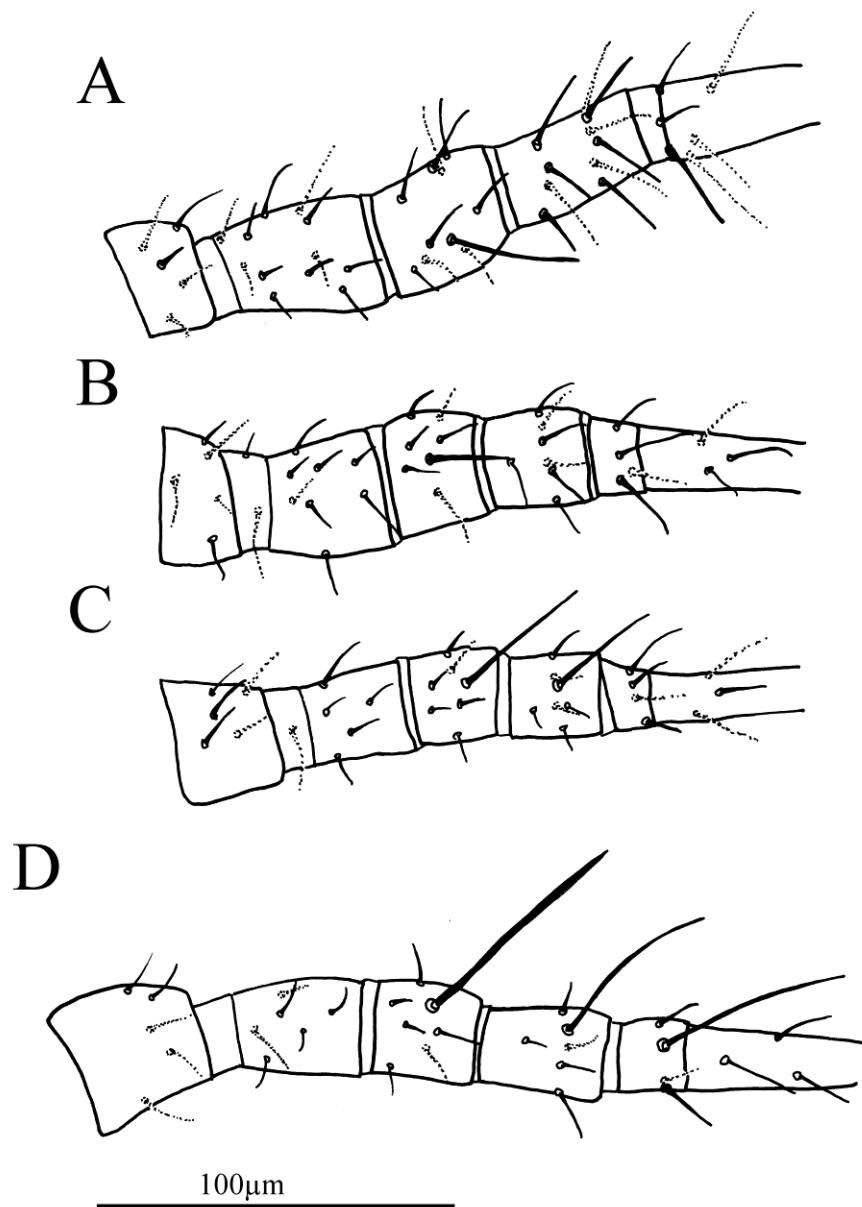


FIGURE 91. *Amblyseius tamatavensis* Bloomers, 1974, Male, A. leg I anterodorsal view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV dorsal view.

Subtribe Arrenoseiina Chant & McMurtry, 2004b

壯綏蟎亞族



Arrenoseiina Chant & McMurtry, 2004b: 220.

Type genus - *Amblyseius* (*Arrenoseius*) Wainstein, 1962: 12.

This subtribe is characterized by idiosoma strongly sclerotized, brown; dorsal shield broader; sternal, genital and female ventrianal shields broad, strongly reticulated; ectal strip universal; macrosetae on legs II and III often absent. Setae *s*₄, *Z*₄ and *Z*₅ are usually normal length, not longer. Five genera belong to this subtribe, including *Arrenoseius* Wainstein, *Iphiseiodes* De Leon, *Paraamblyseius* Muma, *Pararrenoseius* Chant & McMurtry, *Phytoscutus* Muma.

Key to species in the subtribe Arrenoseiina from Taiwan

1. Seta *j*₅ present..... genus *Paraamblyseius* Muma
..... *formosanus* (Ehara, 1970)
- Seta *j*₅ absent..... genus *Phytoscutus* Muma
..... *salebrosus* (Chant, 1960)

Genus *Paraamblyseius* Muma, 1962

擬鈍綏蟎屬

Paraamblyseius Muma, 1962: 8.

Type species - *Paraamblyseius lunatus* Muma, 1962: 8.

There are 9 valid species in this genus (Demite *et al.* 2019), including *P. ogdeni* only described by male specimens (De Leon 1966). All species are 10A:9B, but *P. lunatus* have seta ZV3 absent (Chant & McMurtry (2004b) reported *P. guangdongensis* lack ZV3, but original description provided ZV3 present).

Diagnosis – Idiosomal pattern 10A:9B/JV-3:ZV, or 10A:9B/JV-3:ZV-3 (*P. lunatus*). Dorsal shield round, broad, heavily sclerotized, brownish, densely punctate. Dorsal setae short to medium in length, sometimes stout, blunt, or foliate. Sternal shield heavily sclerotized, reticulated. Genital shield broad, heavily sclerotized, reticulated, truncated posteriorly. Female ventrianal shield broad, heavily sclerotized, reticulated, , with 3 pair of preanal setae, *gv3* conspicuous. Peritreme usually extending to *j1* level. Spermatheca with atrium nodular, calyx funnel-shaped or saccular. Chelicera fixed digit usually with 6-8 teeth, movable digit with 2-3 teeth. Legs without macrosetae. Ge II with 7 setae. Male ventrianal shield triangular, spermatodactyl with strong toe, heel reduced or vestigial.

***Paraamblyseius formosanus* (Ehara, 1970)**

臺灣擬鈍綏蟎



(Figures 92–95)

Iphiseius formosanus Ehara, 1970: 59.

Paraamblyseius formosanus.—Denmark, 1988: 29.

Female (n=4)

A reddish or brownish, strongly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV-3.

Dorsum. Dorsal shield rotund, broad, strongly reticulated; **350** 323 (293–350) long (*j1*–*J5* level) and **263** 247 (222–263) wide at level of *j6*, **258** 234 (204–258) wide at level of *S4*; six pairs of solenostomes on dorsal shield, (*gd1*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), twelve pairs of lyrifissures, (*id1*, *id2*, *id4*, *id6*, *idm2*, *idm3*, *idm4*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 11 9 (8–11), *j3* 20 17 (14–20), *j4* 13 15 (13–20), *j5* 15 15 (14–15), *j6* 23 25 (20–31), *J2* 28 29 (22–37), *J5* 6 10 (6–14), *z2* 20 19 (19–20), *z4* 22 22 (19–23), *z5* 15 13 (9–15), *Z1* 33 36 (26–44), *Z4* 49 41 (36–937), *Z5* 35 35 (29–45), *s4* 30 25 (21–30), *S2* 35 35 (28–40), *S4* 19 19 (18–21), *S5* 19 21 (19–23), *r3* 17 14 (12–17), *R1* 15 14 (14–15). Setae *z4* thickened, *Z1*, *Z4*, *Z5*, *s4*, *S2*, *S4*, *S5* foliate, arising from tubercles, other setiform.

Peritreme. Peritreme extend to *j1* level; peritremal shield much enlarged posteriorly, with unique scalloped pattern, fused anteriorly with dorsal shield with one pair of solenostomes (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternal shield strongly sclerotized, much wider than long, with posterior margin concave, **43** 41 (35–43) long, **119** 109 (92–119) wide, and with three pairs of setae *st1* **19** 20 (18–22), *st2* **20** 19 (16–21), *st3* **19** 18 (16–19), and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae I–IV. Metasternal platelets

tear-shaped, with one pair of metasternal setae, *st4* **20** 16 (11–20), with one pair of lyrifissures (*pst3*). Genital shield broad, heavily sclerotized, reticulated, broadly truncate posteriorly, **100** 112 (100–125) wide at level of genital seta, with genital setae, *st5* **18** 19 (16–25). Distances between *st1-st1* **47** 45 (39–50), *st2-st2* **68** 64 (57–70), *st3-st3* **84** 81 (75–91), *st1-st3* **55** 51 (47–56), *st5-st5* **82** 84 (75–97). Ventrianal shield large, broad, strongly sclerotized, reticulated, **124** 121 (105–144) long, **185** 183 (164–207) wide at level of ZV2, **85** 85 (76–92) wide at level of anus; with four pairs of pre-anal setae, *JV1* **9** 12 (9–16), *JV2* **9** 9 (9–9), *ZV2* **9** 10 (9–11), solenostomes *gv3* small and rounded; *Pa* **12** 11 (9–13), *Pst* **15** 13 (11–15) on shield. Setae *JV4* **9** 10 (9–10), *JV5* **15** 15 (14–15), *ZV1* **13** 12 (10–14) on interscutal membrane. All setae smooth, sharp pointed. Two pairs of metapodal plates **50** 39 (34–50) long, **15** 10 (5–15) wide, **4** 4 (4–5) long, **3** 4 (3–2) wide.

Spermatheca. Calyx V-shaped, **13** 12 (11–13) long, **13** 13 (13–14) wide, small atrium connected to the calyx without neck, minor and major ducts visible.

Chelicera. Movable digit **25** 23 (21–25) long, with two anterior teeth; fixed digit **23** 22 (21–23) long, anterior half with two teeth, posterior half with six teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): 2-3/2-2/2-1, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: Leg I-IV without macroseta.

Male (n=2)

A reddish, robust, strongly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3,4:ZV-3.

Dorsum. Dorsal shield rotund, broad, strongly reticulated; 279 (271–287) long

(*j1-J5* level) and 192 (172–212) wide at level of *j6*, 179 (173–185) wide at level of *S4*, six pairs of solenostomes on dorsal shield, (*gd1, gd4, gd5, gd6, gd8, gd9*), twelve pairs of lyrifissures, (*id1, id2, id4, id6, idm2, idm3, idm4, idm6, is1, idl2, idl3, idl4*); length of setae: *j1* 7 (7–8), *j3* 16 (15–16), *j4* 11 (10–13), *j5* 13 (12–15), *j6* 22 (19–26), *J2* 20 (16–25), *J5* 7 (7–7), *z2* 24 (19–29), *z4* 27 (23–31), *z5* 11 (7–15), *Z1* 24 (18–30), *Z4* 34 (30–38), *Z5* 32 (29–34), *s4* 27 (23–31), *S2* 24 (22–27), *S4* 16 (16–17), *S5* 19 (17–20), *r3* 18 (16–20), *R1* 16 (15–17). Setae *z4* thickened, *Z1, Z4, Z5, s4, S2, S4, S5* foliate, arising from tubercles, other setiform. Setae *r3* and *R1* inserted on dorsal shield.

Peritreme. Peritreme extending to *j1* level; peritremal shield much enlarged posteriorly, with unique scalloped pattern, fused anteriorly with dorsal shield.

Venter. Sternogenital shield strongly reticulated, posterior margin wide and straight, longer than wide, 102 (95–109) long, 89 (85–92) wide at level of *st2*, with five pairs of setae, *st1* 16 (14–17), *st2* 14 (12–16), *st3* 13 (12–13), *st4* 13 (11–16), *st5* 11 (11–12), three pairs of lyrifissures (*pst1, pst2, pst3*). Exopodal shield at coxae I–IV. Distances between *st1-st1* 44 (43–45), *st2-st2* 55 (51–58), *st3-st3* 64 (59–68), *st4-st4* 57 (51–62), *st5-st5* 44 (42–46), *st1-st5* 97 (93–101). Ventrianal shield subtriangular, strongly reticulated, 120 (120–120) long, 151 (140–161) wide at anterior corner, 69 (65–74) at level of anus, fused with peritremal shield cingulum; with three pairs of pre-anal setae, *JV1* 10 (10–10), *JV2* 8 (7–9), *ZV2* 8 (6–10), solenostomes *gv3* small and rounded; *Pa* 9 (8–10), *Pst* 8 (6–10) on shield. Setae *JV5* 16 (15–17) on interscutal membrane. All setae smooth.

Chelicera. Movable digit 16 (11–21) long, with one tooth; fixed digit 14 (9–19) long, with one tooth on anterior half, five teeth on posterior half. Spermatodactyl toe-shaped, shaft 20 (20–20) long, heel rounded, foot 5 (4–7) long.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): 2-3/2-2/2-1,

2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: Leg I-IV without macroseta.

Specimens examined. Kenting, Pingtung County, one holotype female (AC-13069) from *Calamus margaritae* (Arecaceae), 4.iv.1966, S. Ehara (NSMT); Kenting, Pingtung County, three paratype females (ZIHU-3541, 3542, 3543) from *Calamus margaritae* (Arecaceae), 4.iv.1966, S. Ehara (HUM); Kenting, Pingtung County, one allotype male (ZIHU-3540) from *Calamus margaritae* (Arecaceae), 4.iv.1966, S. Ehara (HUM); Wufenqi, Jiaoxi Township, Yilan county, one female (no. 680–1) from *Melastoma candidum* (Melastomataceae), 16.vii.2010, J. R. Liao & M. C. Chiu (NTU); Paomagudao, Jiaoxi Township, Yilan County, one male (no. 701–1) from fern, 16.vii.2010, J. R. Liao & M. C. Chiu (NTU).

Distribution. Asia: Taiwan (Ehara, 1970).

Remarks. Ehara (1970) reported this speices from *Calamus margaritae* in Kenting National Park, and Tseng (1976) also found it from the same locality on *Garcinia spicata*. Gupta (1980) recorded this species in India, but he proposed this probably is *P. fragariae* (Gupta 1986). The present investigation observed this species from fern and *Melastoma candidum* in Yilan County and propose that this speices distributed in low altitude rainforest, and feed on different plants. The fern-living adaptation of mites need to be investigated. The present study compared the holotype specimen with other specimens, no significant difference was found.

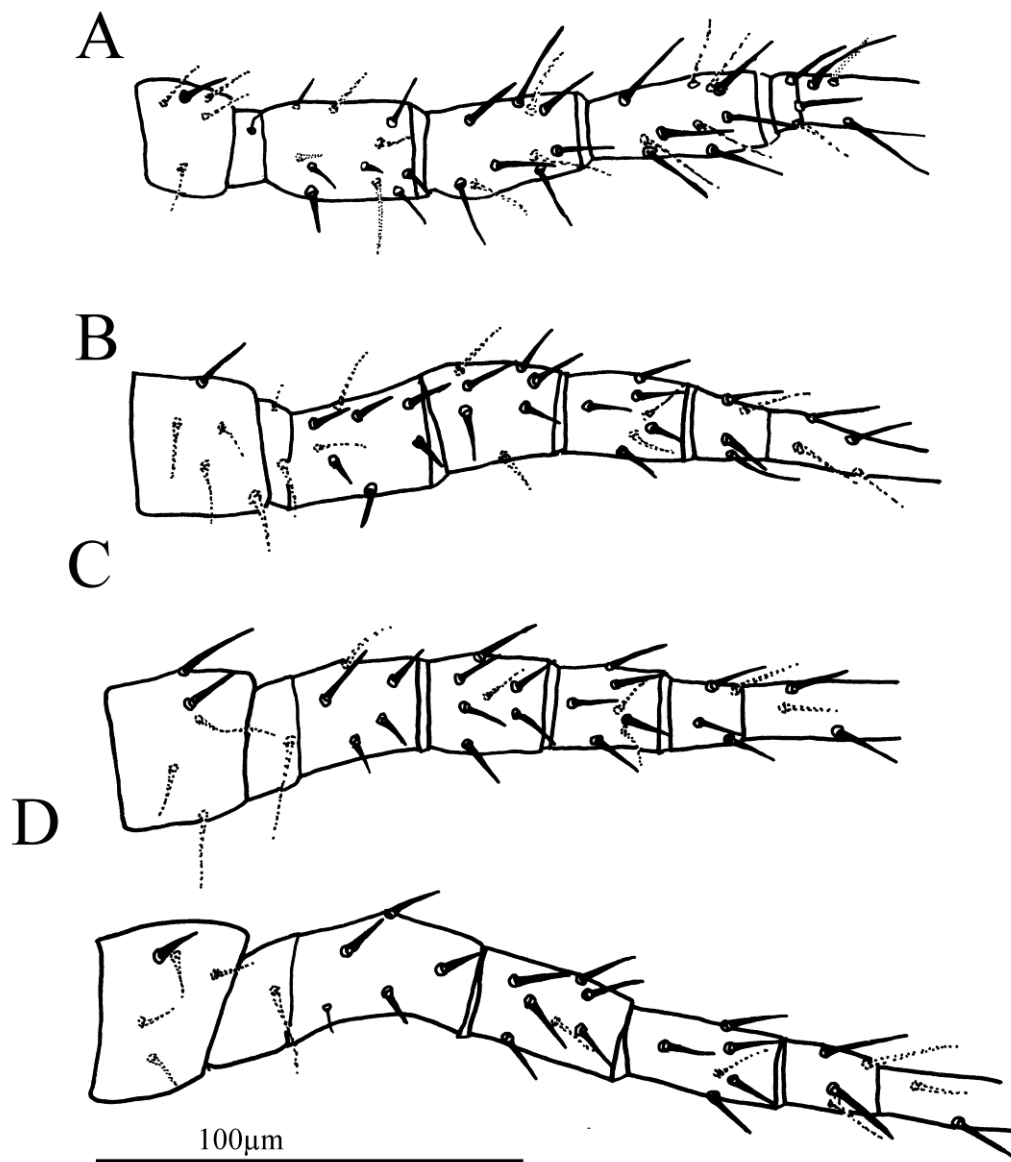


FIGURE 93. *Paraamblyseius formosanus* (Ehara, 1970), Female, legs A. leg I anterior view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV dorsal view.

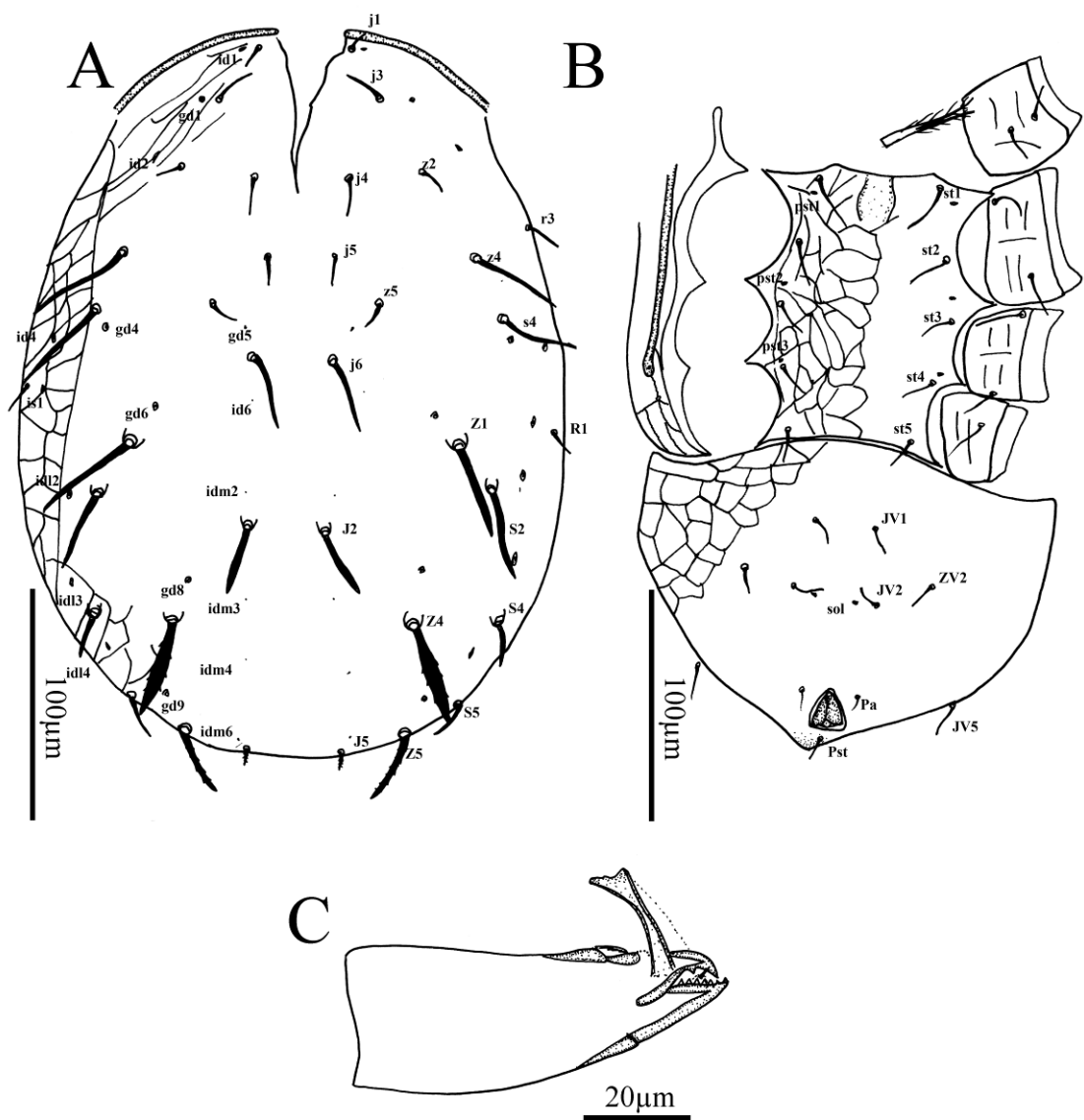


FIGURE 94. *Paraamblyseius formosanus* (Ehara, 1970), Male, A. dorsal shield; B. ventral idiosoma; C. chelicera and spermatodactyl.

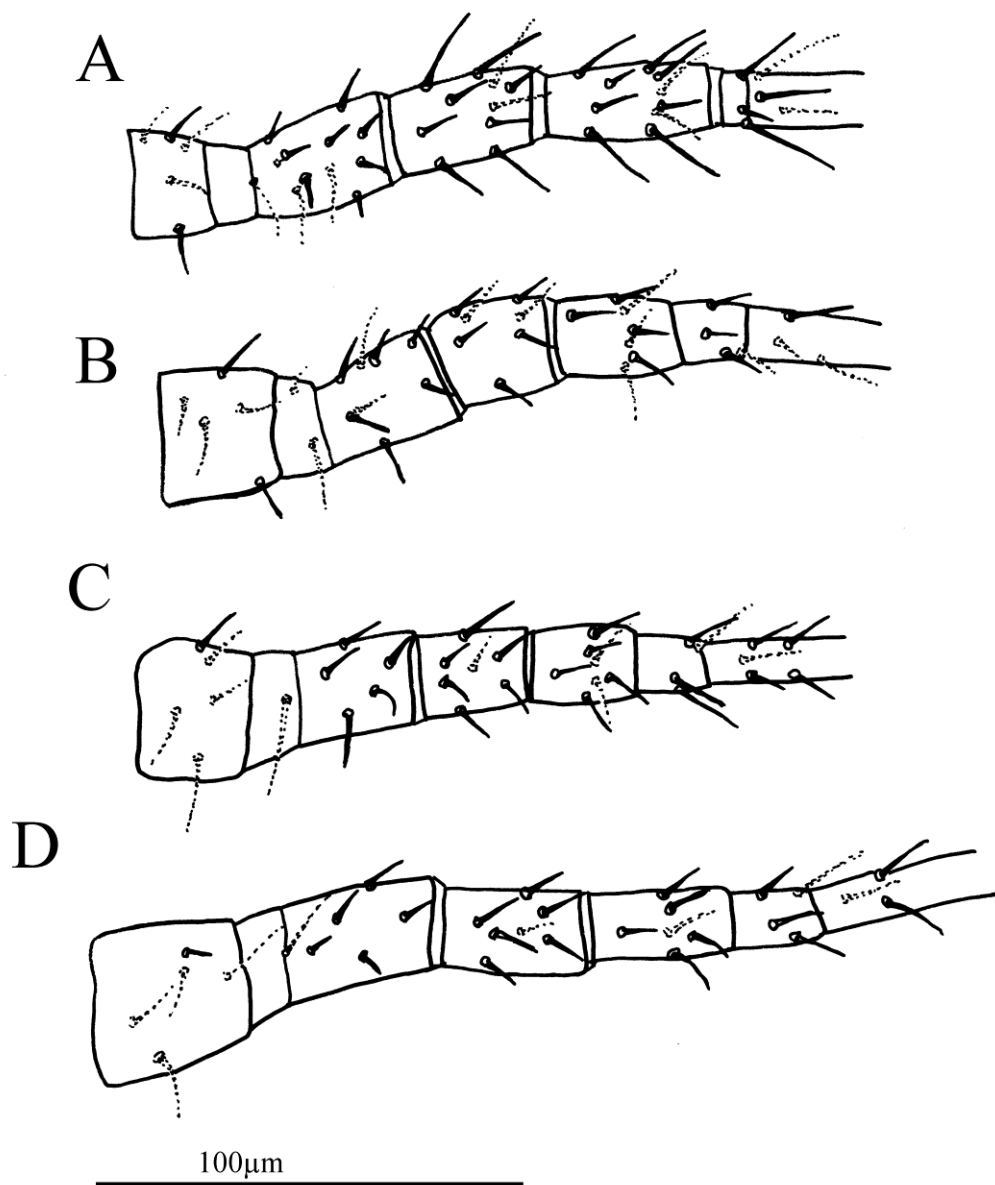


FIGURE 95. *Paraamblyseius formosanus* (Ehara, 1970), Male, A. leg I dorsal view, B. leg II posterior view, C. leg III dorsal view, D. leg IV dorsal view.

Genus *Phytoscutus* Muma, 1961

植盾蟎屬



Phytoscutus Muma, 1961: 275.

Phytoscutella Muma, 1961: 275. Type species - *Typhlodromus (Amblyseius) salebrosus* Chant, 1960b: 58.

Iphiseius (Trochoseius) Pritchard & Baker, 1962: 259. Type species - *Iphiseius (Trochoseius) gongylus* Pritchard & Baker, 1962: 304.

Amblyseius (Phytoscutella).—Ehara & Bhandhufalck, 1977: 73.

Trochoseius.—Matthysse & Denmark, 1981: 341.

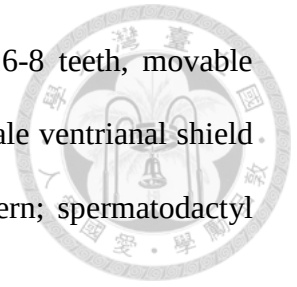
Amblyseius (Trochoseius).—Ueckermann & Loots, 1985: 129.

Type species - *Phytoscutus sexpilis* Muma, 1961: 275.

There are 14 valid species in this genus (Demite *et al.* 2019), characterized by seta *j5* absent. In addition, *P. bakeri* was described by male specimen (Gupta 1980).

Diagnosis – One podosomal setal pattern, P-9A, four opisthosomal setal pattern, 0-6E (setae *J2*, *S2*, *S4* absent), 0-7D (setae *J2*, *S2* absent), 0-8E (seta *J2* absent), 0-9B. Seta *ZV3* absent from most species and seta *JV4* absent from *P. eugenus*. Dorsal shield heavily sclerotized, reddish, or brownish. Dorsal setae *s4*, *Z4*, *Z5* always long, smooth, or slightly serrated, dorsocentral setae always short/minute, other setae short to medium. Sternal shield heavily sclerotized, wider than long, with or without reticulated. Genital shield heavily sclerotized, truncated posteriorly. Female ventrianal shield large, broad, heavily sclerotized, heavily reticulated, with 3 pair of preanal setae, *gv3* conspicuous. Peritreme usually extending to *j1* level, peritremal shield much larger, robust, with unique scalloped pattern. Spermatheca with atrium small, calyx cup-shaped, bell-shaped,

V-shaped, elongated, scular. Chelicera fixed digit usually with 6-8 teeth, movable digit with 3 teeth. Leg IV with 3 macrosetae. Ge II with 7 setae. Male ventrianal shield triangular, with 3 pair of preanal setae arranged in triangular pattern; spermatodactyl slender, wand-like, with heel apparently suppressed.



***Phytoscutus salebrosus* (Chant, 1960)**

粗糙植盾蟎



(Figures 96–99)

Typhlodromus (*Amblyseius*) *salebrosus* Chant, 1960: 58.

Phytoscutella salebrosus.—Muma, 1961: 275.

Amblyseius (*Amblyseius*) *salebrosus*.—Ehara, 1966: 23.

Phytoscutus taoi Lo, 1970: 49. (Synonymy according to Ehara & Bhandhufalck 1977).

Female (n=6)

A redish, robust, strongly sclerotized mite. Idiosomal setal pattern: 9A:8E/JV-3:ZV-3.

Dorsum. Dorsal shield strongly sclerotized, reddish or brownish in color, globular, strongly reticulated laterally; 421 (373–453) long (*j1*–*J5* level) and 395 (358–454) wide at level of *j6*, 377 (325–415) wide at level of *S4*; five pairs of solenostomes on dorsal shield, (*gd2*, *gd4*, *gd6*, *gd8*, *gd9*), twelve pairs of lyrifissures, (*id1*, *id1a*, *id2*, *id4*, *idm2*, *idm3*, *idm4*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 21 (18–23), *j3* 50 (43–57), *j4* 8 (6–12), *j6* 12 (8–16), *J5* 11 (8–14), *z2* 11 (8–14), *z4* 25 (14–35), *z5* 10 (7–13), *Z1* 15 (12–19), *Z4* 181 (170–198), *Z5* 209 (173–238), *s4* 124 (100–147), *S2* 64 (56–77), *S4* 15 (12–20), *S5* 15 (12–21), *r3* 16 (13–22), *R1* 14 (11–17). Setae *s4*, *S2*, *Z4*, *Z5* elongated, *j1*, *j3*, *j6*, *z2*, *z4*, *S4* longer, other minute. All setae smooth, except for *Z4* and *Z5* slightly serrated.

Peritreme. Peritreme extending to *j1* level; peritremal shield much enlarged posteriorly, with unique scalloped pattern, fused anteriorly with dorsal shield with one pair of solenostomes (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternal shield strongly sclerotized, much wider than long, with anterior margin depressed, posterior margin concave, 37 (33–45) long, 112 (104–119) wide, and

with three pairs of setae *st1* 24 (19–26), *st2* 22 (19–26), *st3* 23 (21–25), and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae II–IV. Metasternal platelets tear-shaped, with one pair of metasternal setae, *st4* 22 (20–24), with one pair of lyrifissures (*pst3*). Genital shield strongly sclerotized, much narrower than ventrianal shield 129 (122–137) wide at level of genital seta, *st5* 24 (21–28). Distances between *st1-st1* 47 (43–52), *st2-st2* 65 (62–72), *st3-st3* 92 (87–99), *st1-st3* 58 (53–62), *st5-st5* 97 (92–104). Ventrianal shield large, broad, strongly sclerotized, reticulated, with 184 (168–205) long, 227 (206–242) wide at level of ZV2, 195 (173–213) wide at level of anus; with four pairs of pre-anal setae, *JV1* 19 (16–21), *JV2* 17 (14–21), *ZV2* 17 (14–24), solenostome *gv3* small and rounded; *Pa* 17 (13–20), *Pst* 19 (14–22) on shield. Setae *JV4* 12 (10–15), *JV5* 33 (25–38), *ZV1* 16 (12–19) on interscutal membrane. All setae smooth. Two pairs of metapodal plates 25 (17–28) long, 10 (7–13) wide, 4 (3–5) long, 4 (3–5) wide.

Spermatheca. Calyx elongate, saccular, 15 (15–15) long, 4 (4–4) wide, small atrium connected to the calyx without neck, minor and major ducts visible.

Chelicera. Movable digit 22 (19–25) long, with two teeth; fixed digit 19 (17–21) long, anterior half with one tooth, posterior half with seven teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* III (ad2) 37 (36–38), *Sti* III (ad) 27 (25–31), *St* III (ad) 24 (23–25), *Sge* IV (ad2) 65 (60–71), *Sti* IV (ad) 46 (42–52), *St* IV (d) 39 (35–41).

Male (n=3)

A red, robust, strongly sclerotized mite. Idiosomal setal pattern: 9A:8E/JV-3,4:ZV-1,3.

Dorsum. Dorsal shield strongly sclerotized, reddish or brownish in color, globular, strongly reticulated laterally; 322 (315–330) long (*j1*–*J5* level) and 280 (254–311) wide at level of *j6*, 266 (240–303) wide at level of *S4*, five pairs of solenostomes on dorsal shield, (*gd2*, *gd4*, *gd6*, *gd8*, *gd9*), twelve pairs of lyrifissures, (*id1*, *id1a*, *id2*, *id4*, *idm2*, *idm3*, *idm4*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 14 (12–15), *j3* 36 (33–38), *j4* 8 (5–11), *j6* 16 (14–16), *J5* 9 (8–10), *z2* 20 (12–25), *z4* 18 (9–25), *z5* 8 (8–9), *Z4* 145 (133–154), *Z5* 190 (178–206), *s4* 107 (90–124), *S2* 61 (60–62), *S4* 17 (12–22), *S5* 14 (12–16), *r3* 19 (16–23), *R1* 15 (11–18). All setae smooth, except for *Z4* and *Z5* slightly serrated.

Peritreme. Peritreme extending to *j1* level; peritremal shield much enlarged posteriorly, with unique scalloped pattern.

Venter. Sternogenital shield strongly reticulate, posterior margin wide and straight, longer than wide, 134 (128–137) long, 99 (90–107) wide at level of *st3*, with five pairs of setae, *st1* 23 (21–25), *st2* 24 (20–27), *st3* 19 (18–20), *st4* 20 (18–21), *st5* 17 (16–18), three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Distances between *st1*–*st1* 48 (45–49), *st2*–*st2* 62 (54–66), *st3*–*st3* 73 (66–79), *st4*–*st4* 63 (59–67), *st5*–*st5* 55 (52–57), *st1*–*st5* 110 (109–112). Exopodal shield at coxae II–IV. Ventrianal shield subtriangular, strongly reticulated, 166 (162–174) long, 203 (195–216) wide at anterior corner, 139 (134–144) at level of anus, fused with peritremal shield cingulum; with three pairs of pre-anal setae, *JV1* 11 (11–12), *JV2* 16 (15–17), *ZV2* 13 (11–15), solenostomes *gv3* small and rounded; *Pa* 13 (12–14), *Pst* 17 (15–18) on shield. Setae *JV5* 23 (15–30) on interscutal membrane. All ventral setae smooth.

Chelicera. Movable digit 20 (20–20) long, with one tooth; fixed digit 19 (19–19) long, with eight teeth. Spermatodactyl L-shaped, shaft 15 (14–15) long, foot 11 (10–13) long.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* III (ad2) 27 (24–30), *Sti* III (ad) 20 (19–21), *St* III (ad) 16 (16–16), *Sge* IV (ad2) 47 (41–52), *Sti* IV (ad) 38 (37–38), *St* IV (d) 34 (30–42).

Specimens examined. CHINA: 5th branch of State Forestry Administration, Jianfengling National Forest Park, Ledong Li Autonomous County, Hainan Province, two females from *Citrus* sp. (Rutaceae), 17.x.1980, W. N. Wu (GIBAR); Chebaling National Nature Reserve, Shaoguan City, Guangdong Province, one female from Lauraceae plant, 26.iv.1991, W. N. Wu (GIBAR); Xinglong town, Wanning City, Hainan Province, three females from unknown plant, v.1988, W. N. Wu (GIBAR); Chebaling National Nature Reserve, Shaoguan City, Guangdong Province, two females from shrub, 24.iv.1991, W. N. Wu (GIBAR); Bawangling National Forest Park, Changjiang Li Autonomous County, Hainan Province, one female from fern, 23.vi.1987, W. N. Wu (GIBAR); Chebaling National Nature Reserve, Shaoguan City, Guangdong Province, two females from Lauraceae plant, 24.iv.1991, W. N. Wu (GIBAR).

TAIWAN: Muzha, Taipei City, five females (1 holotype and 4 paratypes of *A. taoi*, no. 0935) from *Citrus* sp. (Rutaceae), 28.xi.1967, P. K. C. Lo (TARI); Wufengqi, Jiaoxi Township, Yilan County (24°49.900' N, 121°44.837' E, 108m), one male (no. 680–2) from *Melastoma candidum* (Melastomataceae), 16.vii.2010, J. R. Liao & M. C. Chiu (NTU); Mt. Lala, Fuhsing Dist., Taoyuan City (24°40.515' N, 121°24.001' E, 881m), one female (no. 823–11) from *Morus* sp. (Moraceae), 28.viii.2010, J. R. Liao & J. F. Hsieh (NTU); Mt. Shitou, Sanwan Township, Miaoli County (24°39.277' N, 121°01.539' E, 595m), one female (no. 896–3) from *Litsea* sp. (Lauraceae), 13.x.2010, J. R. Liao (NTU); Zengwen Reservoir, Dapu Township, Chayi County, one female from

Liquidambar formosana (Altingiaceae), 11.i.2011, J. R. Liao (NTU).

Distribution. Asia: China (Hainan (Wu *et al.* 1997)), India (Gupta 1987), Malaysia (Ehara 2002a), Philippines (Corpuz-Raros & Garcia 1994), Taiwan (Lo 1970), Thailand (Ehara & Bhandhufalck 1977).

Remarks. Chant (1960a) described this species from *Citrus* sp. from India, and provided descriptions and illustration. Lo (1970) described a species *Amblyseius taoi* from *Citrus* sp. in Mushan, Taiepi (now Muzha, Wenshan Dist., Taipei City). Ehara & Bhandhufalck (1977) proposed *A. taoi* is junior synonym of *A. salebrosus*. The present study examined the type specimens of *A. taoi* (deposited in TARI), and confirmed this synonym. In addition, the illustration of male spermatodactyl disagree with Gupta (1986).



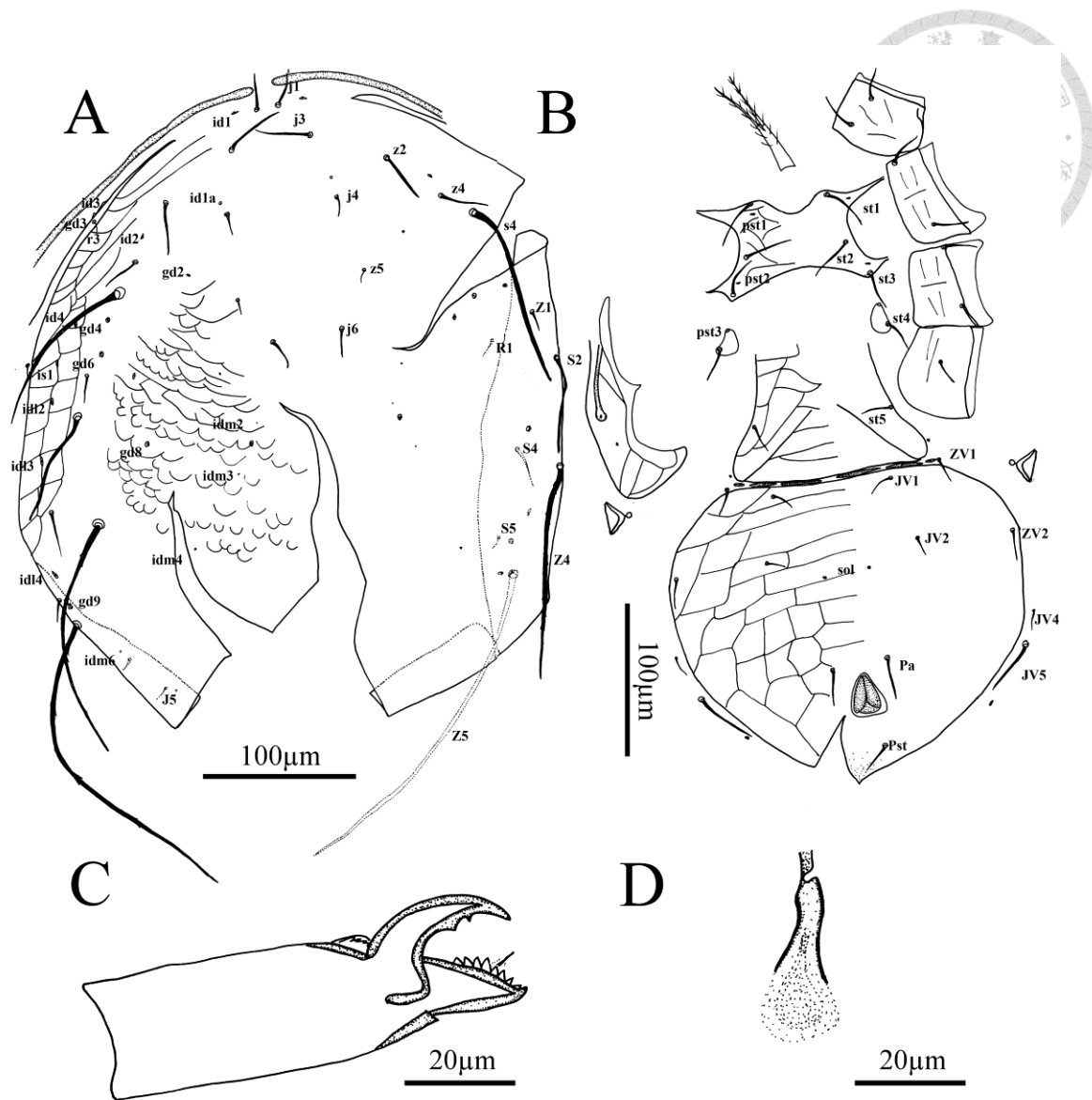


FIGURE 96. *Phytoscutus salebrosus* (Chant, 1960), Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

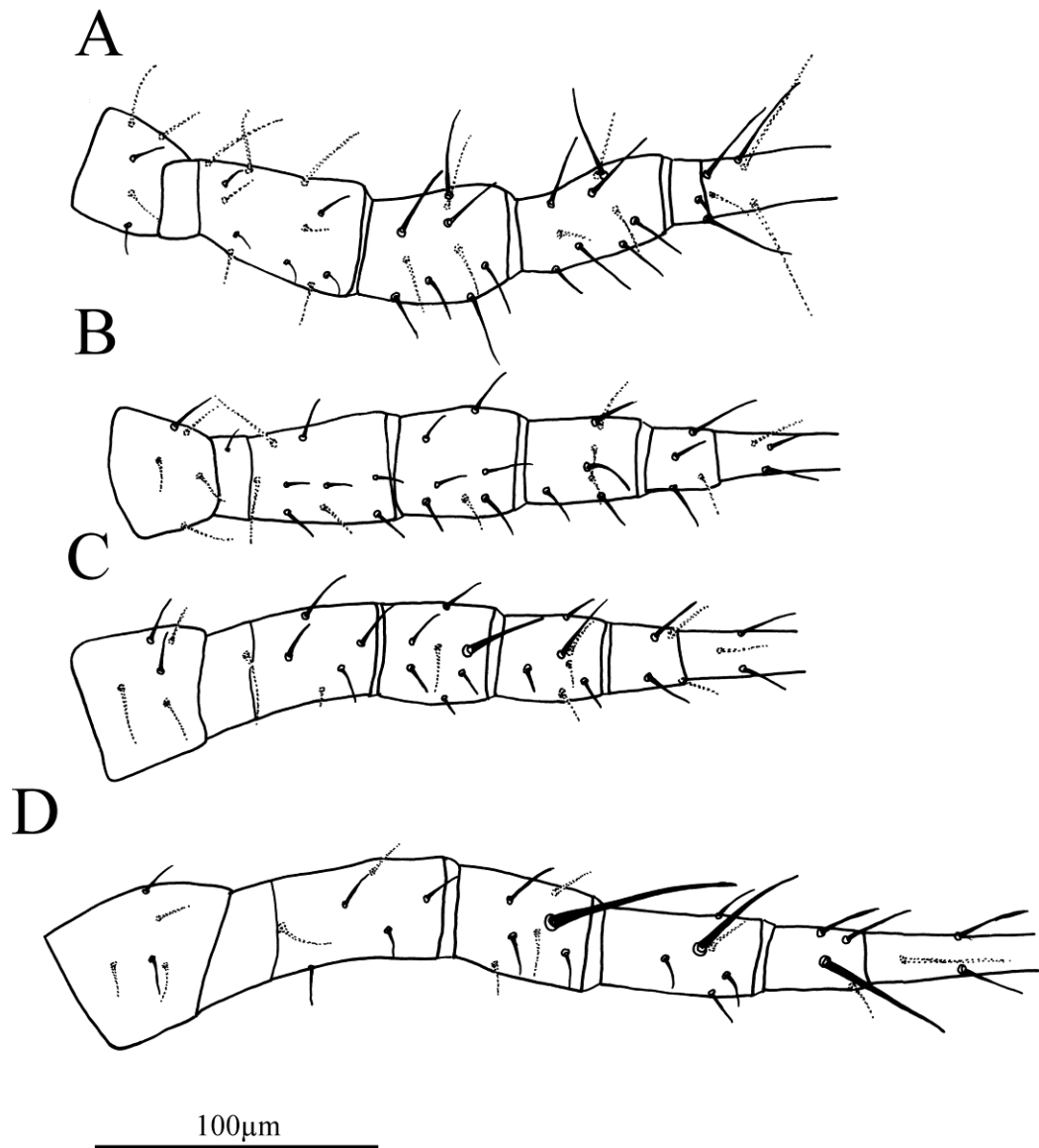


FIGURE 97. *Phytoscutus salebrosus* (Chant, 1960), Female, legs A. leg I anterior view, B. leg II anterodorsal view, C. leg III dorsal view, D. leg IV dorsal view.

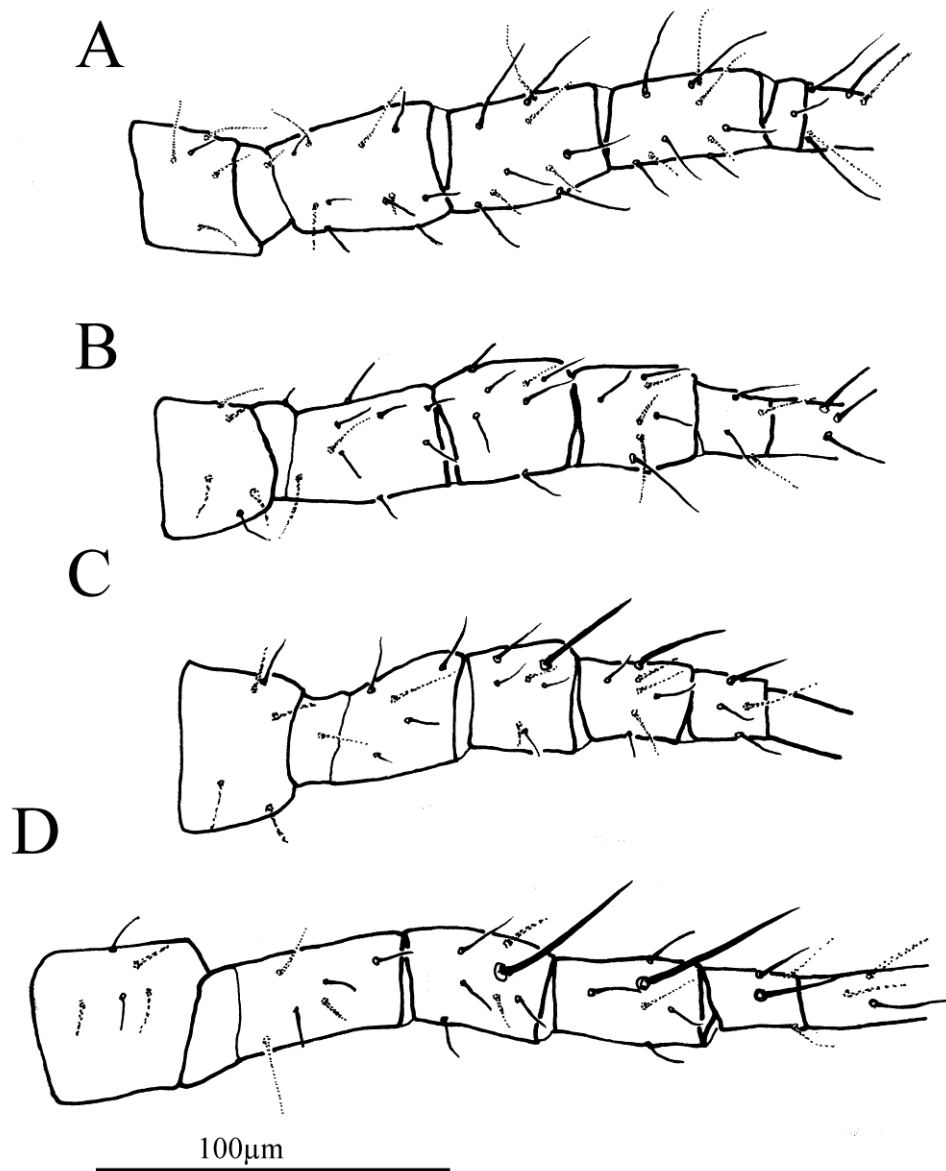


FIGURE 99. *Phytoscutus salebrosus* (Chant, 1960), Male, legs A. leg I anterior view, B. leg II dorsal view, C. leg III posterior view, D. leg IV dorsal view.

Subtribe Proprioseiopsina Chant & McMurtry, 2004a

似前鋸綏蟎亞族



Proprioseiopsina Chant & McMurtry, 2004a: 219.

Type genus - *Proprioseiopsis* Muma, 1961: 277.

This subtribe is characterized by seta *J2* absent and seta *j5* present (except *Flagroseius euflagellatus*). Five genera belong to this subtribe, *Flagroseius* Karg, *Proprioseiopsis* Muma, *Proprioseiulus* Muma & Denmark, *Swirskiseius* Denmark & Evans, *Tenorioseius* Wainstein.

Genus *Proprioseiopsis* Murna, 1959b

似前鋸綏蟎屬

sandersi group Chant, 1959b: 102.

Proprioseiopsis Muma, 1961: 277.

Phytoseiulella Muma, 1961: 276. Type species - *Iphiseius grovesae* Chant, 1959b: 110.

(Synonymy according to Chant & McMurtry 2005a)

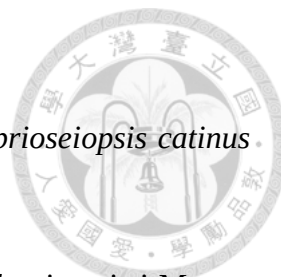
Amblyseiulus Muma, 1961: 278. Type species - *Typhlodromus* (*Amblyseius*) *okanagensis* Chant, 1957a: 293.

Amblyseius (*Pavlovskius*) Wainstein, 1962: 12. Type species - *Typhlodromus* (*Amblyseius*) *terrestris* Chant, 1959b: 108.

Amblyseius (*Skironodromus*) Wainstein, 1962: 12. Type species - *Typhlodromus* (*Amblyseius*) *sandersi* Chant, 1959b: 102.

Amblyseius (*Proprioseiopsis*). —van der Merwe, 1968: 161.

Iphiseius (*Phytoseiulella*). —van der Merwe, 1968: 109.



Proprioseiopsis (*Amblyseiulus*). —Karg, 1983: 303.

Proprioseiopsis (*Patinoseius*) Karg, 1983: 303. Type species - *Proprioseiopsis catinus*.

Karg, 1976: 521.

Proprioseiopsis (*Tuboseius*) Karg, 1983: 303. Type species - *Amblyseius citri* Muma, 1962: 1.

Proprioseiopsis (*Proprioseiopsis*) s.str. Karg, 1983: 303. Type species - *Typhlodromus* (*Amblyseius*) *terrestris* Chant, 1959b: 108.

Proprioseiopsis (*Skironodromus*). —Karg, 1983: 302.

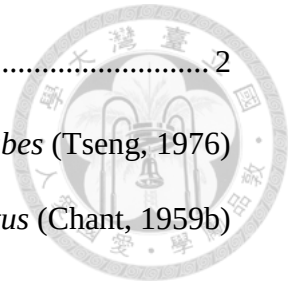
Type species - *Typhlodromus* (*Amblyseius*) *terrestris* Chant, 1959b: 108.

Diagnosis – Idiosomal pattern 10A:8E/JV-3:ZV. Dorsal shield lightly to strongly sclerotized. Dorsal setae s4, Z4, Z5 from moderate to elongated in length, z2, z4, Z1, S2, S4, S5 and dorsocentral setae short/minute. Sternal shield smooth to heavily reticulated, posterior margin concave or straight. Genital shield truncated posteriorly. Female ventrianal shield pentagonal, sometimes with slightly waist, with 3 pair of preanal setae, gv3 conspicuous. Peritreme usually extending to j1 level, ectal strip present on about 20 percent of species. Spermatheca variable. Chelicera fixed digit multidentate about 50 percent species, remaining few teeth. Leg IV with 3 macrosetae. Ge II with 7 setae. Male ventrianal shield triangular, with 3 pair of preanal setae in a triangular pattern, spermatodactyl T-shaped, heel-and-toe variant, or wand-like with both the heel and the toe suppressed.

Key to the species in the genus *Proprioseiopsis* from Taiwan

1. Spermatheca calyx bell-shaped *ovatus* (Garman, 1958)

- Spermatheca calyx not bell-shaped 2
- 2. Spermatheca calyx tubular *pubes* (Tseng, 1976)
- Spermatheca calyx disc-shaped..... *asetus* (Chant, 1959b)



***Proprioseiopsis asetus* (Chant, 1959b)**

少毛鈍綏蟎



(Figures 100–101)

Typhlodromus (*Amblyseius*) *asetus* Chant, 1959b: 80.

Amblyseiulus asetus.—Muma, 1961: 278.

Typhlodromus asetus.—Hirschmann, 1962: 18.

Amblyseius asetus.—Schuster & Pritchard, 1963: 243.

Amblyseius (*Amblyseius*) *asetus*.—Tseng, 1983: 40.

Amblyseius (*Proprioseiopsis*) *asetus*.—Wainstein, 1983: 194.

Proprioseiopsis (*Patinoseius*) *asetus*.—Karg, 1989b: 210.

Female (n=10)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:8E/JV-3:ZV,.

Dorsum. Dorsal shield smooth, anteriorlaterlly reticulated; 370 (337–423) long (*j1*–*J5* level) and 239 (219–280) wide at level of *j6*, 228 (194–273) wide at level of *S4*; seven pairs of solenostomes on dorsal shield, (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), fifteen pairs of lyrifissures, (*id1*, *id2*, *id4*, *id6*, *idm1*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *idx*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 19 (13–23), *j3* 31 (24–36), *j4* 6 (5–7), *j5* 6 (4–9), *j6* 6 (4–7), *J5* 7 (6–8), *z2* 11 (5–15), *z4* 9 (6–11), *z5* 7 (4–11), *Z1* 8 (5–11), *Z4* 79 (66–88), *Z5* 112 (105–122), *s4* 62 (55–69), *S2* 9 (7–12), *S4* 8 (6–11), *S5* 8 (6–10), *r3* 12 (9–15), *R1* 9 (7–13). All setae smooth, except for *Z4* and *Z5* slightly serrated.

Peritreme. Peritreme extending to *j1* level; peritremal shield with one pair of solenostomes (*gd3*), with one pair of lyrifissures (*id3*).

Venter. Sternal shield reticulated, much wider than long, posterior margin concave, 66 (62–71) long, 94 (86–102) wide, and with three pairs of setae *st1* 20 (16–25), *st2* 19 (12–26), *st3* 18 (15–22), and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at

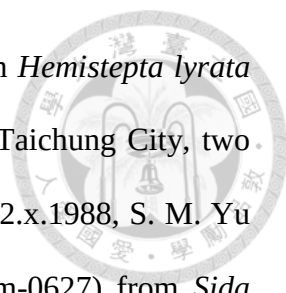
coxae II–IV. Metasternal platelets tear-shaped, with one pair of metasternal setae, *st4* 16 (11–21), with one pair of lyrifissures (*pst3*). Genital shield reticulated, posteriorly truncate, close to ventrianal shield, 81 (71–85) wide at level of genital seta, *st5* 16 (13–20). Distances between *st1-st1* 54 (48–61), *st2-st2* 68 (63–73), *st3-st3* 74 (69–79), *st1-st3* 64 (55–68), *st5-st5* 69 (64–75). Ventrianal shield pentagonal, reticulated, 116 (108–128) long, 95 (89–101) wide at level of ZV2, 71 (63–78) wide at level of anus; with four pairs of pre-anal setae, *JV1* 13 (8–15), *JV2* 12 (10–14), *ZV2* 12 (10–15), *Pa* 10 (8–14), *Pst* 9 10 (8–12) on shield. Setae *JV4* 11 (8–13), *JV5* 67 (52–79), *ZV1* 11 (9–15), *ZV3* 10 (8–12) on interscutal membrane. All setae smooth. Two pairs of metapodal plates 25 (19–30) long, 5 (3–6) wide, 11 (5–15) long, 2 (1–3) wide.

Spermatheca. Calyx disc-shaped, 3 (2–4) long, 10 (8–12) wide, small atrium connected to the calyx without neck, minor and major ducts visible.

Chelicera. Movable digit 30 (25–35) long, with one tooth; fixed digit 29 (25–34) long, anterior half with two teeth, posterior half with seven teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* I (ad1) 21 (21–21), *Sge* II (pd2) 32 (32–32), *Sge* III (ad2) 26 (25–27), *Sge* IV (ad2) 53 (45–60), *Sti* IV (ad) 33 (24–39), *St* IV (d) 64 (56–73).

Specimens examined. TAIWAN: Wanfeng Village, Wufeng Dist., Taichung City, one female from Rice leaf sheath *Oryza sativa* (Poaceae), 4.viii.1977, P. K. C. Lo (TARL); Luye Township, Taitung County, one female (87-0377) from *Camellia sinensis* (Theaceae), 14.iv.1987, C. C. Ho (TARL); Chuxiang, Lugu Township, Nantou County, two females from *Alternanthera nodiflora* (Amaranthaceae), 13.xi.1987, C. C.

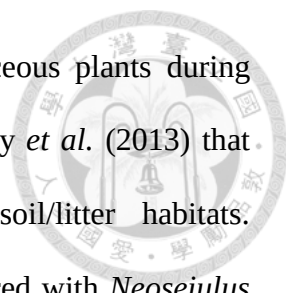


Ho (TARL); TARI, Wufeng Dist., Taichung City, two females from *Hemistepta lyrata* (Asteraceae), 27.x.1988, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, two females (88-Am-0628, 29) from *Tridax procumbens* (Asteraceae), 12.x.1988, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, one female (88-Am-0627) from *Sida rhombifolia* (Malvaceae), 12.x.1988, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, one female (88-Am-0626) from *Emilia sonchifolia* (Asteraceae), 17.x.1988, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, two females (88-Am-0940) from *Allium fistulosum* (Amaryllidaceae), 24.x.1988, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, one female from *Zingiber officinale* (Zingiberaceae), 2.xi.1988, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, one female (88-Am-0625) from *Camellia sinensis*, (Theaceae), 2.xi.1988, S. M. Yu; TARI, Wufeng Dist., Taichung City, two females (88-Am-0652) from *Ipomoea acuminata* (Convolvulaceae), 24.xi.1988, S. M. Yu (TARL); Ludao Township, Taitung County, eight females (88-Am-1251, 53, 68, 71, 72, 73, 74, 75) from *Leucadendron leucocephala* (Proteaceae), 3.vi.1989, C. C. Ho (TARL); TARI, Wufeng Dist., Taichung City, one female (TAL080B023) from *Solanum melongena* (Solanaceae), 4.vi.1991, C. C. Ho (TARL); Yangshan, Chinsha Township, Kinmen County, one female (TAL091C067) from soil, 23.iv.2002, C. C. Ho (TARL); Xinfeng Township, Hsinchu County, eight females (TAL091S165, 66, 73, 75, 76, 77, 78, 80) from *Cuscuta austras* (Convolvulaceae), 23.ix.2002, C. C. Ho (TARL); Chian Township, Hualian County, one female (TAL091H097) from *Michelia compressa* (Magnoliaceae) tree soil, 2.x.2002, C. C. Ho (TARL); Xianda, Kinmen County, one female (TAL091C166) from grass soil, 25.x.2002, C. C. Ho (TARL); Shicheng, Tungshih Dist., Taichung City, four females (TAL092G559, 60, 61, 64) from soil, 24.xi.2003, C. C. Ho (TARL); Wanlong, Xinpi Township, Pingtung County, one female (TAL092D0783) from soil of *Saccharum*

sinensis (Poaceae), 22.iv.2003, C. C. Ho (TARL); Xihu Township, Changhua County, one female from *Vitis vinifera* (Vitaceae), Jean Hsu, 20.iv.2014 (NTU); TARI, Wufeng Dist, Taichung City, one female from *Cucumis melo* (Cucurbitaceae), 1.v.2015, Y. J. Chen (TARI); TARI, Wufeng district, Taichung city, two female from *Zea mays* (Poaceae), 2.vi.2015, Y. J. Chen (TARI).

Distribution. Asia: Saudi Arabia (Negm *et al.* 2012), Taiwan (Tseng 1983), United Arab Emirates (Negm 2014). Central America: Nicaragua (Rodriguez-Morell *et al.* 2013). North America: Cuba (Ramos & Rodriguez 1999), Jamaica (Denmark & Muma 1978), Mexico (Estebanes-Gonzalez & Rodriguez-Navarro 1998), USA (Chant 1959b). Oceania: Hawaii (Wainstein 1983). South America: Brazil (Denmark & Muma 1973).

Remarks. Chant (1959b) described this species from apple in West Virginia. No male information until Muma & Denmark (1970) described both sexes based on Florida specimens. Tseng (1983) reported this species in Taiwan. Denmark & Evans (2011) proposed 10 new synonyms, including *Prop. asetus* as junior synonym of *Prop. mexicanus*. Although no significant morphological difference between *Prop. asetus* and *Prop. mexicanus* were found, the present study disagrees with this synonym, it should be reapproached due to different lifestyles. Ho & Chen (2001) studied the life history of *Prop. asetus* in Taiwan, and proposed the species was apparently thelytokous parthenogenesis due to the lacking of male individuals in laboratory colony, and also no male specimens during field survey. Wu *et al.* (2009) also proposed *Prop. asetus* is thelytokous parthenogenesis in China. However, *Prop. mexicanus* and also some *Prop. asetus* populations were described with both male and female sexes. Two hypotheses were proposed: 1. *Prop. mexicanus* (in U.S.A.) and *Prop. asetus* (in China and Taiwan) are two different species. 2. the mites will show different life histories in different localities (parthenogenesis in China and Taiwan).



The specimens of this species were found on soil or herbaceous plants during survey. This is consistent with the lifestyle hypothesis of McMurtry *et al.* (2013) that some *Proprioseiopsis* species are generalist predator from soil/litter habitats. Additionally, one specimen was collected from grape leaf, discovered with *Neoseiulus barkeri* at the same time and preyed Kanzawa spider mite (*Tetranychus kanzawai*). Y. J. Chen (TARI) also found the mite population feed on thrips from *Cucumis melo* and *Zea mays*. Ho & Chen (2001) proposed the mites had potential to become better biological control agent for thrip pests than well-known predators, such as *Neoseiulus cucumeris*.

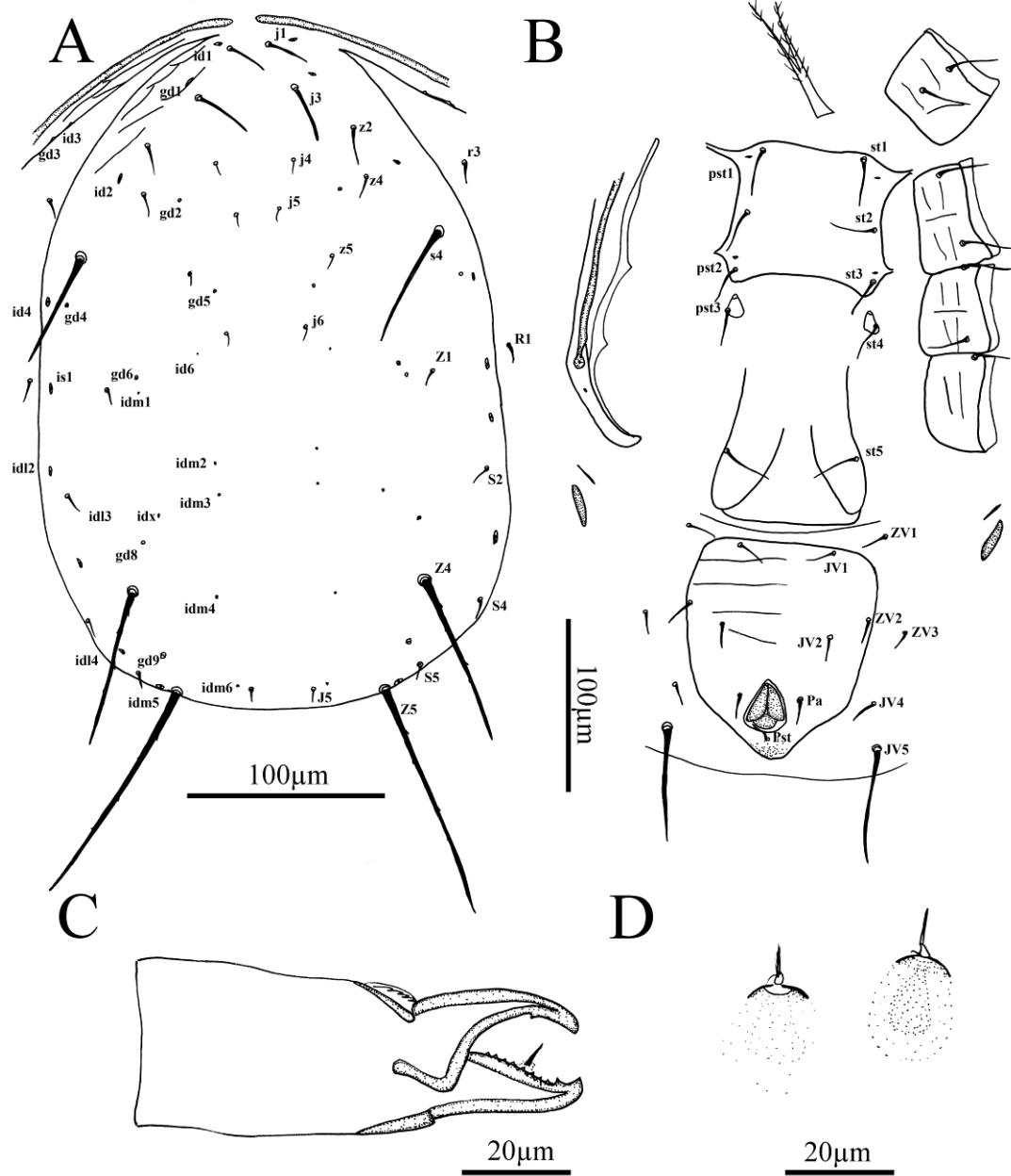


FIGURE 100. *Proprioseiopsis asetus* (Chant, 1959b), Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

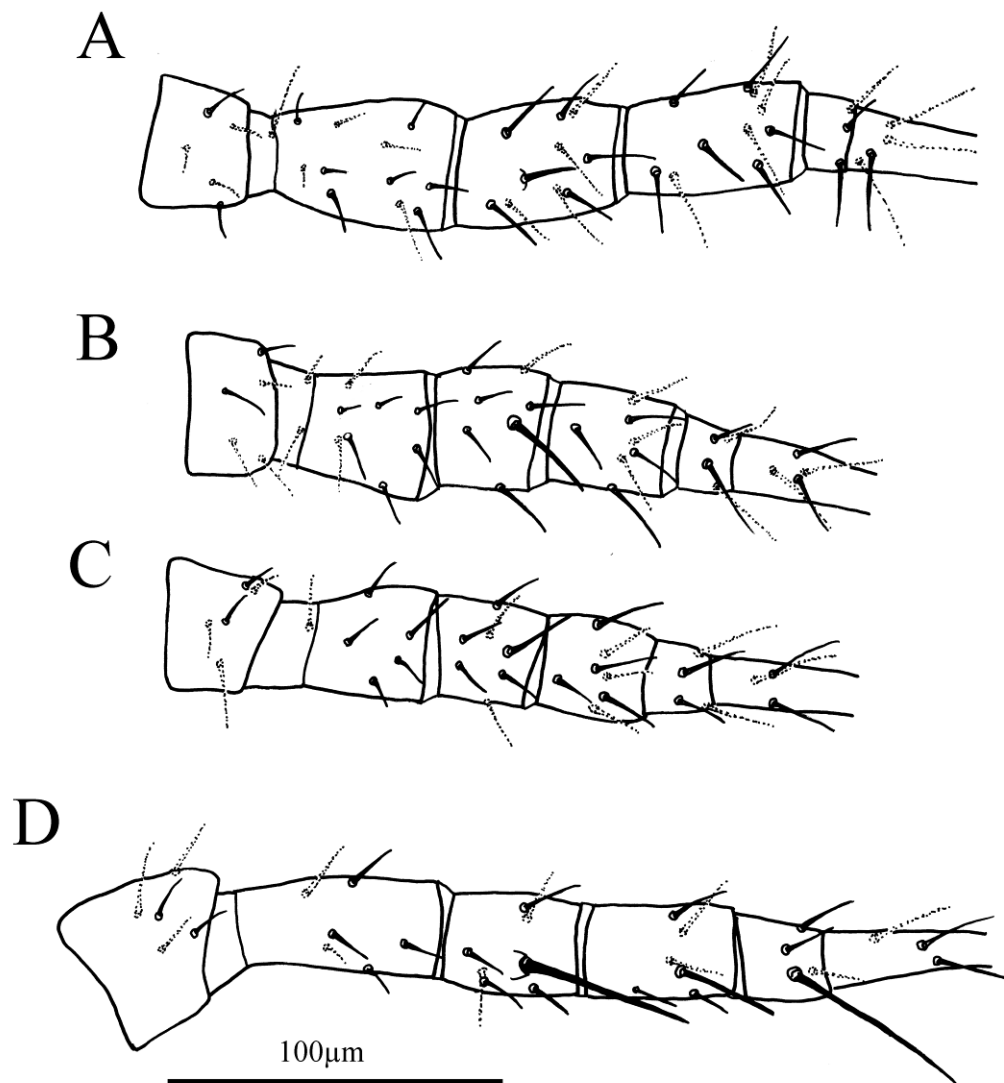


FIGURE 101. *Proprioiseiopsis asetus* (Chant, 1959b), Female, legs A. leg I anterior view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV anterior view.

***Proprioseiopsis ovatus* (Garman, 1958)**

卵圓鈍綏蟎



(Figures 102–103)

Amblyseiopsis ovatus Garman, 1958: 78.

Typhlodromus (*Amblyseius*) *ovatus*.—Chant, 1959b: 90.

Amblyseiulus ovatus.—Muma, 1961: 278.

Typhlodromus ovatus.—Hirschmann, 1962: 19.

Amblyseius ovatus.—Schuster & Pritchard, 1963: 246.

Amblyseius (*Amblyseius*) *ovatus*.—Tseng, 1983: 40.

Proprioseiopsis antonelli Congdon, 2002: 15. (Synonymy according to Denmark & Evans 2011)

Proprioseiopsis cannaensis (Muma, 1962): 4. (Synonymy according to Denmark & Evans 2011)

Proprioseiopsis hudsonianus (Chant & Hansell, 1971): 723. (Synonymy according to Denmark & Evans 2011)

Proprioseiopsis parapeltatus (Wu & Chou, 1981): 274. (Synonymy according to Tseng 1983)

Proprioseiopsis peltatus (van der Merwe, 1968): 119. (Synonymy according to Tseng 1983)

Female (n=3)

A strongly sclerotized mite. Idiosomal setal pattern: 10A:8E/JV-3:ZV,.

Dorsum. Dorsal shield strongly sclerotized , laterally reticulated; 348 (308–400) long (*j1*–*J5* level) and 287 (247–307) wide at level of *j6*, 284 (256–316) wide at level of *S4*; seven pairs of solenostomes on dorsal shield, (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), fifteen pairs of lyrifissures, (*id1*, *id1a*, *id2*, *id4*, *id6*, *idm1*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*,

is1, *idl2*, *idl3*, *idl4*); length of setae: *j1* 26 (25–29), *j3* 58 (48–65), *j4* 7 (5–8), *j5* 7 (6–9), *j6* 5 (4–7), *J5* 8 (7–8), *z2* 29 (29–30), *z4* 12 (11–14), *z5* 6 (4–7), *Z1* 15 (12–18), *Z4* 112 (98–120), *Z5* 104 (97–113), *s4* 68 (65–71), *S2* 14 (11–16), *S4* 14 (12–17), *S5* 13 (11–14), *r3* 20 (18–21), *R1* 13 (12–15). Setae *j1*, *j3*, *s4*, *Z4*, *Z5* elongated. All setae smooth, except for *Z4* and *Z5* slightly serrated.

Peritreme. Peritreme extending to *j1* level; peritremal shield much enlarged posteriorly, ectal strip present, fused anteriorly with dorsal shield with one pair of solenostomes (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternal shield strongly sclerotized, reticulated, much wider than long, posterior margin concave, 51 (44–59) long, 114 (103–123) wide, and with three pairs of setae *st1* 34 (30–38), *st2* 32 (27–39), *st3* 27 (24–30), and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae II–IV. Metasternal platelets tear-shaped, with one pair of metasternal setae, *st4* 27 (21–32), with one pair of lyrifissures (*pst3*). Genital shield strongly sclerotized, about same width as ventrianal shield, reticulated, posteriorly truncate, close to ventrianal shield, 107 (91–116) wide at level of genital seta, *st5* 28 (22–34). Distances between *st1-st1* 48 (45–53), *st2-st2* 69 (61–75), *st3-st3* 88 (75–96), *st1-st3* 56 (50–60), *st5-st5* 93 (82–107). Ventrianal shield strongly sclerotized, pentagonal, reticulated, 107 (93–115) long, 107 (99–114) wide at level of ZV2, 79 (69–93) wide at level of anus; with four pairs of pre-anal setae, *JV1* 21 (12–26), *JV2* 21 (16–25), *ZV2* 21 (12–29), solenostome *gv3* crescentic, *Pa* 14 (13–15), *Pst* 13 (12–15) on shield. Setae *JV4* 14 (10–17), *JV5* 76 (66–84), *ZV1* 18 (13–22), *ZV3* 11 (10–12) on interscutal membrane. All setae smooth. Two pairs of metapodal plates 28 (25–31) long, 5 (4–6) wide, 11 (9–13) long, 4 (3–6) wide.

Spermatheca. Calyx elongate, saccular, 15 (14–16) long, 7 (6–8) wide, small atrium connected to the calyx without neck, minor and major ducts visible.

Chelicera. Movable digit 31 (27–36) long, with one tooth; fixed digit 31 (30–34) long, anterior half with two teeth, posterior half with one tooth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/2-1, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1. Macrosetae: *Sge* III (ad2) 34 (31–37), *Sti* III (ad) 25 (25–26), *St* III (ad) 24 (24–24), *Sge* IV (ad2) 55 (45–63), *Sti* IV (ad) 40 (39–42), *St* IV (d) 72 (62–83).

Specimens examined. Zhongliao Township, Nantou County, one female from Poaceae plant (Poaceae), 26.ix.1985, C. C. Ho (TARL); Yuli Township, Hualien County, one female from *Arachis hypogaea* (Fabaceae), 19.vi.1986, C. C. Ho (TARL); Yuli Township, Hualien county, one female from *Oxalis corymbosa* (Oxalidaceae), 17.vi.1986, C. C. Ho (TARL); Xinshi Dist., Tainan City, two female from *Ageratum conyzoides* (Asteraceae), 25.xi.1986, C. C. Ho (TARL); Xinshi district, Tainan city, one female from *Hemistepta lyrata* (Asteraceae), 25.xi.1986, C. C. Ho (TARL); Chuxiang, Lugu Township, Nantou County, two females from *Alternanthera nodiflora* (Amaranthaceae), 13.xi.1987, C. C. Ho (TARL); Chuxiang, Lugu Township, Nantou County, two females from *Ageratum houstonianum* (Asteraceae), 13.xi.1987, C. C. Ho (TARL); Meishan Township, Chiayi County, two females from *Centella asiatica* (Apiaceae), 29.v.1998, C. C. Ho (TARI); Tangkungpei, Huisun Timberland, Ren'ai Township, Nantou County, one female from soil, 16.xii.2005, S. L. Lin (TARI); Sandimen Township, Pingtung County, one female from *Lantana camara* (Verbenaceae), 13.vi.201, J. R. Liao & Y. H. Chaing (NTU).

Distribution. Africa: Egypt (Zaher 1986), Ghana (Moraes *et al.* 2007a), Mozambique (Moraes *et al.* 2007a), Sierra Leone (Moraes *et al.* 2007a), South Africa (Moraes *et al.* 2007a). Asia: Japan (Ohno *et al.* 2012), Malaysia (Ehara 2006),

Philippines (Moraes *et al.* 1989b), Saudi Arabia (Alatawi *et al.* 2017; Negm *et al.* 2012), Sri Lanka (Moraes *et al.* 2004b), Taiwan (Tseng 1983), Turkey (Döker *et al.* 2016). Central America: Costa Rica (Chant & Baker 1965), Honduras (Chant & Baker 1965), Puerto Rico (Denmark & Muma 1975), Europe: Spain (Faraji *et al.* 2008). North America: Cuba (Ramos 1991), USA (Schuster & Pritchard 1963). Oceania: Hawaii (Prasad 1968b). South America: Argentina (Guanilo *et al.* 2008a), Brazil (Gondim Jr. & Moraes 2001), Colombia: (Zuluaga 1971), Ecuador: (Garman 1958), Peru: (Guanilo *et al.* 2008c), Venezuela: (Quirós *et al.* 2005).

Remarks. Garman (1958) reported this species only provided few measurements, but it should be noticed that the setae Z4 longer than Z5 based on illustration, the ratio ca. 1.0:0.75. The present study found setae Z4 only a little shorter than Z5. Besides, Garman (1958) described that the ventrianal shield wider than genital shield based on illustration, but the present study found the genital shield slightly wider than ventrianal shield. This species differs to another two *Prioprioseiopsis* species by sclerotized level on dorsal shield. Tseng (1983) recorded the *Prop. ovatus* at weeds. The habitat plant he described should be some kind of herbaceous plant. The species were collected from different counties in Taiwan, but few specimens. We assume real habitat of the species do not be found. The species may occur in soil based on the genus *Proprioseiopsis* lifestyle proposed by McMurtry *et al.* (2013).

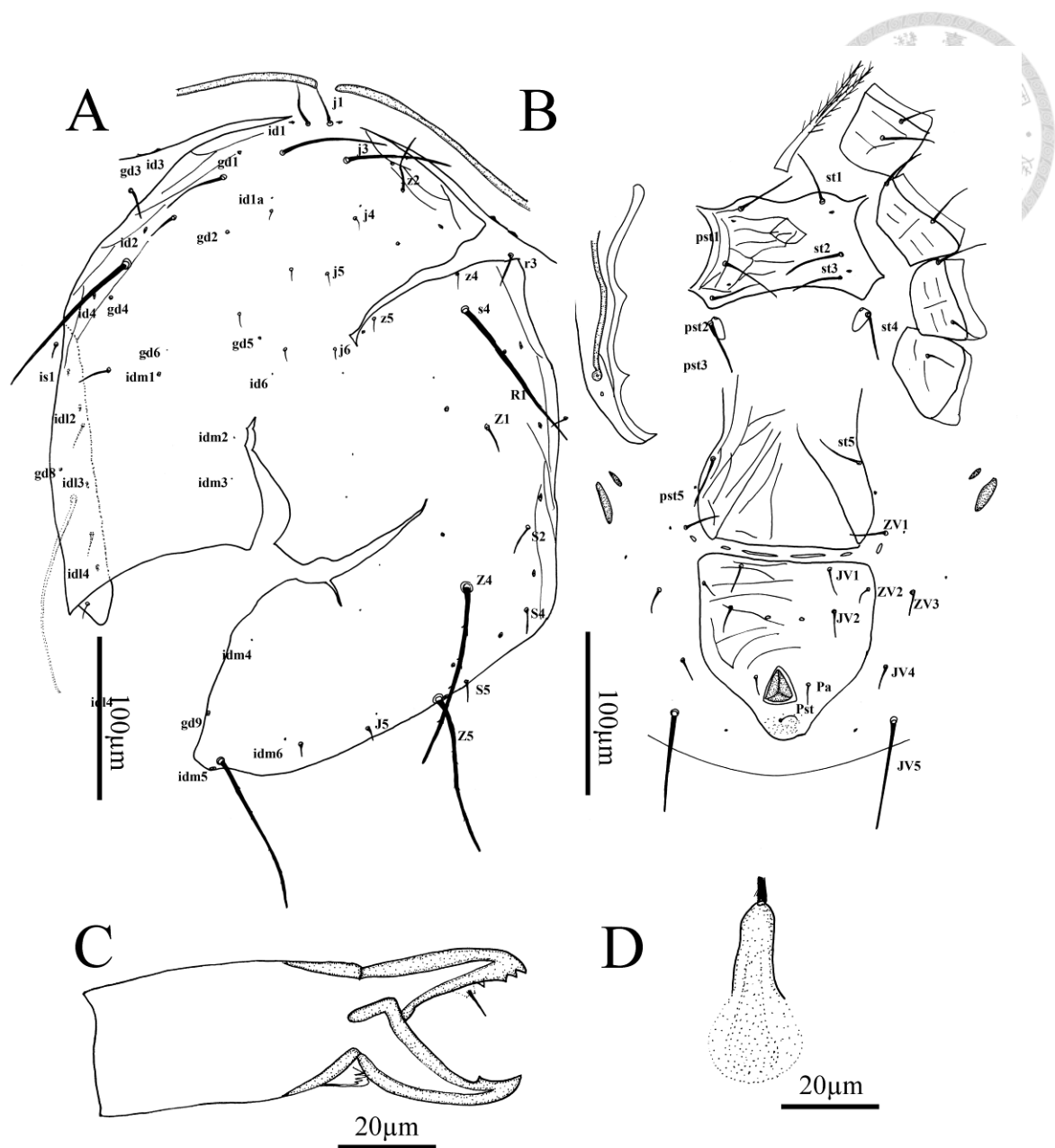


FIGURE 102. *Proprioseiopsis ovatus* (Garman, 1958), Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

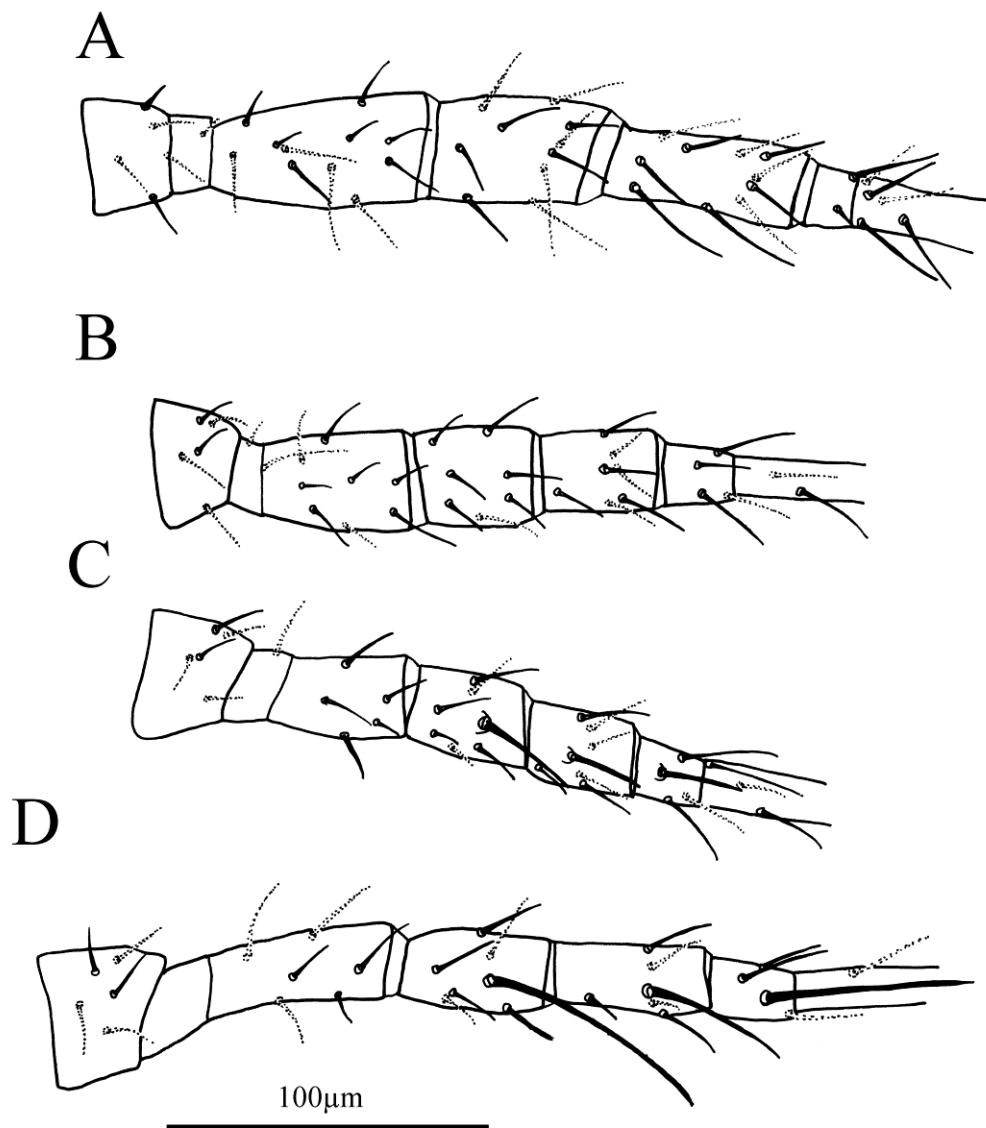


FIGURE 103. *Proprioiseiopsis ovatus* (Garman, 1958), Female, legs A. leg I dorsal view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV anterior view.

Proprioseiopsis pubes (Tseng, 1976)

柔毛鈍綏蟎



(Figure 104)

Amblyseius (Amblyseius) pubes Tseng, 1976: 117.

Female

A lightly sclerotized mite. Idiosomal setal pattern: 10A:8E/JV-3:ZV,.

Dorsum. Dorsal shield smooth; 353 long and 235.2 wide; length of setae: *j1* 20, *j3* 30, *j4* 5, *j5* 5, *j6* ?, *J5* ?, *z2* 15, *z4* 13, *z5* 5, *Z4* 75, *Z5* 100, *s4* 55, *S2* 12, *S4* 8, *S5* ?, *r3* 12.5, *R1* 12.5. All setae smooth.

Peritreme. Peritreme extending to *j1* level.

Venter. Sternal shield smooth, much wider than long, posterior margin concave, and with three pairs of setae *st1*, *st2*, *st3*. Metasternal platelets tear-shaped, with one pair of metasternal setae. Genital shield smooth, with one pair of genital seta, *st5*. Ventrianal shield pentagonal, reticulated, 110 long, 100 wide; with three pairs of pre-anal setae, *JV1*, *JV2*, *ZV2*, with a pair of pores; *Pa*, *Pst* on shield. Setae *JV4*, *JV5* 75, *ZV1*, *ZV3* on interscutal membrane. All setae smooth. Two pairs of metapodal plates 22.5 long, 7.5 wide, 7.5 long, 2.5 wide.

Spermatheca. Calyx longer than wide, tube-shaped.

Chelicera. Movable digit with one tooth; fixed digit with five teeth.

Legs. *Sge* IV 52.5, *Sti* IV 30, *St* IV 62.5.

Specimens examined. No specimens.

Distribution. Asia: Taiwan.

Remarks. Tseng (1976) described this species by simple descriptions and measurements; it is impossible to separate this species and *Prop. aetus*. Although Tseng described the spermatheca of this species is tube-shaped, but it should be same

with *Prop. aetus* based on illustration. The present study still keeps this species but it probably is junior synonym of *Prop. aetus*. This species only described by single holotype female, and the specimen was lost (Liao *et al.* 2017b). The species was collected from *Jasminum* sp. in Tainan city. Unfortunately, no specimen was found in the type locality and other places during survey since 1985.

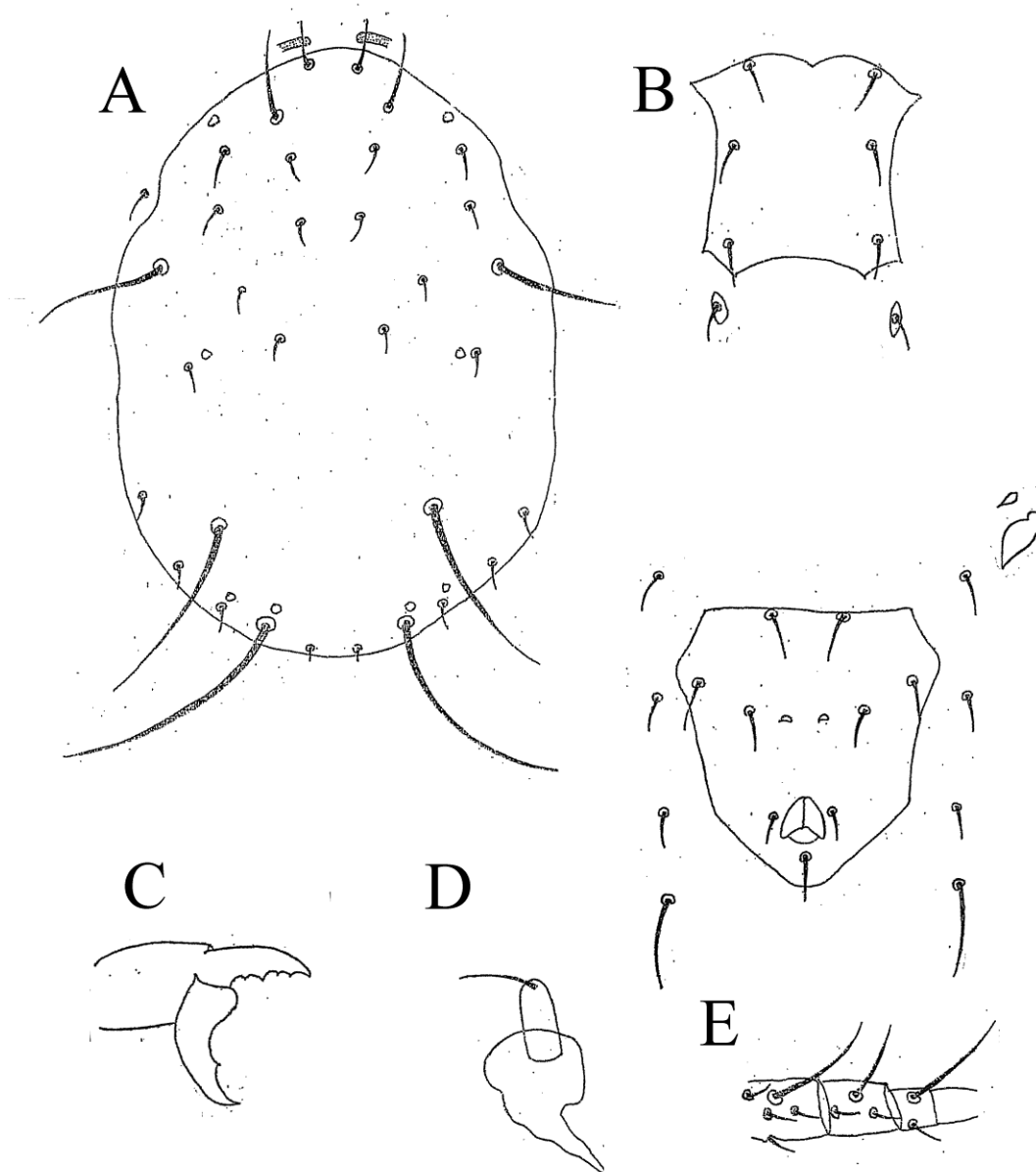


FIGURE 104. *Proprioseiopsis pubes* (Tseng, 1976), (after Tseng 1976), Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca, E. leg IV.

Tribe NEOSEIULINI Chant & McMurtry, 2003a

小新綏蟎族



Neoseiulini Chant & McMurtry, 2003a: 6.

Type genus - *Neoseiulus* Hughes, 1948: 141.

This tribe is characterized by Ge II and Ge III rarely with a macroseta; fixed digit of chelicera usually with fewer than 6 teeth, rarely multidentate; never with these 2 characters together. Ten genera belong to this subtribe, including *Archeosetus* Chant & McMurtry, *Chileseius* Gonzalez & Schuster, *Evansoseius* Sheals, *Macrocaudus* Moraes, McMurtry & Mineiro, *Neoseiulus* Hughes, *Olpiseius* Beard, *Paragigagnathus* Amitai & Grinberg, *Pholaseius* Beard, *Phyllodromus* De Leon, *Rubuseius* Ragusa

Genus *Neoseiulus* Hughes, 1948

小新綏蟎屬

Neoseiulus Hughes, 1948: 141.

Typhlodromus (*Typhlodromopsis*) De Leon, 1959a: 113. Type species - *Typhlodromus cucumeris* Oudemans, 1930: 69.

Amblyseius (*Typhlodromopsis*).—Muma, 1961: 287.

Cydnodromus Muma, 1961: 290. Type species - *Lasioseius marinus* Willmann, 1952: 146.

Phytodromus Muma, 1961: 291. Type species - *Amblyseius leucophaeus* Athias-Henriot, 1959: 139.

Amblyseius (*Amblyseius*) section *Typhlodromopsis* Wainstein, 1962: 15.

Typhlodromopsis.—Muma, 1965: 245.

Dictyonotus Athias-Henriot, 1978. Type species - *Amblyseius huron* Chant & Hansell, 1971: 710. Preoccupied by *Dictyonotus* Kruchbaumer (Hymenoptera).

Dictydionotus Athias-Henriot, 1979: 677. Replacement name for *Dictyonotus* Athias-Henriot, 1978.

Kashmerius Chaudhri *et al.*, 1979: 66. Type species - *Kashmerius reductus* Chaudhri *et al.*, 1979: 66. Junior homonym of *Amblyseius reductus* Wainstein, 1962, also placed in the genus *Neoseiulus*.

Denmarkia Chaudhri *et al.*, 1979: 46. Type species - *Denmarkia disparis* Chaudhri *et al.*, 1979: 46.

Amathia Chaudhri *et al.*, 1979: 48. Type species - *Amathia rancidus* Chaudhri *et al.*, 1979: 48.

Amblyseius (*Neoseiulus*) Karg, 1983: 313.

Typhlodromus (*Neoseiulus*).—Nesbitt, 1951: 34.

Typhlodromus (*Neoseiulus*) section *Neoseiulus*, Wainstein, 1962: 21.

Type species - *Neoseiulus barkeri* Hughes, 1948: 141.

There are 367 valid species in this genus (Demite *et al.* 2019). Chant & McMurtry (2003a) provided with 10 species group in this genus, including *barkeri* Chant, *canadensis* Chant & McMurtry, *cucumeris* Athias-Henriot, *desertus* Chant & McMurtry, *letrauformis* Chant & McMurtry, *leucophaeus* Chant & McMurtry, *paloratus* Beard, *paspalivorus* Tseng, *peruanus* Chant & McMurtry, *rancidus* Chant & McMurtry.

Diagnosis – Idiosomal pattern 10A:9B/JV-3, $\pm$ JV4, $\pm$ ZV1, $\pm$ ZV3. Dorsal shield significantly longer than wide, but some species rotund. Sternal shield L/W ratio ca. 1:1,

some species *st3* inserted on a separated platelet, posterior margin straight, or concave. Genital shield truncated posteriorly. Female ventrianal shield pentagonal, or long and narrow, or reduced, never vase-shaped, with 3 pair of preanal setae, *gv3* conspicuous. Peritreme usually extending to *j1* level. Spermatheca variable. Chelicera fixed digit usually with 3-4 teeth, movable digit with 0-3 teeth. Leg IV with 0-3 macrosetae. Ge II with 7 setae. Male ventrianal shield triangular, setation variable, usually with 3 pair of preanal setae, arranged in a broad triangular pattern, spermatodactyl HT variant, wand-shaped, U-shaped, T-shaped, or penile.

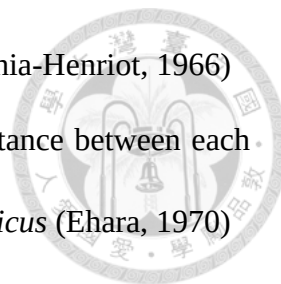
Key to the species in the genus *Neoseiululs* from Taiwan (except *monomacroseta* due to inadequate description)

1. Spermatheca with atrium forked 2
 - Spermatheca with atrium not deeply forked at juncture 5
2. Calyx not markedly constricted or stalked at junction with atrium
 - *barkeri* Hughes, 1948
 - Calyx stalked or narrowly constricted at juncture with atrium 3
3. Setae *j3, j4, j5, j6* minute; leg IV with two macrosetae *makuwa* (Ehara, 1972)
 - Seta *j3, j4, j5, j6* longer; leg IV with one macroseta 4
4. Seta *S5* shorter *longispinosus* (Evans, 1952)
 - Seta *S5* longer *womersleyi* (Schicha, 1975)
5. Dorsal shield longer, with marked “shoulder” at level of seta *r3* 6
 - Dorsal shield not longer, without “shoulder” at level of seta *r3*
 - *spineus* (Tseng, 1976)
6. Distance between ventrianal pores approximately subequal to distance between each

pore and the nearest *JV2*.....*baraki* (Athia-Henriot, 1966)

—Distance between ventrianal pores about 2.5 times as long as distance between each

pore and the nearest *JV2*.....*taiwanicus* (Ehara, 1970)



***Neoseiulus baraki* (Athias-Henriot, 1966)**

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(Figures 105–106)

Amblyseius baraki Athias-Henriot, 1966: 211.

Amblyseius (*Amblyseius*) *baraki*.—Ehara & Bhandhufalck, 1977: 54.

Amblyseius (*Neoseiulus*) *baraki*.—Gupta, 1986: 105.

Female (n=4)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield strongly reticulated, much longer than wide, 407 (379–435) long, 181 (172–190) wide at level of *s4*, 192 (186–201) wide at level of *S4*, with slightly waist at level of seta *R1*, and with a shoulder at level of seta *r3*; seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), thirteen pairs of lyrifissures (*idl1*, *idl1a*, *id2*, *id4*, *id6*, *idm1*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *idx*, *is1*, *idl2*, *idl3*, *idl4*); length of dorsal setae: *j1* 15 (12–18), *j3* 18 (17–19), *j4* 10 (6–13), *j5* 10 (7–13), *j6* 12 (9–15), *J2* 12 (9–13), *J5* 10 (8–12), *z2* 12 (8–14), *z4* 12 (8–15), *z5* 9 (7–11), *Z1* 13 (9–18), *Z4* 23 (20–26), *Z5* 72 (54–80), *s4* 16 (13–18), *S2* 15 (13–17), *S4* 27 (23–28), *S5* 27 (25–31), *r3* 15 (12–18), *R1* 12 (10–14). All setae smooth, except seta *Z5* slightly serrated.

Peritreme. Peritreme extending beyond to *j3* level, peritremal shield smooth, lightly sclerotized, with one pair of solenostome (*gd3*) and one pair of lyrifissures (*id3*).

Venter. Sternal shield long, narrow, reticulated, posterior margin straight, 100 (90–106) long, 89 (79–101) wide at *st3* level, with three pairs of setae *st1* 12 (10–16), *st2* 11 (9–12), *st3* 9 (8–10) and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae II–IV. Metasternal platelets tear-shaped, with a pair metasternal setae, *st4* 12 (10–13), and one pair of lyrifissures (*pst3*). Genital shield reticulated, posteriorly truncate, *st5* 12 (9–15), 76 (71–83) wide. Distances between *st1*–*st1* 44 (43–46), *st2*–*st2*

58 (56–63), *st3-st3* 59 (46–68), *st1-st3* 91 (83–99), *st5-st5* 64 (62–65). Ventrianal shield reticulate, quadrate, 128 (122–135) long, 104 (100–106) wide at level of ZV2 and 93 (88–96) wide at level of anus; with three pairs of pre-anal setae, solenostome *gv3* small and rounded, *JV1* 12 (9–15), *JV2* 9 (8–10), *ZV2* 9 (7–10). Setae *JV4* 10 (8–11), *JV5* 35 (31–37), *ZV1* 9 (8–10), *ZV3* 8 (7–8) on interscutal membrane. All ventral setae smooth. Two pairs of metapodal plates 39 (35–42) long, 5 (4–6) wide, 10 (8–12) long, 3 (2–3) wide.

Spermatheca. Calyx of spermatheca cup-shaped, 4 (4–5) long, 10 (8–12) wide, and atrium nodular, major duct and minor duct visible.

Chelicera. Movable digit 30 (25–34) long, with two teeth; fixed digit 27 (23–30) long, anterior half with two teeth, posterior half with eight teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *St IV* (d) 48 (46–49).

Specimens examined. CHINA: Martyrs Cemetery, Zhuhai City, Guangdong Province, one female from *Nerium oleander* (Apocynaceae), 6.x.1983, W. N. Wu (GIABR); Fuzhou City, Fujian Province, four females from *Dicranopteris linearis* (Gleicheniaceae), 23.iii.1998, W. N. Wu (GIABR).

TAIWAN: Wanfeng Village, Wufeng Dist., Taichung City, one female from *Imperata cylindrica* (Poaceae), 20.ii.1978, C. C. Ho (TARL); Shicheng, Dongshi Dist., Taichung City, two females (TAL092G562, 563) from soil, 24.xi.2003, C. C. Ho (TARL); Shanshang Dist., Tainan City, one female (HAL099B671) from *Echinochloa colona* (Poaceae), 19.vii.2010, C. C. Ho (TARL); Pingtung City, one female from *Saccharum* sp. (Poaceae), 14.viii.2015, P. C. Ma (NPUST); Pingtung City, one female from

Saccharum sp. (Poaceae), 14.viii.2015, P. C. Ma (NPUST).

Distribution. Africa: Algeria (Athias-Henriot 1966), Benin (Zannou *et al.* 2006), Burundi (Zannou *et al.* 2006), Kenya (Zannou *et al.* 2006), Mozambique (Zannou *et al.* 2005), Tanzania (Famah Sourassou *et al.* 2012). Asia: China (Fujian (Wu 1986), Sri Lanka (Moraes *et al.* 2004b), Taiwan (Tseng 1983), Thailand (Ehara & Bhandhufalck 1977). Central America: Panama (Quirós-McIntire & Rodríguez 2010). North America: Costa Rica (Rodríguez-Morell *et al.* 2013), Cuba (Ramos & Rodriguez 2004). South America: Brazil (Lawson-Balagbo *et al.* 2008).

Remarks. Athias-Henriot (1966) described this species from *Phalaris* sp. in Algeria. This species is close to *N. taiwanicus*, but differs from distance between preanal pores closer (wider in *taiwanicus*); differs from one macroseta on Ge IV (no macroseta in *taiwanicus*).

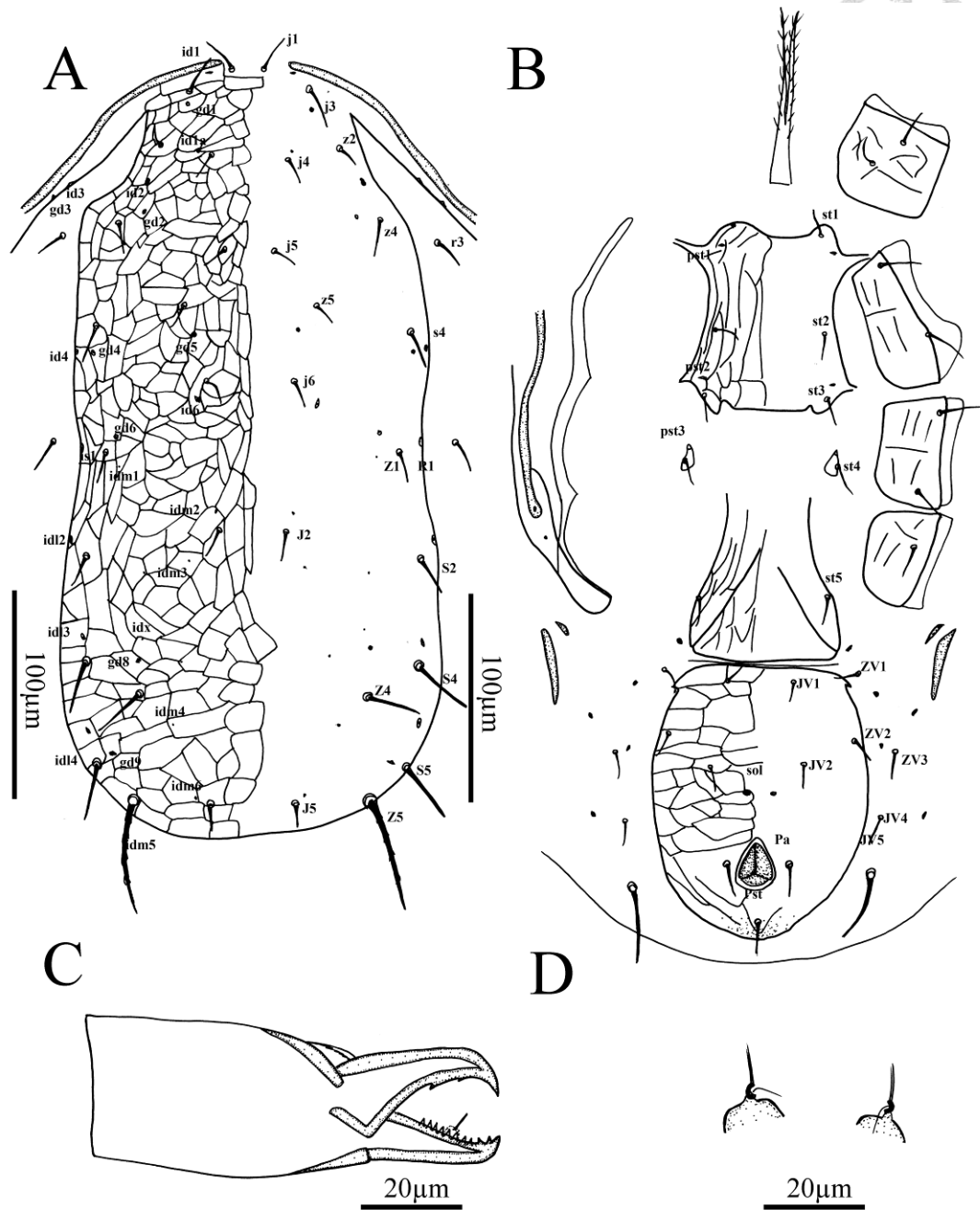


FIGURE 105. *Neoseiulus baraki* (Athia-Henriot, 1966), Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

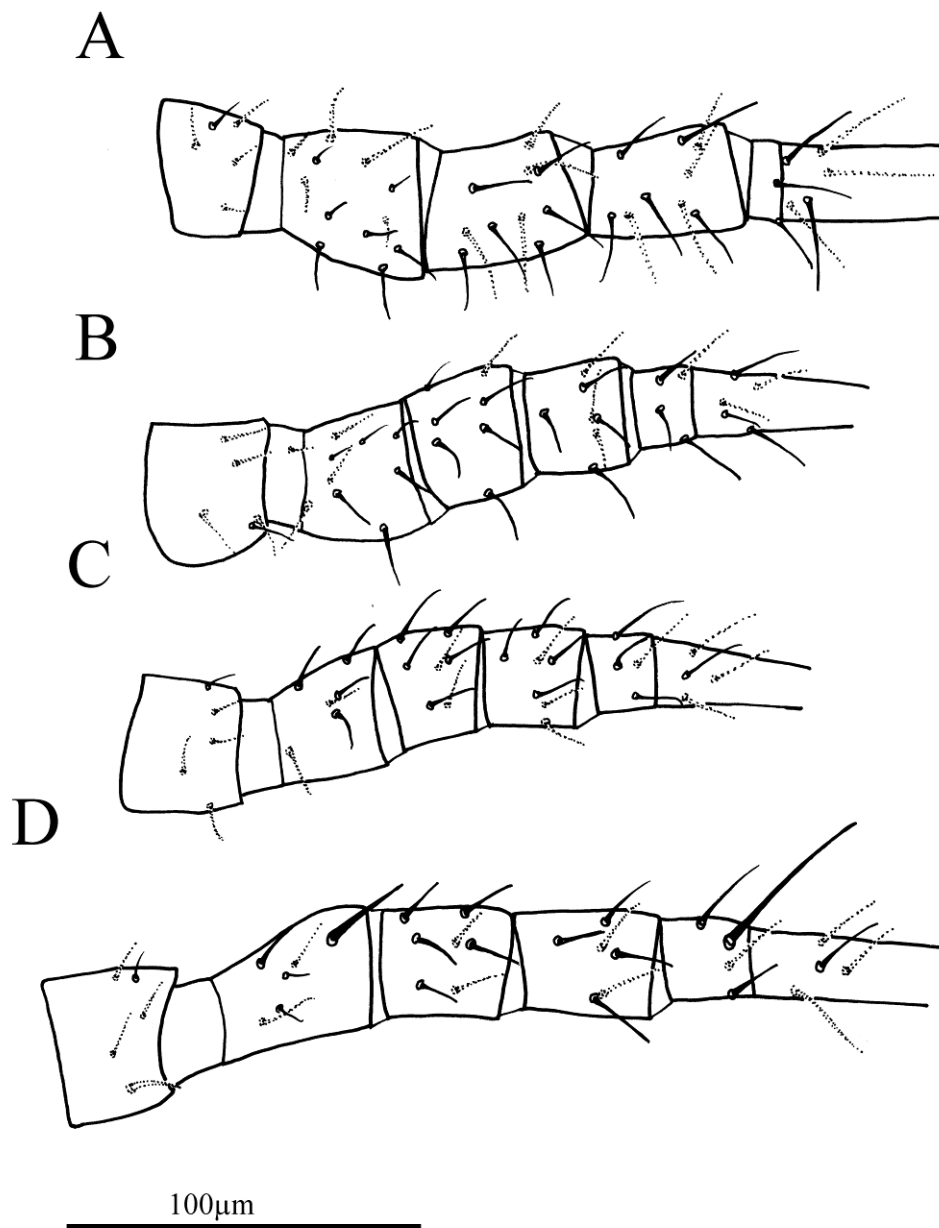


FIGURE 106. *Neoseiulus baraki* (Athia-Henriot, 1966), Female, legs A. leg I anterior view, B. leg II dorsal view, C. leg III posterior view, D. leg IV posterior view.

***Neoseiulus barkeri* Hughes, 1948**

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(Figures 107–110)

Neoseiulus barkeri Hughes, 1948: 141.

Lasioseius polonicus Willmann, 1949: 117. (Synonymy according to Nesbitt 1951: 36; not synonym by Chant 1959: 61; Ragusa & Athias-Henriot 1983: 660).

Typhlodromus (*Neoseiulus*) *barkeri*.—Nesbitt, 1951: 35.

Typhlodromus (*Typhlodromus*) *barkeri*.—Chant, 1959b: 61.

Typhlodromus (*Amblyseius*) *barkeri*.—Hughes, 1961: 222.

Typhlodromus barkeri.—Hirschmann, 1962: 2.

Amblyseius mckenziei Schuster & Pritchard, 1963: 268. (Synonymy according to Athias-Henriot 1966).

Amblyseius (*Amblyseius*) *usitatus* van der Merwe, 1965: 71. (Synonymy according to Ueckermann & Loots 1988: 148; Chant & McMurtry 2003a: 37).

Amblyseius oahuensis (Prasad, 1968b: 1518). (Synonymy according to Ragusa & Athias-Henriot 1983).

Amblyseius picketti Specht, 1968: 681. (Synonymy according to Ragusa & Athias-Henriot 1983).

Amblyseius cydnodactylon (Shehata & Zaher, 1969: 177). (Synonymy according to Ragusa & Athias-Henriot 1983).

Amblyseius mycophilus Karg, 1970: 290. (Synonymy according to Ragusa & Athias-Henriot 1983).

Amblyseius (*Amblyseius*) *barkeri*.—Ehara, 1972: 147.

Amblyseius (*Amblyseius*) *pieteri* Schultz, 1972: 147. (Synonymy according to Ueckermann & Loots, 1988: 147; not synonym by Chant & McMurtry, 2003a:

124).

Amblyseius barkeri.—Swirski *et al.*, 1973: 70.

Amblyseius masiaka Blommers & Chazeau, 1974: 308. (Synonymy according to Ueckermann & Loots 1988).

Amblyseius sugonjaevi Wainstein & Abbasova, 1974: 796. (Synonymy according to Ragusa & Athias-Henriot 1983).

Amblyseius (Neoseiulus) barkeri.—Karg, 1983: 313.

Neoseiulus kermanicus Daneshvar, 1987: 14. (Synonymy according to Faraji *et al.* 2007).

Female (n=10)

A slightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV

Dorsum. Dorsal shield mostly smooth, except for a few striae anterolaterally, 358 (332–381) long (*j1*–*J5* level) and 197 (177–212) wide at level of *j6*, 195 (178–214) wide at level of *S4*; six pairs of solenostomes (*gd1*, *gd3*, *gd4*, *gd6*, *gd8*, *gd9*), thirteen pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); muscle-marks (sigilla) visible on podosoma; length of dorsal setae: *j1* 18 (14–20), *j3* 23 (18–29), *j4* 17 (13–20), *j5* 17 (14–20), *j6* 18 (15–24), *J2* 21 (18–26), *J5* 12 (10–14), *z2* 21 (16–26), *z4* 21 (16–26), *z5* 17 (14–20), *Z1* 22 (17–25), *Z4* 37 (31–42), *Z5* 52 (43–59), *s4* 25 (18–31), *S2* 25 (20–30), *S4* 22 (18–27), *S5* 21 (17–27), *r3* 21 (17–25), *R1* 19 (15–21). All setae smooth, setiform, except *Z4* and *Z5*, slightly serrated.

Peritreme. Peritreme extending to *j1* level; peritremal shield smooth, with one pair of solenostomes (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, slightly reticulated, posterior margin concave; 68 (65–71) long, 77 (73–83) wide at level of *st3*, with 3 pairs of setae *st1* 29 (26–31), *st2* 26 (23–29), *st3* 26 (20–30), and two pairs of lyrifissures (*pst1*, *pst2*). Metasternal



platelets tear-shaped, with a pair of metasternal setae, *st4* 28 (24–31), one pair of lyrifissures (*pst3*). Genital shield smooth, truncate posteriorly, with one pair of genital setae *st5* 26 (21–29), 74 (63–79) wide at level of genital setae, one pair of lyrifissures (*pst5*) beside genital shield. Exopodal shield at coxae II–IV. Distances between *st1-st1* 52 (49–57), *st2-st2* 65 (63–69), *st3-st3* 73 (69–78), *st1-st3* 68 (63–71), *st5-st5* 64 (58–73). Ventrianal shield smooth, weakly sclerotized, pentagonal, 127 (115–141) long, 106 (96–113) wide at ZV2 level, 80 (74–89) wide at level of anus; with 3 pairs of pre-anal setae, *JV1* 24 (21–27), *JV2* 25 (22–27), *ZV2* 25 (21–27), 1 pair of para-anal, *Pa* 16 (12–18), *Pst* 19 (13–21) on shield, solenostomes *gv3* crescentic. Setae *ZV1* 25 (21–29), *ZV3* 18 (15–21), *JV4* 21 (17–24), *JV5* 46 (40–53) on interscutal membrane. All setae smooth, setiform. Two pairs of metapodal plates 25 (21–28) long, 4 (3–5) wide, 13 (11–19) long, 2 (2–2) wide.

Spermatheca. Calyx flaring towards vesicle, 20 (12–30) long, 8 (5–13) wide, atrium deeply forked at juncture connect to calyx without neck, major duct and minor duct visible, major duct visible as wide as atrium.

Chelicerae. Movable digit 31 (29–34) long, with three teeth; fixed digit 32 (29–34) long, anterior half with two teeth, posterior half with four teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *St IV* 67 (59–72).

Male (n=10)

Idiosomal setal pattern: 10A:9B/JV-3,4:ZV-3

Dorsum. Dorsal shield smooth, 287 (275–293) long (*j1-J5* level) and 191 (182–198) wide at level of *j6*, 165 (156–175) wide at level of *S4*; six pairs of

solenostomes (*gd1*, *gd3*, *gd4*, *gd6*, *gd8*, *gd9*), thirteen pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); muscle-marks (sigilla) visible on podosoma; length of setae: *j1* 15 (13–17), *j3* 20 (18–23), *j4* 16 (14–19), *j5* 15 (14–17), *j6* 15 (13–19), *J2* 17 (15–19), *J5* 11 (9–12), *z2* 19 (17–22), *z4* 19 (17–20), *z5* 16 (12–20), *Z1* 18 (16–19), *Z4* 30 (27–32), *Z5* 38 (34–40), *s4* 22 (18–24), *S2* 21 (18–24), *S4* 20 (17–22), *S5* 17 (13–21), *r3* 18 (16–21), *R1* 17 (16–18). All setae smooth, except *Z5*, slightly serrated. Setae *r3* and *R1* inserted on dorsal shield.

Peritreme. Peritreme extending beyond to *j3* level; peritremal shield smooth, with 1 pair of solenostomes (*gd3*) and 1 pair of lyrifissures (*id3*).

Venter. Sternogenital shield smooth, with few lateral striae, longer than wide, 120 (112–126) long, 89 (83–97) wide at level of *st5*, with 5 pairs of setae, *st1* 25 (24–27), *st2* 24 (21–25), *st3* 23 (20–25), *st4* 23 (21–24), *st5* 22 (21–25), 3 pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Exopodal shield at coxae II–IV. Distances between *st1*–*st1* 48 (44–52), *st2*–*st2* 59 (56–62), *st3*–*st3* 61 (58–64), *st4*–*st4* 47 (44–50), *st5*–*st5* 35 (31–39), *st1*–*st5* 112 (107–117). Ventrianal shield subtriangular, with slightly reticulated, 119 (110–123) long and 144 (136–156) wide at level of anterior corner, 78 (72–85) at level of anus, fused with peritremal shield cingulum; with 4 pairs of pre-anal setae, *JV1* 21 (20–23), *JV2* 19 (15–22), *ZV1* 21 (19–23), *ZV2* 20 (19–22), solenostomes *gv3* crescentic, 16 (14–19) apart; *Pa* 13 (12–15), *Pst* 15 (13–17) on shield. Setae *JV5* 28 (23–38) on interscutal membrane.

Chelicerae. Movable digit 22 (21–23) long, with 1 tooth. Fixed digit 22 (20–23) long, anterior half with one tooth, with *pilus dentilis*; Spermatodactyl T-shaped, shaft 17 (15–18) long, foot 18 (15–20) long.

Legs. Coxal formula 2, 2, 2, 1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: St IV (d) 57 (54–60).

Specimens examined. CHINA: Fujian Academy of Agricultural Sciences, Fuzhou City, Fujian Province, two females from Lab colony, unknown, Y. X. Zhang (GIABR); Henen Province, one female from *Carica papaya* (Caricaceae), unknown, W. N. Wu (GIABR); Long Yu Bay, Loyang City, Henen Province, one female from *Larix kaempferi* (Pinaceae), unknown, W. N. Wu (GIABR); Mt. Tongbai, Henen Province, one female from unknown plant, unknown, W. N. Wu (GIBAR); Unknown, one female from *Carica papaya* (Caricaceae), 15.ix.1981, W. N. Wu (GIABR); Shaxian County, Sanming City, Fujian Province, one female from *Artemisia argyi* (Asteraceae), ?.ix.1993, W. N. Wu (GIABR); Lab rear, one female from unknown plant, ??.1996. Y. X. Zhang (GIBAR); Yangcun Township, Guangdong Province, one female from *Citrus* sp. (Rutaceae), 16.v.1997, W. N. Wu (GIABR); Fujian Academy of Agricultural Sciences, Fuzhou City, Fujian Province, three females (HAL099C157, 158, 169) from Lab colony, 1.xi.2010, Y. X. Zhang (TARL).

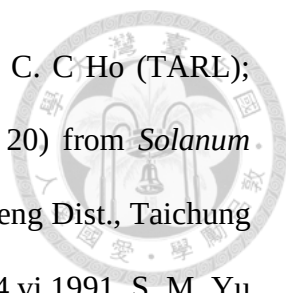
ISRAEL: Quarantine specimens, one female (HAL095G063) from *Kochia* sp. (Amaranthaceae), 31.x.2006, BAPHIQ Hsinchu Branch (TARL); Quarantine specimens, one female (HAL095G064) from *Limonium* sp. (Plumbaginaceae), 31.x.2006, BAPHIQ Hsinchu Branch (TARL).

JAPAN: Quarantine specimens, one female (HAL100B075) from *Vitis vinifera* (Vitaceae), 2.v.2011, C. C. Ho (TARL); Quarantine specimens, one female (QAR101H013) from *Perilla frutescens* (Lamiaceae), 23.viii.2011, C. C. Ho (TARL); Quarantine specimens, one female (QAR101H023) from *Chrysanthemum* sp.

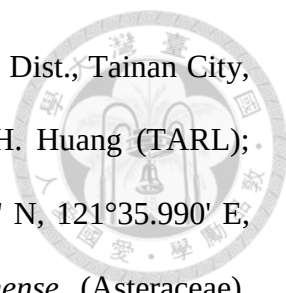
(Asteraceae), 21.ix.2011, BAPHIQ Hsinchu Branch (TARL); Quarantine specimens, one female (QAR102H036) from *Perilla frutescens* (Lamiaceae), 3.ix.2013, BAPHIQ Hsinchu Branch (TARL); Quarantine specimens, one female (QAR102H050) from *Perilla frutescens* (Lamiaceae), 13.ix.2013, BAPHIQ Hsinchu Branch (TARL).

NETHERLANDS: Quarantine specimens, one female (HAL095F309) from *Lactuca sativa* var. *capitata* (Asteraceae), 14.ix.2006, BAPHIQ Hsinchu Branch (TARL); Quarantine specimens, one female (QAR101H001) from *Malus pumila* (Rosaceae), 5.iv.2011, BAPHIQ Hsinchu Branch (TARL); Quarantine specimens, one female (QAR102H038) from *Thymes* sp. (Lamiaceae), 5.ix.2013, BAPHIQ Hsinchu Branch (TARL).

TAIWAN: TARI, Wufeng Dist., Taichung City, two females (TAL080B018, 20) from *Mimosa pudica* (Fabaceae), 19.xi.1986, C. C. Ho (TARL); Chiayi County, one female from *Morus alba* (Moraceae), 22.ii.1988, C. C. Ho (TARI); Chianan Station, Chiayi County, one female (88-170) from *Morus alba* (Moraceae), 22.iii.1988, C. C. Ho (TARL); Baihe Dist., Tainan City, one female from *Sambucus formosana* (Adoxaceae), 23.vi.1988, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, one female from *Sida rhombifolia* (Malvaceae), 12.x.1988, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, one female from *Allium fistulosum* (Amaryllidaceae), 24.x.1988, S. M. Yu (TARL); Xiaomen Village, Xiyu Township, Penghu County, one female (89-Am-0984) from unknown plant, 21.iv.1989, C. C. Ho (TARL); Wai'an Village, Xiyu Township, Penghu County, one female (90-Am-1057) from *Achyranthes obtusifolia* (Amaranthaceae), 21.iv.1989, C. C. Ho (TARL); Baisha Township, Penghu County, one female (91-Am-1066) from soil, 22.iv.1989, C. C. Ho (TARL); Wai'an Village, Xiyu Township, Penghu County, two females (92-Am-0983, 93-Am-1058) from unknown plant, 22.iv.1989, C. C. Ho (TARL); TARI, Wufeng Dist., Taichung



City, one female from *Solanum melongena* (Solanaceae), 4.vi.1991, C. C. Ho (TARL); TARI, Wufeng Dist., Taichung City, two females (TAL080B018, 20) from *Solanum melongena* (Solanaceae), 11.vi.1991, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, one female (88-Am-0686) from *Arachis hypogaea* (Fabaceae), 4.vi.1991, S. M. Yu (TARL); Kinmen County, two females from *Sorghum bicolor* (Poaceae), 15.vii.1996, C. C. Ho (TARI, TARL); Qigu Dist., Tainan City, two females (TAL091B001, 017) from soil of *Saccharum sinensis* (Poaceae), 10.iv.2002, C. C. Ho (TARL); Zengwen, Shanhua Dist., Tainan City, one female (TAL091B227) from soil of *Citrullus vulgaris* (Cucurbitaceae), 10.iv.2002, C. C. Ho (TARL); Qigu Dist., Tainan City, one female (TAL091B377) from soil of *Saccharum sinensis* (Poaceae), 10.iv.2002, C. C. Ho (TARL); Mt. Taiwu, Kinmen County, one female (TAL091C133) from *Livistona chinensis* (Arecaceae), 24.iv.2002, C. C. Ho (TARL); Experimental Farm, TARI, Wufeng Dist., Taichung City, four females (TAL091I010, 11, 32, 33) from unknown plant, 22.viii.2002, C. C. Ho (TARL); Nanliao, North Dist., Hsinchu City, three females (TAL091S072, 132, 133) from *Allium fistulosum* (Amaryllidaceae), 24.ix.2002, C. C. Ho (TARL); Experimental Farm, TARI, Wufeng Dist., Taichung City, one female (TAL091I035) from unknown plant, 5.xii.2002, C. C. Ho (TARL); Dongshih Forest Garden, Dongshi Dist., Taichung City, two females (TAL092G442, 43) from soil, 23.iii.2003, C. C. Ho (TARL); Daping Village, Juguang Township, Lienchiang County, two females from soil of *Allium fistulosum* (Amaryllidaceae), 17.ix.2003, C. C. Ho (TARL); Heping Dist., Taichung City, three females (TAL093B437, 38, 39) from soil, 23.iii.2004, C. C. Ho (TARL); Dongshih Forest Garden, Dongshi Dist., Taichung City, two females (TAL093B550, 708) from soil, 23.iii.2004, C. C. Ho (TARL); Daguang Village, Heping Dist., Taichung City, three females (TAL093B766, 67, 68) from soil, 23.iii.2004, C. C. Ho (TARL); Shubogong, Dongshi Dist., Taichung City, one female



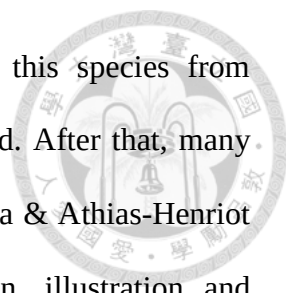
(TAL093B857) from soil, 23.iii.2004, C. C. Ho (TARL); Guanmiao Dist., Tainan City, one female from *Ananas comosus* (Bromeliaceae), 1.ix.2004, S. H. Huang (TARL); Elephant trunk rock, Lanyu Twonship, Taitung County (22°01.077' N, 121°35.990' E, 24 m), one female (HAL099B487) from *Crossostephium chinense* (Asteraceae), 5.iv.2010, C. C. Ho (TARL); Elephant trunk rock, Lanyu Twonship, Taitung County (22°01.077' N, 121°35.990' E, 24 m), one female (no.467–7) from *Crossostephium chinense* (Asteraceae), 5.iv.2010, J. R. Liao & C. C. Ho (NTU); Lunbei Township, Yunlin County, one female (no. 903-2) from *Morus* sp. (Moraceae), 24.x.2014, J. F. Hsieh & J. R. Liao (NTU); Ziwei Forest, Sanxia Dist., New Taipei City, one female (no. 1213–5) from *Cyclobalanopsis glauca* (Fagaceae), 25.ix.2013, J. R. Liao (NTU); Xihu Township, Changhua County, two females (no. 1285–2, 3) from *Vitis vinifera* (Vitaceae), 20.iv.2014, J. R. Liao (NTU); Puling Township, Nantou County, fifteen females (no. 1561–1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15) from *Cucumis sativus* (Cucurbitaceae), 28.viii.2015, J. R. Liao (NTU); Xinyi Township, Nantou County, two females from *Capsicum annuum* var. *grossum* (Solanaceae), 26.viii.2015, Y. J. Chen (TARI).

THAILAND: Quarantine specimens, one female (HAL095F297) from *Asparagus officinalis* (Asparagaceae), 15.viii.2006, BAPHIQ Hsinchu Branch (TARL); Quarantine specimens, one female (HAL095F298) from *Ocimum sanctum* (Lamiaceae), 21.viii.2006, BAPHIQ Hsinchu Branch (TARL); Quarantine specimens, one female (QAR101H031) from *Asparagus officinalis* (Asparagaceae), 19.x.2011, BAPHIQ Hsinchu Branch (TARL); Quarantine specimens, one female (HAL101B144) from *Asparagus officinalis* (Asparagaceae), 13.ii.2012, BAPHIQ Hsinchu Branch (TARL); Quarantine specimens, one female (QAR102H022) from *Asparagus officinalis* (Asparagaceae), 17.vi.2013, BAPHIQ Hsinchu Branch (TARL); Quarantine specimens,

one female (QAR102H029) from *Asparagus officinalis* (Asparagaceae), 21.vi.2013, BAPHIQ Hsinchu Branch (TARL).

USA: Quarantine specimens, one female (QAR101H014) from *Anthriscus cerefolium* (Apiaceae), 27.viii.2011, BAPHIQ Hsinchu Branch (TARL).

Distribution. Africa: Algeria (Athias-Henriot 1961; Ragusa & Athias-Henriot 1983), Benin (Zannou *et al.* 2006), Burundi (Zannou *et al.* 2006), Canary Islands (Ferragut & Peña-Estévez 2003), Cape Verde (Ueckermann 1992), Egypt (Abo-Shnaf & Moraes 2014), Ghana (Moraes *et al.* 1989a), Guinea (Ragusa & Athias-Henriot 1983), Kenya (Zannou *et al.* 2006), Malawi (Zannou *et al.* 2005), Morocco (Kreiter *et al.* 2004), Ozambique (Zannou *et al.* 2006), Nigeria (Moraes *et al.* 1989a), Reunion Island (Quilici *et al.* 2000), Senegal (Kade *et al.* 2011), South Africa (Ueckermann & Meyer 1988), Tunisia (Kreiter *et al.* 2002c); Yemen (Ueckermann 1996). Asia: China (Fujian (Wu 1981), Guangdong (Wu 1982), Hainan (Wu & Ou 2002a), Jiangxi (Zhu & Chen 1983a)), Iran (Rahmani *et al.* 2010), Israel (Swirski & Amitai 1965), Japan (Ehara 1972), Jordan (Allawi 1991), Oman (Hountondji *et al.* 2010), Saudi Arabia (Al-Atawi 2011), South Korea (Ryu 1997), Syria (Barbar 2013), Thailand (Oliveira *et al.* 2012), Turkey (Swirski & Amitai 1982). Europe: Cyprus (Amitai 1992), England (Hughes 1948), Finland (Tuovinen 1993), France (Kreiter *et al.* 2000), Georgia (Wainstein & Vartapetov 1973), Germany (Karg 1965), Greece (Papaioannou-Souliotis 1981), Italy (Athias-Henriot 1961), Latvia (Petrova *et al.* 2000), Netherlands (Van de Vrie 1963), Norway (Denmark & Edland 2002), Portugal (Ferreira & Carmona 1994), Russia (Meshkov 1999), Spain (Ragusa & Athias-Henriot 1983), Sweden (Steeghs *et al.* 1993), Ukraine (Wainstein & Shcherbak 1972). North America: USA (Denmark & Evans 2011). Oceania: Australia (Waite & Gerson 1994), Hawaii (Denmark & Evans 2011). South America: Brazil (Moraes *et al.* 1993), Chile (Ragusa & Vargas 2002).



Remarks. Hughes (1948) provided the first description of this species from germinating barley at the London Docks, both sexes were described. After that, many acarologists provided their own opinions of this species (e.g. Ragusa & Athias-Henriot 1983). Beaulieu & Beard (2018) reported detailed redescription, illustration and measurements based on syntypes (Hughes (1948) did not assign a single holotype). Based on the result, several species were discussed for suspected synonyms.

This species is considered as lifestyle of phytoseiid subtype III-e. This subtype species is living on soil/litter, and also on plant. Because of diverse food preferences, this species is considered as biological control agent. This species can be reared by astigmatid mites. In some countries, there are some commercial products of this species for controlling thrips.

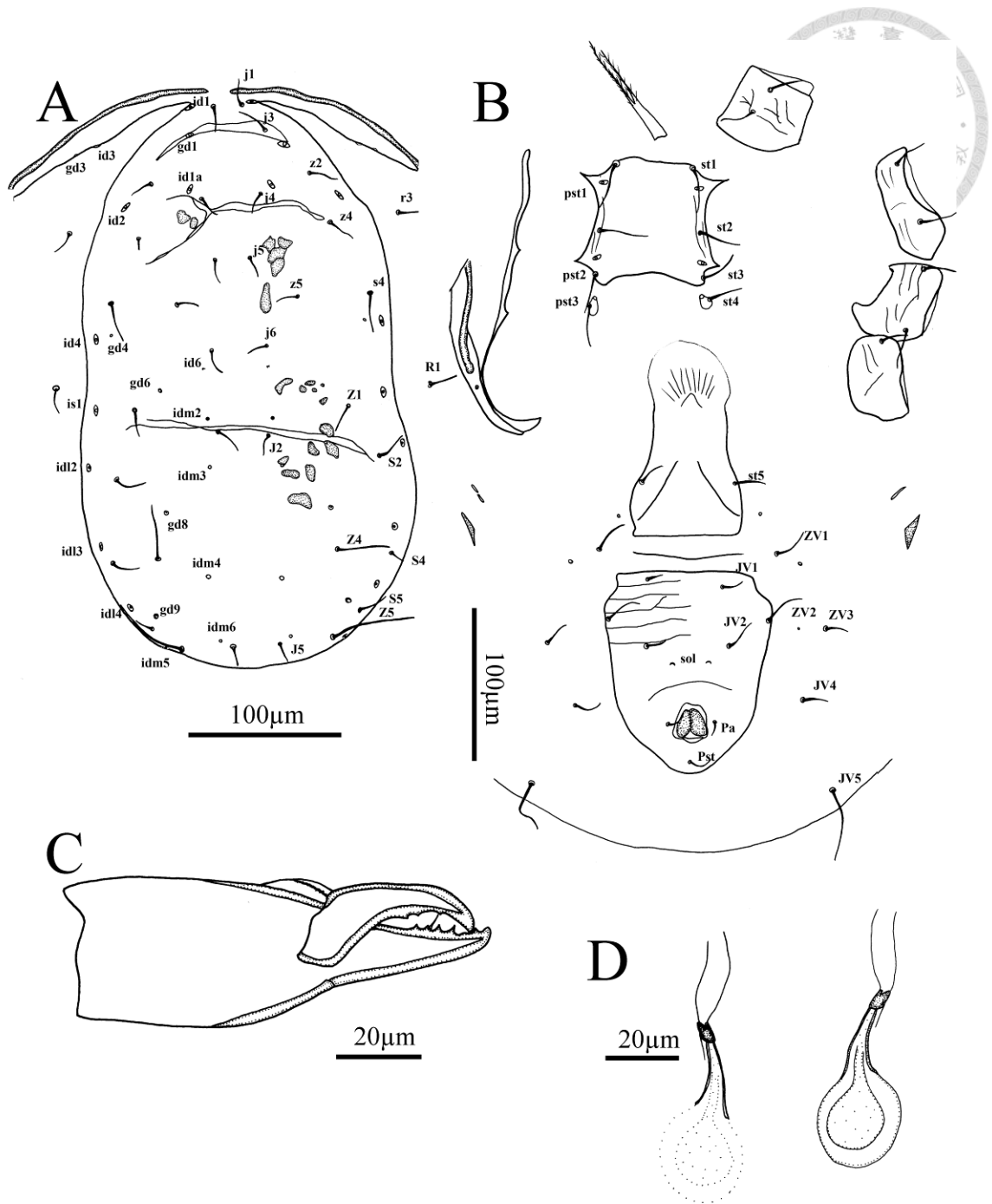


FIGURE 107. *Neoseiulus barkeri* Hughes, 1948, Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

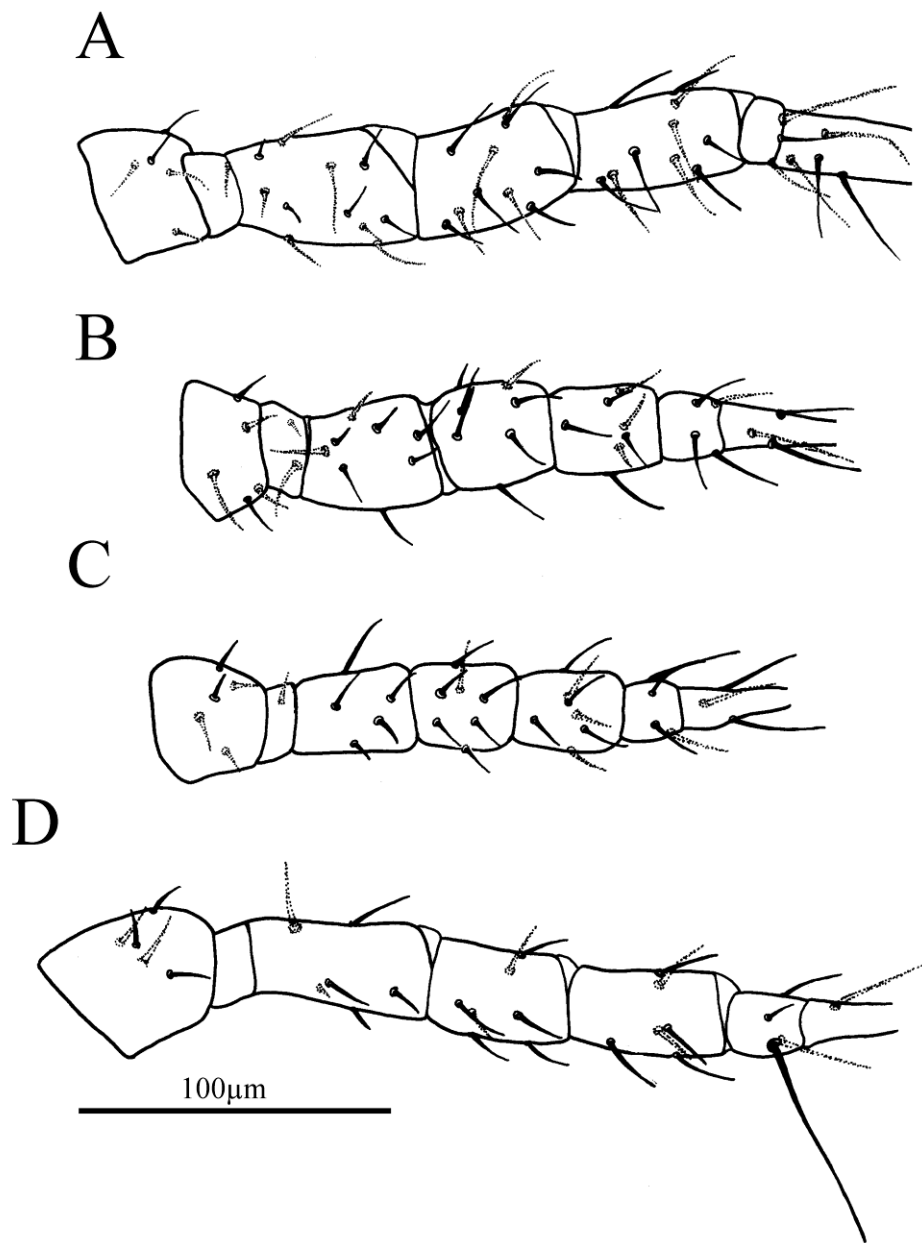


FIGURE 108. *Neoseiulus barkeri* Hughes, 1948, Female, legs A. leg I anterior view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV anterior view.

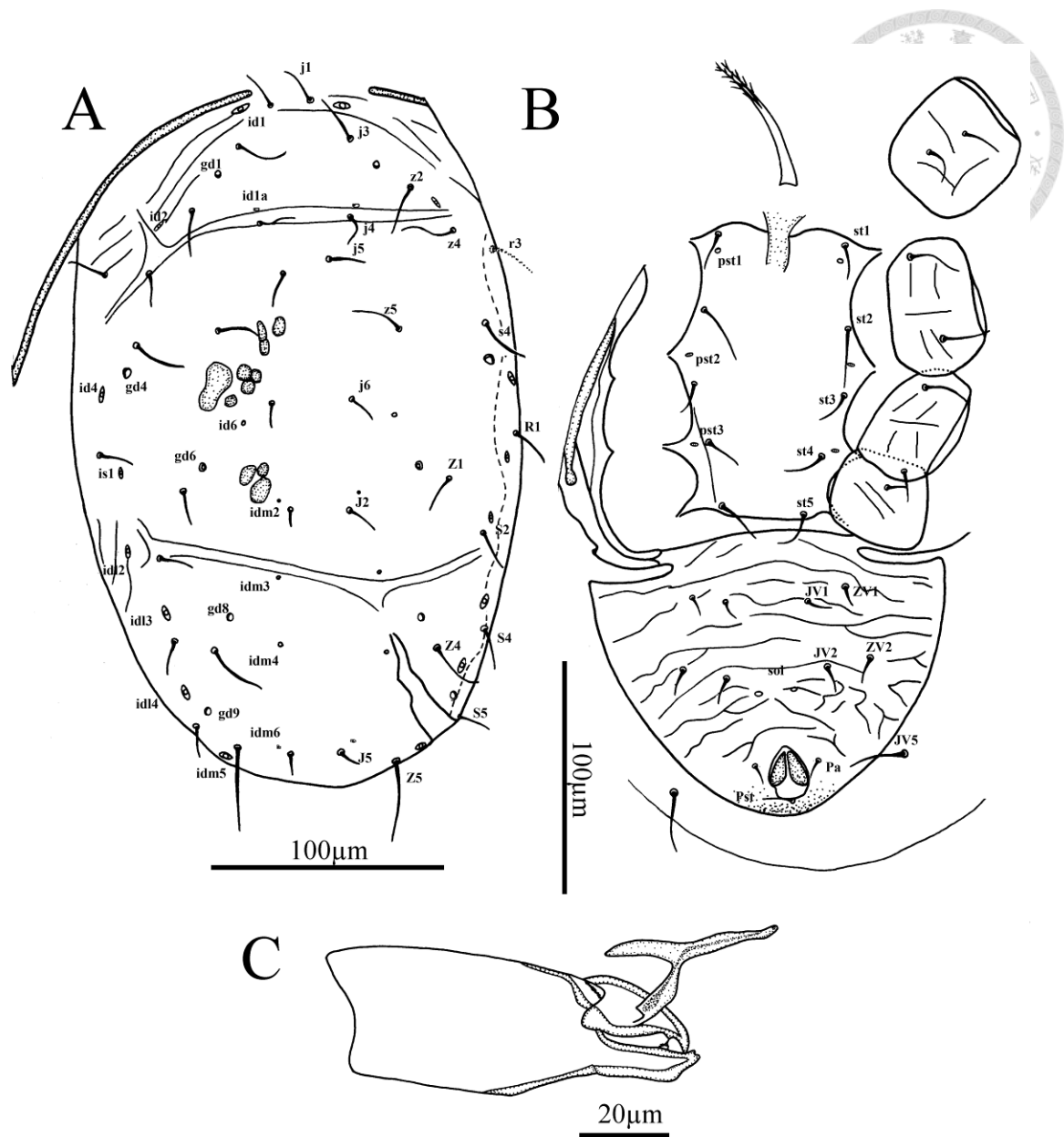


FIGURE 109. *Neoseiulus barkeri* Hughes, 1948, Male, A. dorsal shield; B. ventral idiosoma; C. chelicera and spermatodactyl.

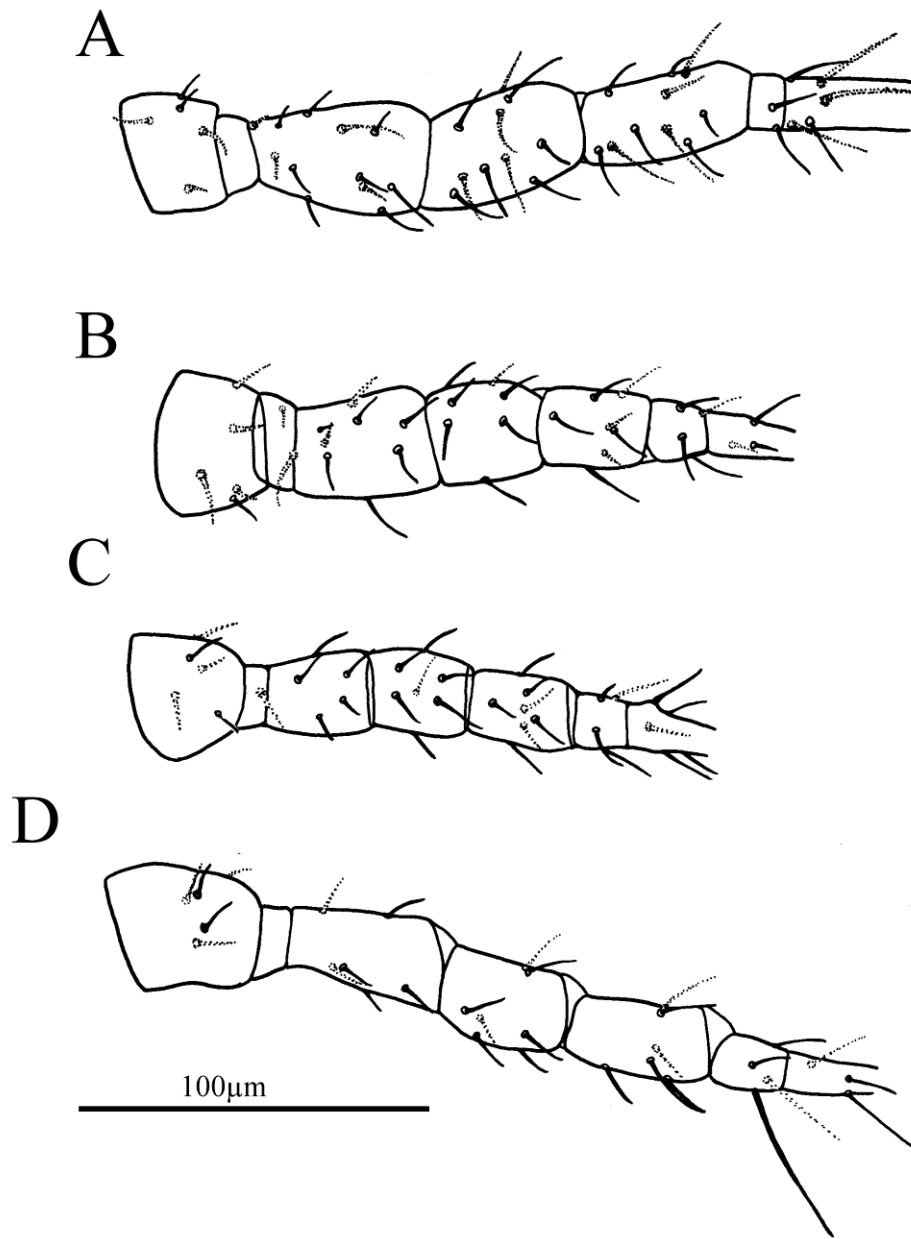


FIGURE 110. *Neoseiulus barkeri* Hughes, 1948, Male, legs A. leg I anterior view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV anterior view.

***Neoseiulus longispinosus* (Evans, 1952)**

長毛小新綏蟎



(Figures 111–114)

Typhlodromus longispinosus Evans, 1952: 413.

Amblyseius longispinosus.—Ehara, 1959: 288.

Typhlodromus (*Amblyseius*) *longispinosus*.—Chant, 1959b: 74.

Cydnodromus longispinosus.—Muma, 1961: 290.

Amblyseius (*Typhlodromopsis*) *longispinosus*.—Muma, 1961 : 287.

Amblyseius (*Amblyseius*) *longispinosus*.—Ehara, 1966a: 21.

Amblyseius (*Neoseiulus*) *longispinosus*.—Gupta, 1985: 354.

Female (n=10)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield smooth, anterolaterally reticulated, 333 (298–348) long, 186 (169–197) wide at level of *s*₄, 183 (170–201) wide at level of *S*₄; five pairs of solenostomes (*gd*₂, *gd*₄, *gd*₆, *gd*₈, *gd*₉), thirteen pairs of lyrifissures (*id*₁, *id*_{1a}, *id*₂, *id*₄, *id*_{m2}, *id*_{m3}, *id*_{m4}, *id*_{m5}, *id*_{m6}, *is*₁, *id*_{l2}, *id*_{l3}, *id*_{l4}); length of dorsal setae: *j*₁ 19 (15–22), *j*₃ 64 (54–76), *j*₄ 57 (52–66), *j*₅ 68 (54–80), *j*₆ 77 (58–88), *J*₂ 71 (53–88), *J*₅ 10 (7–17), *z*₂ 70 (53–98), *z*₄ 76 (56–92), *z*₅ 35 (25–42), *Z*₁ 82 (64–95), *Z*₄ 77 (69–84), *Z*₅ 85 (64–94), *s*₄ 90 (71–103), *S*₂ 79 (66–97), *S*₄ 67 (56–74), *S*₅ 19 (12–24), *r*₃ 63 (52–70), *R*₁ 61 (45–78). All setae long, serrated, except *j*₁, *J*₅, *z*₅ smooth.

Peritreme. Peritreme extending to *z*₂ level, peritrematic shield smooth, lightly sclerotized, with one pair of solenostome (*gd*₃) and one pair of lyrifissures (*id*₃).

Venter. Sternal shield reticulated, posterior margin concave, wider than long, 58 (49–66) long, 89 (79–97) wide at *st*₃ level, with three pairs of setae *st*₁ 35 (29–44), *st*₂ 35 (27–41), *st*₃ 31 (24–40) and two pairs of lyrifissures (*pst*₁, *pst*₂). Exopodal shield at

coxae II–IV. Metasternal platelets tear-shaped, with a pair metasternal setae, *st4* 32 (22–43), and one pair of lyrifissures (*pst3*). Genital shield reticulated, *st5* 32 (25–39), 72 (67–77) wide. Distances between *st1-st1* 53 (48–57), *st2-st2* 61 (56–64), *st3-st3* 74 (65–83), *st1-st3* 60 (57–63), *st5-st5* 59 (51–70). Ventrianal shield pentagonal, reticulated, 117 (111–122) long, 95 (82–103) wide at level of ZV2 and 73 (68–84) wide at level of anus; with three pairs of pre-anal setae, *JV1* 28 (21–37), *JV2* 27 (19–32), *ZV2* 28 (21–35), solenostome *gv3* crescentic, *Pa* 16 (13–18), *Pst* 18 (13–21) on shield. Setae *JV4* 19 (15–24), *JV5* 71 (56–92), *ZV1* 31 (25–37), *ZV3* 18 (12–23) on interscutal membrane. All ventral setae smooth, seta *JV5* serrated. Two pairs of metapodal plates 29 (21–36) long, 4 (3–6) wide, 14 (10–19) long, 3 (2–3) wide.

Spermatheca. Calyx of spermatheca saccular, 21 (15–24) long, 6 (5–8) wide, atrium deeply forked at juncture with major duct.

Chelicera. Movable digit 25 (23–27) long, with two teeth; fixed digit 25 (23–26) long, anterior half with two teeth, posterior half with one tooth teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): 2-3/2-2/2-1, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *St* IV (d) 82 (71–90).

Male (n=5)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3,4:ZV-1,3.

Dorsum. Dorsal shield smooth, anterolaterally reticulated, 251 (236–277) long, 173 (158–187) wide at level of *s4*, 134 (116–142) wide at level of *S4*, with five pairs of solenostomes (*gd2*, *gd4*, *gd6*, *gd8*, *gd9*), thirteen pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 13 (11–15), *j3* 45 (40–49), *j4* 42 (36–49), *j5* 45 (42–52), *j6* 53 (43–62), *J2* 50 (46–53), *J5* 8 (6–10), *z2* 51

(48–56), *z4* 53 (46–58), *z5* 29 (27–30), *Z1* 51 (46–57), *Z4* 54 (51–61), *Z5* 55 (48–61), *s4* 61 (54–66), *S2* 56 (50–64), *S4* 26 (20–30), *S5* 16 (13–21), *r3* 40 (34–47), *R1* 35 (31–40). All setae long, serrated, except *j1*, *J5*, *z5* smooth. Setae *r3* and *R1* inserted on dorsal shield.

Peritreme. Peritreme extending to *z2* level; peritrematic shield lightly sclerotized.

Venter. Sternogenital shield reticulated, posterior margin almost straight, longer than wide, 109 (104–118) long, 78 (70–81) wide at level *st2*, with five pairs of setae *st1* 24 (19–30), *st2* 26 (24–28), *st3* 20 (18–24), *st4* 20 (15–25), *st5* 18 (16–21), three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Exopodal shield at coxae II–IV. Distance between *st1-st1* 42 (39–46), *st2-st2* 52 (51–54), *st3-st3* 55 (50–59), *st4-st4* 44 (40–48), *st5-st5* 38 (37–38), *st1-st5* 100 (95–102). Exopodal shield at coxae II–IV. Ventrianal shield subtriangular, reticulated, 108 (103–119) long, 148 (140–166) wide at level of anterior corner and 55 (50–63) wide at level of anus, fused with peritrematic shield cingulum; with three pairs of pre-anal setae, *JV1* 18 (16–20), *JV2* 16 (12–20), *ZV2* 18 (10–22), solenostome *gv3* crescentic, *Pa* 10 (8–12), *Pst* 11 (8–15) on shield; *JV5* 35 (31–37) on interscutal membrane. All ventral setae smooth.

Chelicera. Movable digit 18 (16–19) long, with two teeth; fixed digit 18 (17–20), with two teeth on anterior half, with *pilus dentilis*. Spermatodactyl T-shaped, shaft 13 (12–13) long, heel rounded, foot 21 (20–24) long.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): 2-3/2-2/2-1, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *St* IV (d) 66 (63–69).

Specimens examined. PHILIPPINES: BPI, Bago Oshiro, Davao City, Mindanao, four females three nymphs (LACR 5869, Aca 7247) from *Carica papaya* (Caricaceae),

25.vi.2011, M. M. Arcelo (UPLB-MNH); BPI, Bago Oshiro, Davao City, Mindanao, five females one male (LACR 5869, Aca 7247) from *Carica papaya* (Caricaceae),

25.vi.2011, M. M. Arcelo (UPLB-MNH); BPI, Bago Oshiro, Davao City, Mindanao, two females four males one nymph (LACR 5869, Aca 7247) from *Carica papaya*

(Caricaceae), 25.vi.2011, M. M. Arcelo (UPLB-MNH); BPI, Bago Oshiro, Davao City, Mindanao, five females one male (LACR 5869, Aca 7247) from *Carica papaya*

(Caricaceae), 25.vi.2011, G. M. Quimio (UPLB-MNH).

TAIWAN: Unknown, one female from *Asclepias curassavica* (Apocynaceae),

25.xii.2003, H. S. Fang (TARL); Mt. Nanren, Manzhou Township, Pingtung County, six females (TAL094B177, 78, 81, 87, 94) from unknown plant, 16.ii.2005, C. C. Ho

(TARL); Xinshi Dist. Tainan City, one female (TAL0995B221), 13.iv.2005, C. C. Ho (TARL); Guanziling, Baihe Dist., Tainan City (23°19.301' N, 120°29.014' E, 451m),

two females (no. 1021–1, 2) from *Carica papaya* (Caricaceae), 11.i.2011, J. R. Liao (NTU); Guanziling, Baihe Dist., Tainan City (23°19.301' N, 120°29.014' E, 451m), one

female (no. 1023–3) from *Trema orientalis* (Cannabaceae), 11.i.2011, J. R. Liao (NTU); Guanziling, Baihe Dist., Tainan City (23°19.301' N, 120°29.014' E, 451m), two females

(no. 1028–4, 6) from *Phyllostachys makinoi* (Poaceae), 11.i.2011, J. R. Liao (NTU); Guanziling, Baihe Dist., Tainan City (23°19.301' N, 120°29.014' E, 451m), one female

(no. 1031–5) from *Ampelopsis* sp. (Vitaceae), 11.i.2011, J. R. Liao (NTU); Zhuolan Township, Miaoli County, one female (no. 1218–2) from *Vitis cinifera* (Vitaceae),

23.x.2013, Jean Hsu (NTU); Zhuolan Township, Miaoli County, four females (no. 1225–3, 4, 6, 10) from *Vitis vinifera* (Vitaceae), 20.xi.2013, Jean Hsu (NTU); Zhuolan

Township, Miaoli County, one female (no. 1232–3) from *Vitis cinifera* (Vitaceae), 20.xi.2013, Jean Hsu (NTU); Guanziling, Baihe Dist., Tainan City (23°20.035' N, 120°28.930' E, 348m), three females one male (no. 1825–1, 2, 4, 8) from *Manihot*

esculenta (Euphorbiaceae), 10.viii.2016, J. R. Liao (NTU); Guanziling, Baihe Dist., Tainan City (23°19.330' N, 120°28.993' E, 451m), seven females (no. 1834–1, 2, 3, 4, 5, 6, 7) from *Bauhinia variegata* (Fabaceae), 10.viii.2016, J. R. Liao (NTU).

Distribution. Asia: China (Fujian (Wu 1981), Guangdong (Wu 1982), Guangxi (Xin *et al.* 1981), Hainan (Chen *et al.* 1980), Hong Kong (Ehara & Lee 1971), Yunnan (Xin *et al.* 1981)), Egypt (Zaher 1986), India (Ehara 1958), Indonesia (Evans 1952); Japan (Ehara 1959), Malaysia (Muma 1967), Pakistan (Chaudhri *et al.* 1979); Philippines (Corpuz & Rimando 1966), South Korea (Lee & Ryu 1989), Sri Lanka (Moraes *et al.* 2004b), Taiwan (Ehara 1970), Thailand (Ehara & Bhandhufalck 1977), Vietnam (Nguyen *et al.* 2016). Europe: Russia (Wainstein 1979). North America: Cuba (Hastie *et al.* 2010), Dominican Republic (Ferragut *et al.* 2011), Guadeloupe (Moraes *et al.* 2000), Martinique (Moraes *et al.* 2000), Nicaragua (Rodríguez-Morell *et al.* 2013), Saint Barthelemy (Moraes *et al.* 2000), USA (Denmark & Evans 2011). Oceania: Australia (Ehara 1958), Hawaii (Garrett & Haramoto 1967), New Zealand (Collyer 1964a), Papua New Guinea (Schicha & Gutierrez 1985).

Remarks. Evans (1952) described this species based on three females on *Manihot utilissima* in Indonesia. Schicha (1975) examined the type specimen of *N. longispinosus* and reported the differences between *N. womersleyi*. Seta *L8* (*S5*) is short and smooth in *N. longispinosus* but longer and serrated in *N. womersleyi*. Distance between preanal pore is closer in *N. longispinosus*, but wider in *N. womersleyi*. However, Xin *et al.* (1981) reported a species *N. pseudolongispinosus*, who considered this species is close to *N. longispinosus* and *N. womersleyi*, but provided several differences (e.g. seta *S5* length same with *N. womersleyi* but distance of preanal pore same with *N. longispinosus*).

Ho *et al.* (1995) provided detailed comparisons between this species and *N.*

womersleyi about their biology, reproductive compatibility and geographical distribution. This species mainly distributed in southern Taiwan and Ludao, rather than *N. womersleyi* distributed in whole Taiwan and Penghu. Yeh *et al.* (2000) conducted the genetic diversity between *N. longispinosus* and *N. womersleyi* based on RAPD analysis; they reported these two species have greater genetic distances not like the morphological differences only few characters different.

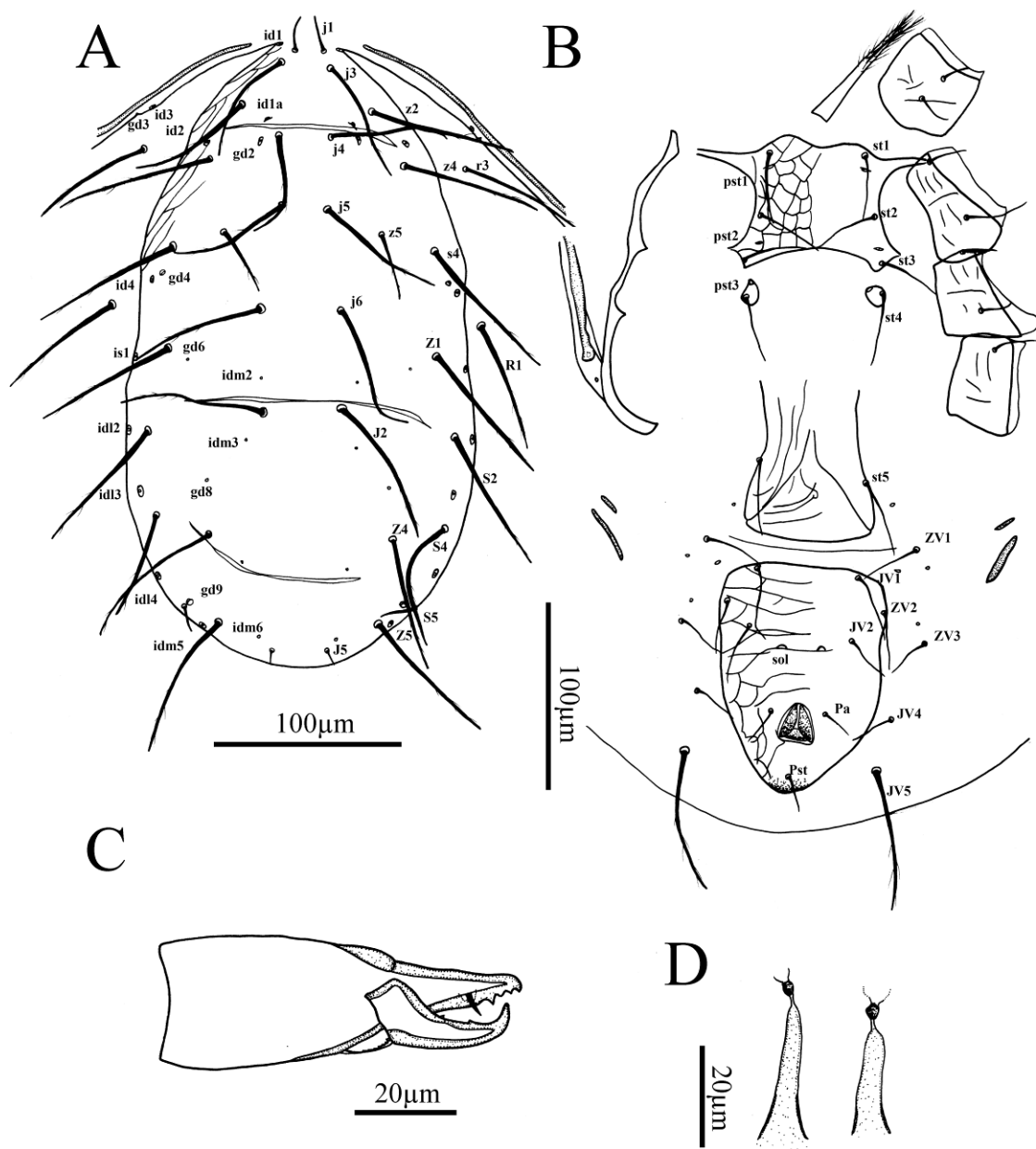


FIGURE 111. *Neoseiulus longispinosus* (Evans, 1952), Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

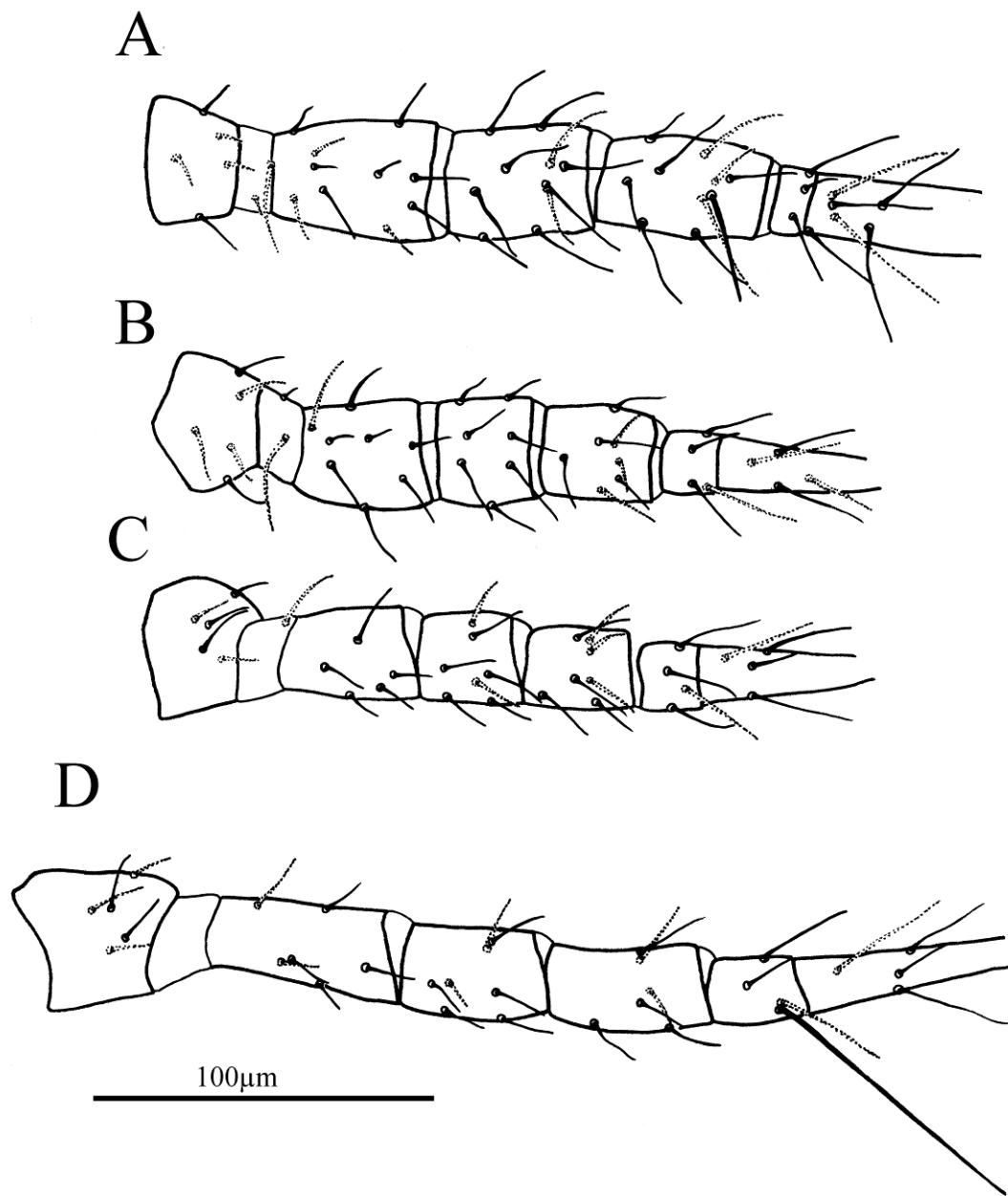


FIGURE 112. *Neoseiulus longispinosus* (Evans, 1952), Female, legs A. leg I dorsal view, B. leg II dorsal view, C. leg III anterior view, D. leg IV anterior view.

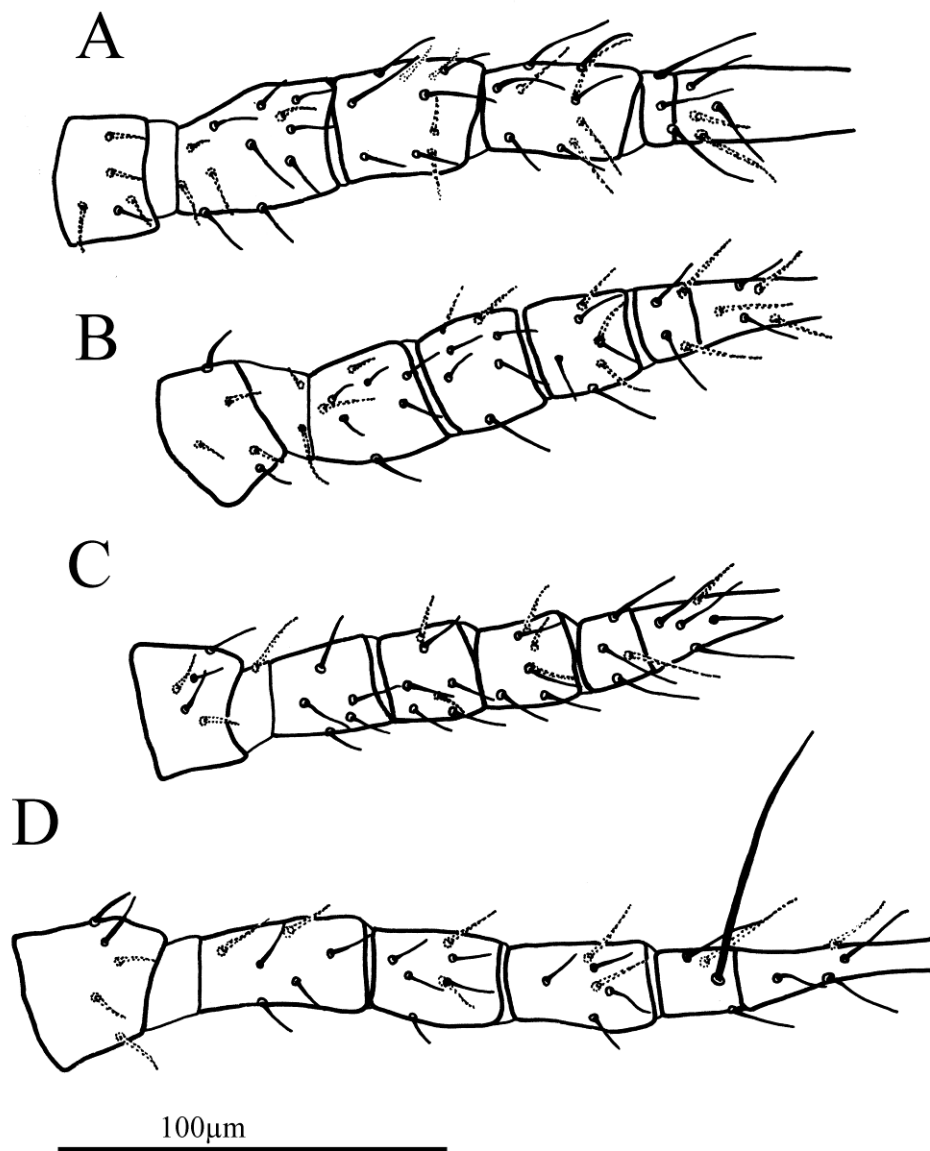


FIGURE 114. *Neoseiulus longispinosus* (Evans, 1952), Male, legs A. leg I posterior view, B. leg II dorsal view, C. leg III anterior view, D. leg IV dorsal view.

Neoseiulus makuwa (Ehara, 1972)

真桑小新綏蟎



(Figures 115–118)

Amblyseius (Amblyseius) makuwa Ehara, 1972: 154.

Amblyseius makuwa.—Wu *et al.*, 1991: 147.

Amblyseius (Neoseiulus) makuwa.—Ehara & Amano, 1998: 37.

Female (n=10)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield smooth, laterally reticulated, **333** 332 (306–347) long, **200** 193 (170–213) wide at level of *s4*, **208** 187 (163–212) wide at level of *S4*; seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), fifteen pairs of lyrifissures (*id1*, *id2*, *id4*, *id6*, *idm1*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *idx*, *is1*, *idl2*, *idl3*, *idl4*); length of dorsal setae: *j1* **16** 16 (12–19), *j3* **17** 21 (16–27), *j4* **7** 9 (6–12), *j5* **7** 9 (5–12), *j6* **6** 10 (6–13), *J2* **7** 10 (6–14), *J5* **5** 8 (5–11), *z2* **11** 12 (6–18), *z4* **9** 12 (6–17), *z5* **8** 9 (5–12), *Z1* **7** 11 (7–16), *Z4* **37** 41 (32–54), *Z5* **56** 57 (51–61), *s4* **24** 29 (23–34), *S2* **22** 18 (12–22), *S4* **11** 13 (8–16), *S5* **14** 11 (8–14), *r3* **18** 14 (9–20), *R1* **11** 11 (6–15). All setae smooth, except *Z4* and *Z5* slightly serrated.

Peritreme. Peritreme extending to *j1* level, peritremal shield smooth, lightly sclerotized, with one pair of solenostome (*gd3*) and one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, posterior margin concave, wider than long, **62** 63 (59–68) long, **79** 81 (77–89) wide at *st3* level, with three pairs of setae *st1* **29** 26 (20–30), *st2* **24** 24 (18–27), *st3* **20** 21 (16–27) and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae II–IV. Metasternal platelets tear-shaped, with a pair metasternal setae, *st4* **22** 19 (14–22), and one pair of lyrifissures (*pst3*). Genital shield smooth, *st5* **23** 22 (16–26), **71** 74 (66–89) wide. Distances between *st1*–*st1* **55** 51

(48–55), *st2-st2* **57** 64 (57–67), *st3-st3* **68** 71 (65–75), *st1-st3* **59** 61 (59–64), *st5-st5* **58** 63 (58–70). Ventrianal shield pentagonal, slightly reticulated, **109** 111 (94–123) long, **104** 99 (93–107) wide at level of ZV2 and **73** 68 (59–77) wide at level of anus; with three pairs of pre-anal setae, *JV1* **13** 16 (11–20), *JV2* **9** 15 (9–20), ZV2 **13** 17 (12–27), solenostome *gv3* crescentic, *Pa* **11** 14 (9–18), *Pst* **15** 14 (9–16) on shield. Setae *JV4* **7** 12 (7–17), *JV5* **38** 39 (35–46), *ZV1* **9** 16 (9–29), *ZV3* **12** 11 (8–16) on interscutal membrane. All ventral setae smooth. Two pairs of metapodal plates **29** 21 (14–29) long, **6** 4 (3–6) wide, **13** 11 (8–14) long, **3** 2 (1–3) wide.

Spermatheca. Calyx of spermatheca elongate, flaring distally, trumpet-like, **43** **35** (32–43) long, **9** **7** (4–10) wide, and atrium enlarged, appearing vacuolate, joined to calyx by a stalk, which slender, elongate into calyx.

Chelicera. Movable digit **30** 30 (27–32) long, with one tooth; fixed digit **29** 30 (25–32) long, anterior half with two teeth, posterior half with three teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): 2-3/2-2/1-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* IV (ad2) **42** 42 (39–49), *St* IV (d) **57** 59 (54–61).

Male (n=1)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3,4:ZV-1,3.

Dorsum. Dorsal shield smooth, laterally reticulated, 265 long, 132 wide at level of *s4*, 117 wide at level of *S4*, with seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), fifteen pairs of lyrifissures (*idl1*, *idl2*, *idl3*, *idl4*, *idm1*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *idx*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 9, *j3* 15, *j4* 7, *j5* 8, *j6* 9, *J2* 7, *J5* 6, *z2* 10, *z4* 9, *z5* 8, *Z1* 9, *Z4* 27, *Z5* 38, *s4* 14, *S2* 15, *S4* 12, *S5* 9, *r3* 12, *R1* 7. All setae

smooth, except Z4 and Z5 slightly serrated. Setae *r3* and *R1* inserted on dorsal shield.

Peritreme. Peritreme extending beyond to *j3* level; peritremal shield lightly sclerotized.

Venter. Sternogenital shield smooth, lateral slightly reticulated, posterior margin almost straight, longer than wide, 110 long, 77 wide at level *st2*, with five pairs of setae *st1* 18, *st2* 15, *st3* 15, *st4* 15, *st5* 12, three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Distance between *st1-st1* 48, *st2-st2* 56, *st3-st3* 57, *st4-st4* 46, *st5-st5* 30, *st1-st5* 102. Exopodal shield at coxae II–IV. Ventrianal shield subtriangular, reticulated, 110 long, 125 wide at level of anterior corner and 68 wide at level of anus, fused with peritremal shield cingulum; with three pairs of pre-anal setae, *JV1* 9, *JV2* 9, *ZV2* 8, solenostome *gv3* crescentic, *Pa* 6, *Pst* 9 on shield. *JV5* 17 on interscutal membrane. All ventral setae smooth.

Chelicera. Movable digit 22 long, with one tooth; fixed digit 23, with two teeth on anterior half, with *pilus dentilis*. Spermatodactyl T-shaped, shaft 19 long, heel rounded, foot 40 long,.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): 2-3/2-2/1-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* IV (ad2) 28, *St* IV (d) 45.

Specimens examined. CHINA: Shaowu City, Nanping City, Fujian Province, two females from dried leaf of *Oryza sativa* (Poaceae), 22.xi.1995 W. N. Wu (GIBAR); Mt. Baiyun, Baiyun District, Guangzhou City, Guangdong Province, one female from Poaceae plant, 25-28.vii.2001, J. Z. Lin (GIBAR); Shaowu City, Nanping City, Fujian Province, one female from dried leaf of *Oryza sativa* (Poaceae), 22.xi.1995 W. N. Wu (GIBAR); Mt. Tongbai, Nanyang City, Henan Province, one male from *Triticum*

aestivum (Poaceae), 8.vi.2001, J. Z. Lin (GIBAR).

JAPAN: Kita-ushu, Usa, Oita Prefecture, Kyushu, one holotype female (NSMT-AC13110) from *Cucumis melo* L. sp. *agrestis* var. *makuwa* (Cucurbitaceae), 13.vii.1972, M. Nakashima (NSMT); Quarantine specimen, one female (HAL095F296) from *Vitis vinifera* (Vitaceae), 3.viii.2006, Hsinchu Branch (TARL); Quarantine specimen, one female (HAL095F310) from *Brassica rapa* (Brassicaceae), 15.ix.2006, Hsinchu Branch (TARL).

TAIWAN: Zhongxingling, Xinshe Dist., Taichung City, one female from *Averrhoa carambola* (Oxalidaceae), 26.v.1987, C. C. Ho (TARL); Chuxiang, Lugu Township, Nantou County, one female from *Euphorbia hirta* (Euphorbiaceae), 13.xi.1987, C. C. Ho (TARL); Chuxiang, Lugu Township, Nantou County, eight females from *Camellia sinensis* (Theaceae), 13.xi.1987, C. C. Ho (TARL); Chuxiang, Lugu Township, Nantou County, five females from *Alternanthera nodiflora* (Amaranthaceae), 13.xi.1987, C. C. Ho (TARL); Chuxiang, Lugu Township, Nantou County, two females from *Amaranthus spinosus* (Amaranthaceae), 13.xi.1987, C. C. Ho (TARL); Chuxiang, Lugu Township, Nantou County, two females from *Ageratum houstonianum* (Asteraceae), 13.xi.1987, C. C. Ho (TARL); Chuxiang, Lugu Township, Nantou County, two females from *Camellia sinensis* (Theaceae), 11.xii.1987, C. C. Ho (TARL); Fonghuanggu, Lugu Township, Nantou County, one female from *Alternanthera nodiflora* (Amaranthaceae), 11.xii.1987, C. C. Ho (TARL); Chuxiang, Lugu Township, Nantou County, one female from *Camellia sinensis* (Theaceae), 24.xii.1987, C. C. Ho (TARL); Shizhao, Zhuqi Township, Chiayi County, one female one male (TAL077G010, 11) from witch's broom of bamboo (Poaceae), 15.vi.1988, C. C. Ho (TARL); Yilan County, seven females one male from *Rubus hayatakoidzumii* (Rosaceae), 18.ix.1988, C. C. Ho (TARL); Daping Village, Juguang Township, Lienchiang County, seven females one male (TAL092N041, 42, 43,

44, 45, 46, 47, 48) from soil of *Luffa cylindrica* (Cucurbitaceae), 17.ix.2003, C. C. Ho (TARL); Fanzitian, Tamsui Dist., New Taipei City, one female (TAL093C189) from *Glycine max* (Fabaceae), 23.vii.2004, C. C. Ho (TARL).

THAILAND: Quarantine specimen, one female (QAR102H022) from *Lactuca sativa* (Asteraceae), 15.ix.2006, Hsinchu Branch (TARL).

Distribution. Africa: Cameroon (Zannou *et al.* 2006). Asia: China (Fujian (Lin *et al.* (2000), Hainan (Wu & Ou 2002a), Jiangxi (Zhu & Chen 1983a), Wuling Mountain Reigion (Wu & Lan 1992a), Indonesia (Ehara 2002b), Japan (Ehara 1972), Saudi Arabia (Negm *et al.* 2012), South Korea (Ryu 1993), Taiwan (Tseng 1983), United Arab Emirates (Negm 2014).

Remarks. Ehara (1972) described this species from melon in Japan. The present study compared the holotype and Taiwanese specimens, no differences were found. During the survey, this species were observed which related with tetranychid mites, the biological control potential need further experiment in future.

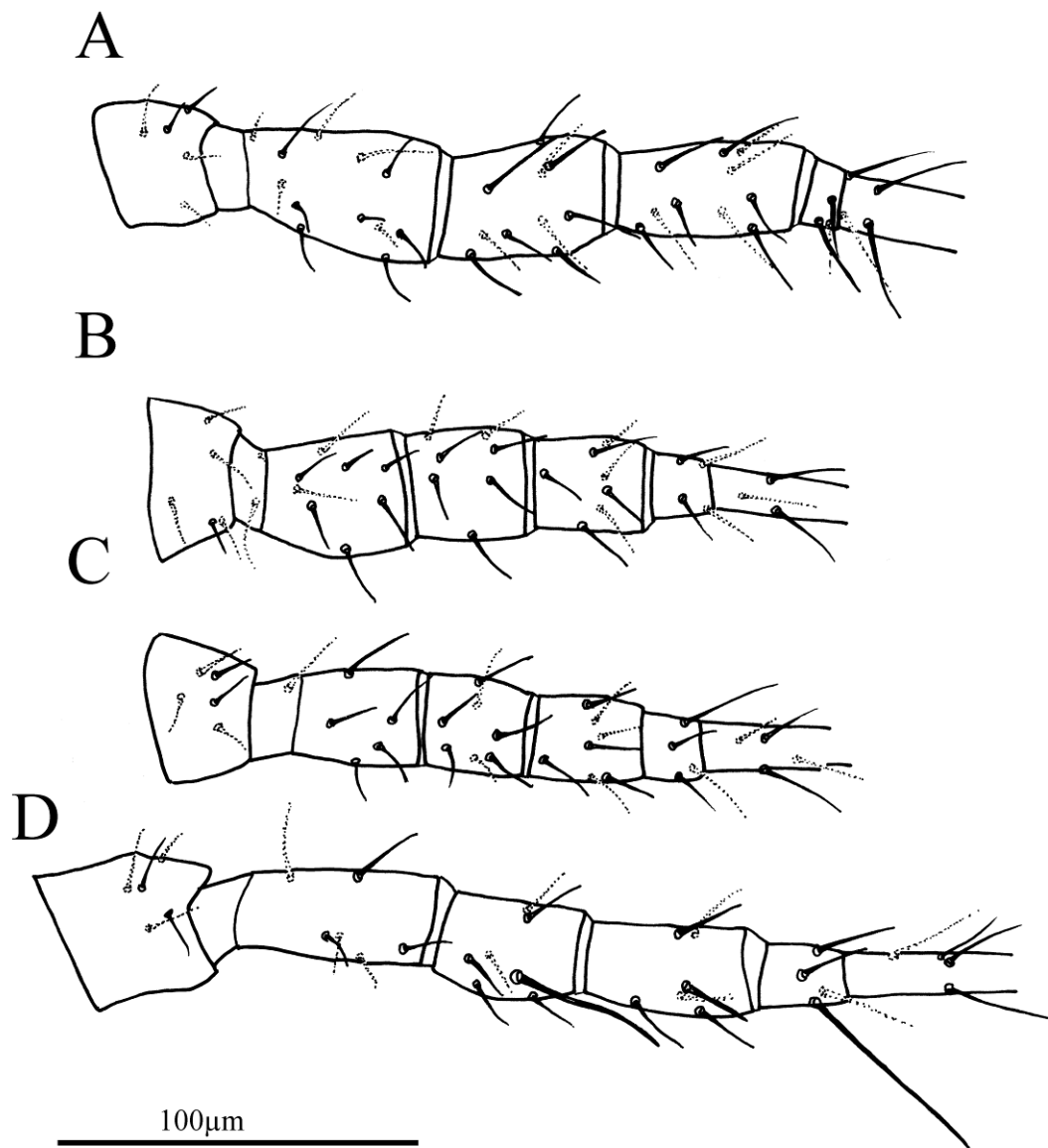


FIGURE 116. *Neoseiulus makuwa* (Ehara, 1972), Female, legs A. leg I anterior view, B. leg II dorsal view, C. leg III anterodorsal view, D. leg IV anterior view.

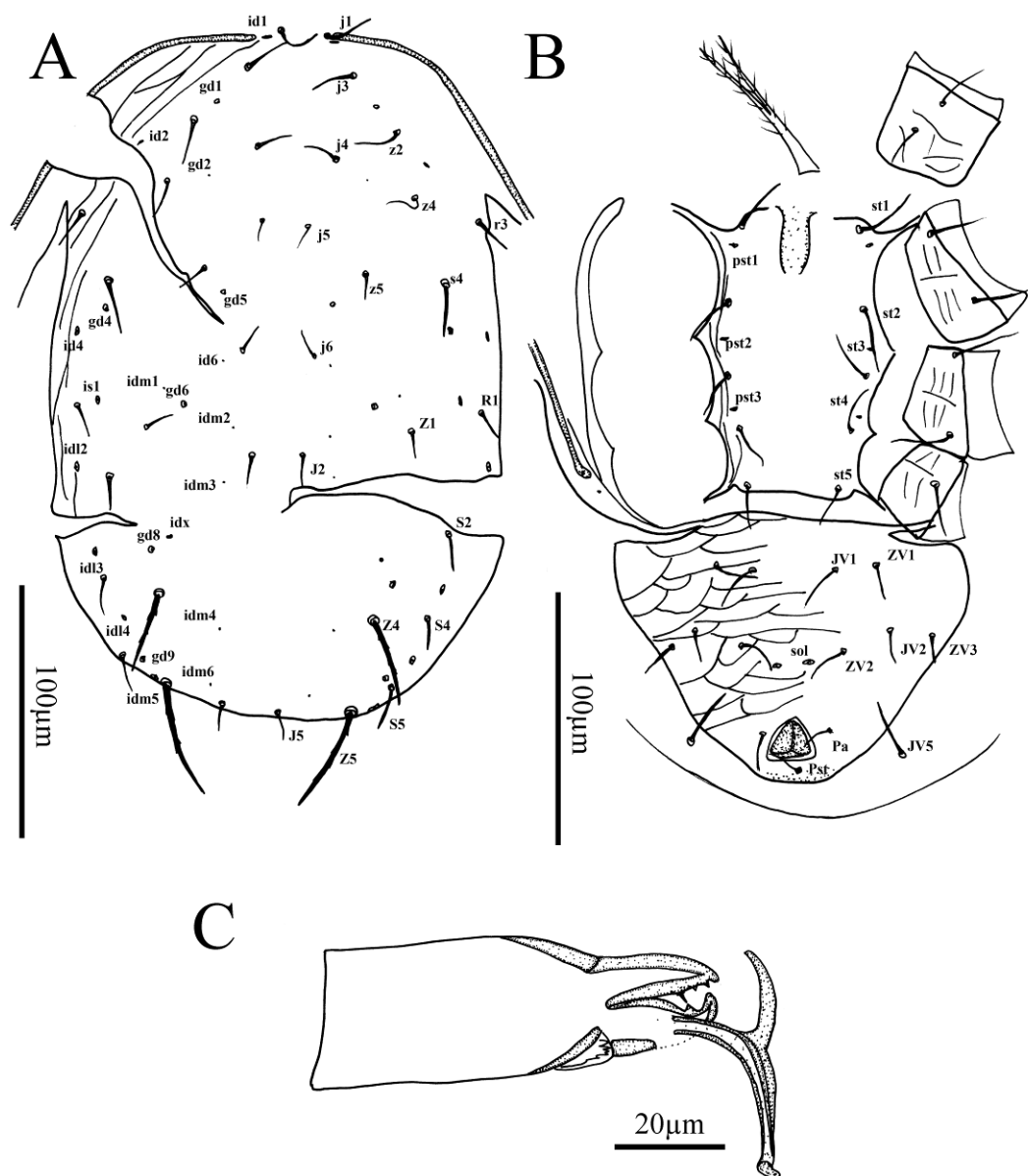


FIGURE 117. *Neoseiulus makuwa* (Ehara, 1972), Male, A. dorsal shield; B. ventral idiosoma; C. chelicera and spermatodactyl.

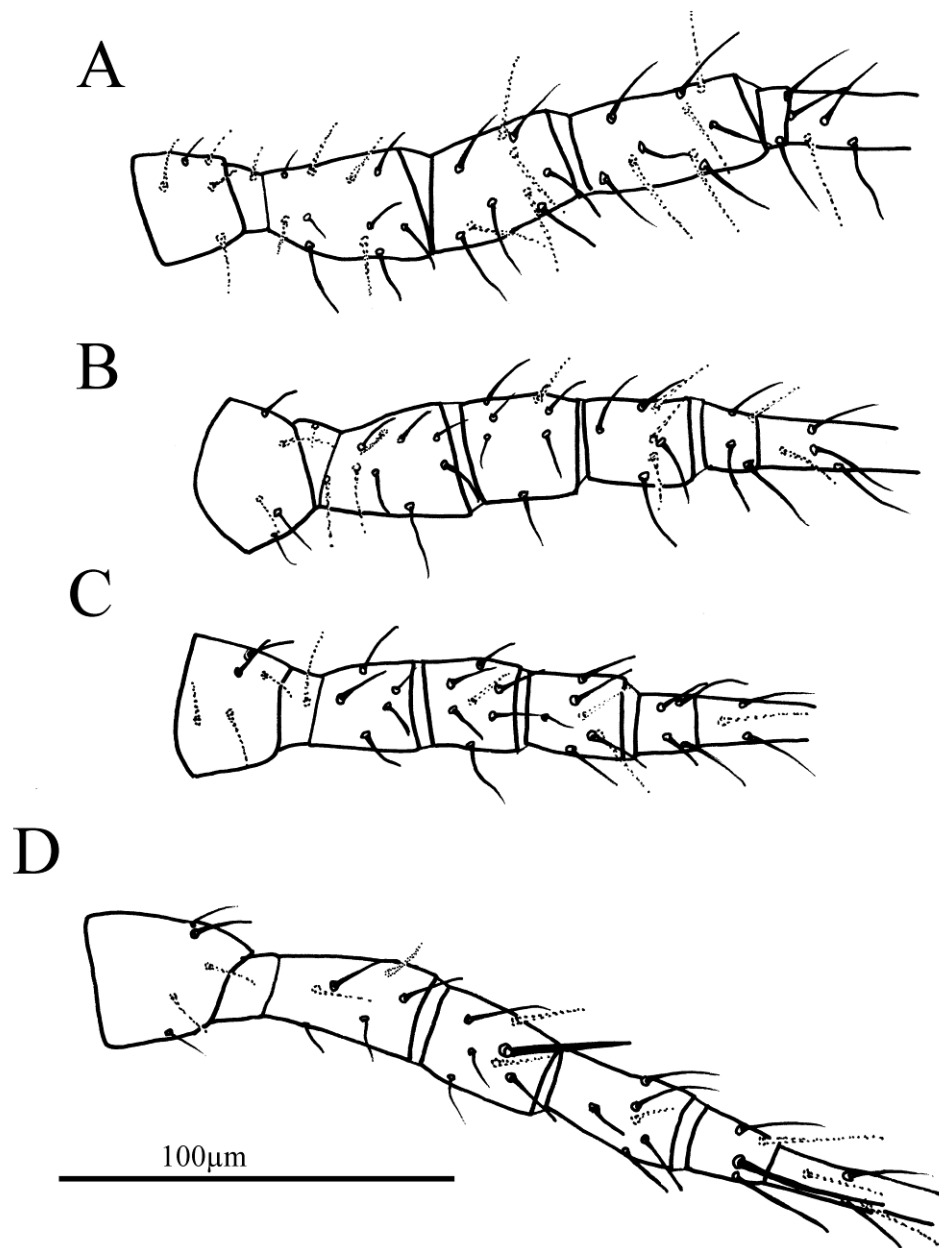


FIGURE 118. *Neoseiulus makuwa* (Ehara, 1972), Male, legs A. leg I anterior view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV dorsal view.

Neoseiulus monomacrosetus (Tseng, 1976)

單大毛小新綏蟎



(Figure 119)

Amblyseius (*Amblyseius*) *monomacroseta*.—Tseng, 1976: 121.

Amblyseius (*Neoseiulus*) *monomacroseta*.—Wu *et al.*, 2009: 99.

Neoseiulus monomacrosetus.—Moraes *et al.*, 2004a: 134.

Female

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield lightly sclerotized, smooth, 392 long, 253.8 wide; length of dorsal setae: *j1* 15, *j3* 25, *j4* 17.5, *j5* 17.5, *j6* 17.5, *J2* 17.5, *J5* ?, *z2* 12.5, *z4* 12.5, *z5* 17.5, *Z1* 17.5, *Z4* 35, *Z5* 50, *s4* 17.5, *S2* 25, *S4* 20, *S5* 12.5, *r3* 17.5, *R1* 17.5. All setae smooth.

Peritreme. Peritreme extending to *j1* level.

Venter Sternal shield wider than long, with three pairs of setae. Metasternal platelets tear-shaped, with a pair metasternal setae *st4*. Genital shield smooth, one pair of genital seta *st5*. Ventrianal shield large, pentagonal; with three pairs of pre-anal setae, solenostome *gv3* crescentic. Setae *JV5* on interscutal membrane. All ventral setae smooth. Two pairs of metapodal plates 17.5 long, 2.5 wide, ? long, ? wide.

Spermatheca. Calyx of spermatheca saccular, with neck.

Chelicera. Fixed digit anterior half with two teeth, posterior half with two teeth; movable digit unidentate.

Legs. Macrosetae: *St IV* 17.5 (?).

Specimens examined. No specimens.

Distribution. Asia: Taiwan (Tseng, 1976).

Remarks. Tseng (1976) described this species based on single holotype female

from pineapple in Tainan Hsien. The measurements lack of seta *J5* length; besides, the length of *St IV* is 17.5, it should be mistake based on illustration. However, the specimen is lost (Liao *et al.* 2017b), it is impossible to confirm the species status.

One collection data of *Neoseiulus barkeri* were found “Guanmiao Dist., Tainan City, one female from *Ananas comosus* (Bromeliaceae), 1.ix.2004, S. H. Huang (TARL)”. These specimens collected from pineapple in Tainan, it was congruent with type locality of *N. monomacroseta*. Because of the simple descriptions and illustration, the present study suspect this species is junior synonym of *N. barkeri*, but should need further study.

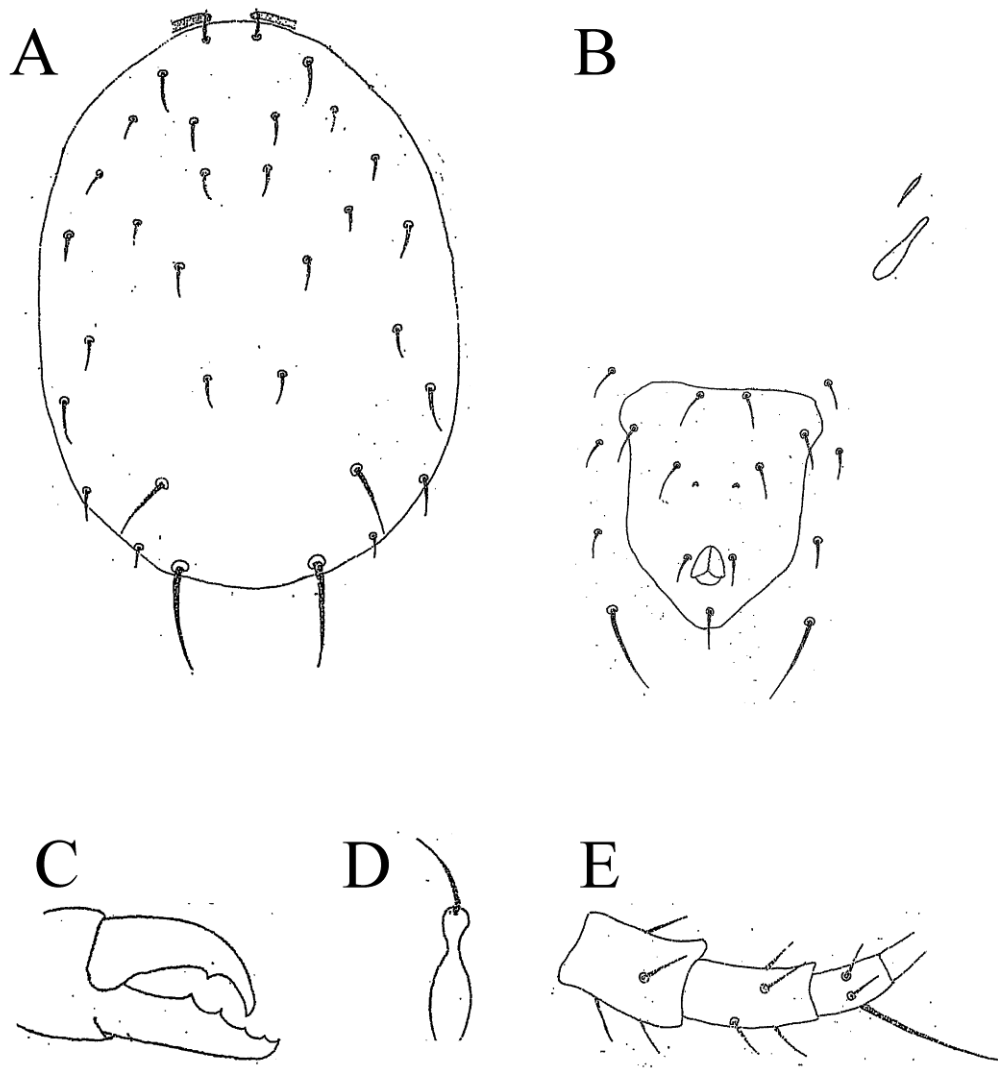


FIGURE 119. *Neoseiulus monomacrosetus* (Tseng, 1976), (after Tseng 1976), Female,
A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca, E. leg IV.

Neoseiulus spineus (Tseng, 1976)

刺小新綏蟎



(Figure 120)

Amblyseius (*Amblyseius*) *spineus*.—Tseng, 1976:118.

Amblyseius (*Neoseiulus*) *spineus*.—Wu *et al.*, 2009: 71.

Female

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield smooth, with slightly waist, smooth, 411.6 long, 243 wide; length of dorsal setae: *j1* 27.5, *j3* 45, *j4* 27.5, *j5* 27.5, *j6* 35, *J2* 45, *J5* 15, *z2* 32.5, *z4* 40, *z5* 32.5, *Z1* 47.5, *Z4* 62.5, *Z5* 85, *s4* 47.5, *S2* 57.5, *S4* 57.5, *S5* 55, *r3* 45, *R1* 45. All setae smooth.

Peritreme. Peritreme extending beyond to *j3* level.

Venter. Sternal shield as long as wide, with three pairs of setae. Metasternal platelets tear-shaped, with a pair metasternal setae *st4*. Genital shield smooth, one pair of genital seta *st5*. Ventrianal shield pentagonal, with waist, with slightly reticulated 132 long, 112.5 wide; with three pairs of pre-anal setae, solenostome *gv3* crescentic. Setae *JV5* 90 on interscutal membrane. All ventral setae smooth. Two pairs of metapodal plates 22.5 long, 3 wide, 7.5 long, ? wide.

Spermatheca. Calyx of spermatheca funnel-shaped with atrium, major duct visible.

Chelicera. Fixed digit with 10 teeth; movable digit unidentate.

Legs. Macrosetae: *Sge* IV 37.5, *Sti* IV 42.5, *St* IV 85.

Specimens examined. No specimens.

Distribution. Asia: Taiwan (Tseng, 1976).

Remarks. Tseng (1976) described this species based on only one holotype female from grape in Ho-li, Taichung Hsien. Liao *et al.* (2017b) reported that specimen was

lost. Because of the simple descriptions and illustrations, it is impossible to identify the species status. Besides, Tseng (1976) reported the lengths of three macrosetae on leg IV, but he also provided a table of macrosetae on legs distribution with two macrosetae on leg IV, this circumstance made confused. The present study consider this species have three macrosetae on leg IV based on original illustration.

During the survey in Taiwan, some specimens of *N. womersleyi* collected in Taichung, Dongshi Dist. (close to type locality of *N. spineus*); and also found *N. womersleyi* on grape. Although there are some differences between these two species, the present study suspected this species as junior synonym of *N. womersleyi*.

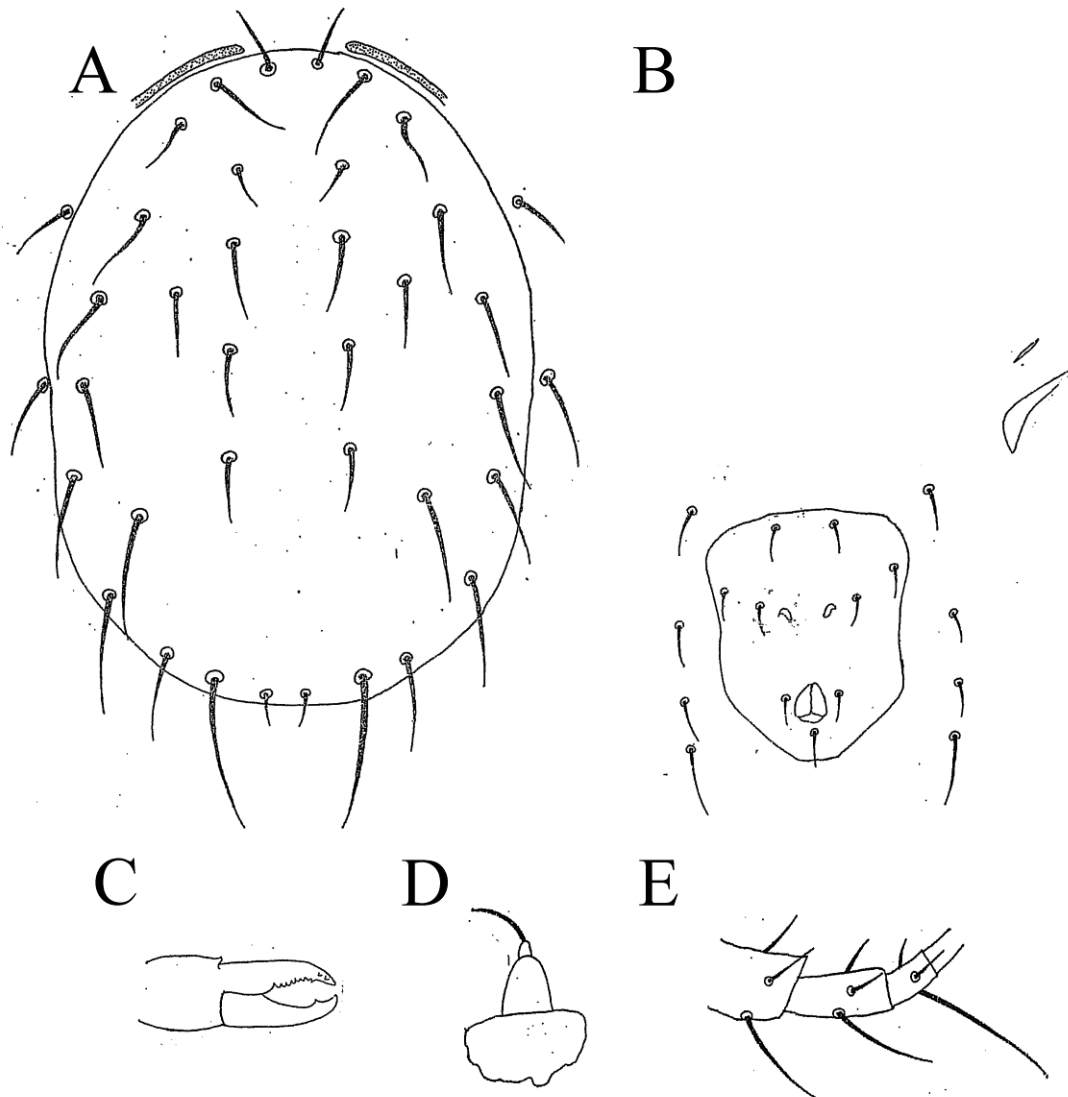


FIGURE 120. *Neoseiulus spineus* (Tseng, 1976), (after Tseng 1976), Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca, E. leg IV.

Neoseiulus taiwanicus (Ehara, 1970)

臺灣小新綏蟎



(Figures 121–124)

Amblyseius (*Amblyseius*) *taiwanicus* Ehara, 1970: 56

Amblyseius taiwanicus.—Schicha, 1981b: 206.

Amblyseius (*Neoseiulus*) *taiwanicus*.—Wu *et al.*, 2009: 124.

Female (n=6)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield strongly reticulated, much longer than wide, **351** 351 (331–363) long, **138** 145 (138–154) wide at level of s4, **135** 145 (138–154) wide at level of S4, with slightly waist at level of seta R1, and with a shoulder at level of seta r3; seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), thirteen pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of dorsal setae: *j1* **7** 9 (7–11), *j3* **13** 11 (10–13), *j4* **7** 7 (7–8), *j5* **8** 7 (6–8), *j6* **8** 8 (7–9), *J2* **10** 8 (6–10), *J5* **7** 9 (7–11), *z2* **11** 9 (7–11), *z4* **10** 9 (8–10), *z5* **9** 9 (7–11), *Z1* **10** 9 (7–12), *Z4* **18** 19 (16–27), *Z5* **46** 54 (46–58), *s4* **9** 11 (9–14), *S2* **10** 12 (10–15), *S4* **11** 12 (10–14), *S5* **15** 17 (15–21), *r3* **11** 11 (9–13), *R1* **10** 9 (7–12). All setae smooth, except seta Z5 slightly serrated.

Peritreme. Peritreme extending beyond to *j3* level, peritremal shield smooth, lightly sclerotized, with one pair of solenostome (*gd3*) and one pair of lyrifissures (*id3*).

Venter. Sternal shield long, narrow, reticulated, posterior margin straight, **81** 91 (81–101) long, **68** 75 (67–82) wide at *st3* level, with three pairs of setae *st1* **10** 9 (7–12), *st2* **10** 9 (7–10), *st3* **10** 8 (7–10) and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae II–IV. Metasternal platelets tear-shaped, with a pair metasternal setae, *st4* **9** 9 (7–14), and one pair of lyrifissures (*pst3*). Genital shield reticulated, posteriorly

truncate, *st5* **14** 9 (7–14), **70** 68 (64–71) wide. Distances between *st1-st1* **41** **43** (41–45), *st2-st2* **52** 52 (49–55), *st3-st3* **56** **56** (52–60), *st1-st3* **82** 81 (78–85), *st5-st5* **54** 57 (54–62). Ventrianal shield reticulate, quadrate, **105** 110 (103–114) long, **79** 87 (79–93) wide at level of ZV2 and **79** 81 (79–86) wide at level of anus; with three pairs of pre-anal setae, *JV1* **7** **8** (6–9), *JV2* **5** 7 (5–9), *ZV2* **8** 8 (7–10), solenostome *gv3* small and rounded, *Pa* **10** 10 (9–12), *Pst* **11** 12 (11–14). Setae *JV4* **11** **9** (7–11), *JV5* **22** 26 (22–29), *ZV1* **8** 7 (6–9), *ZV3* **9** 7 (6–9) on interscutal membrane. All ventral setae smooth. Two pairs of metapodal plates **35** 36 (34–38) long, **4** **4** (3–4) wide, **7** 7 (6–8) long, **3** 2 (1–3) wide.

Spermatheca. Calyx of spermatheca cup-shaped, **35** 36 (34–38) long, **4** **4** (3–4) wide, and atrium nodular, minor duct visible.

Chelicera. Movable digit **22** 22 (21–24) long, with two teeth; fixed digit **23** 23 (20–24) long, anterior half with two teeth, posterior half with five teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): 2-3/2-2/2-1, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *St* IV (d) **21** 24 (21–27).

Male (n=5)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3,4:ZV-1,3.

Dorsum. Dorsal shield strongly reticulated, much longer than wide, 276 (269–284) [284] long, 123 (121–126) [121] wide at level of *s4*, 123 (116–131) [119] wide at level of *S4*, with slightly waist at level of seta *R1*, and with a shoulder at level of seta *r3*; seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), thirteen pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*);

length of setae: *j1* 7 (5–8) [8], *j3* 9 (7–9) [8], *j4* 6 (6–7) [7], *j5* 6 (5–7) [7], *j6* 6 (5–8) [6], *J2* 7 (6–9) [9], *J5* 7 (5–8) [8], *z2* 7 (5–11) [7], *z4* 8 (6–9) [7], *z5* 7 (5–8) [7], *Z1* 8 (6–9) [8], *Z4* 13 (11–17) [11], *Z5* 40 (35–47) [35], *s4* 9 (8–10) [8], *S2* 10 (7–13) [7], *S4* 11 (7–12) [7], *S5* 15 (11–18) [11], *r3* 8 (7–10) [7], *R1* 8 (7–10) [7]. All setae smooth, except seta *Z5* slightly serrate, setae *r3*, *R1* on membrane. Setae *r3* and *R1* inserted on lateral integument.

Peritreme. Peritreme extending beyond to *z2* level; peritremal shield lightly sclerotized, with one pair of solenostome (*gd3*), with one pair of lyrifissures (*id3*).

Venter. Sternogenital shield reticulated, posterior margin irregular, much longer than wide, 136 (127–150) [137] long, 65 (57–74) [60] wide at level *st2*, with five pairs of setae *st1* 7 (4–10) [10], *st2* 7 (5–9) [9], *st3* 6 (5–6) [6], *st4* 6 (5–7) [7], *st5* 6 (4–7) [6], three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Exopodal shield at coxae II–IV. Distance between *st1-st1* 41 (32–50) [50], *st2-st2* 42 (38–44) [43], *st3-st3* 45 (41–54) [41], *st4-st4* 33 (29–37) [36], *st5-st5* 32 (31–34) [31], *st1-st5* 118 (112–125) [118]. Exopodal shield at coxae II–IV. Ventrianal shield subtriangular, reticulated, 102 (97–108) [108] long, 120 (115–128) [118] wide at level of anterior corner and 76 (72–79) [72] wide at level of anus, fused with peritremal shield cingulum; with three pairs of pre-anal setae, *JV1* 5 (5–6) [5], *JV2* 5 (4–6) [6], *ZV2* 6 (4–7) [4], solenostome *gv3* small and rounded, *Pa* 7 (6–8) [7], *Pst* 9 (8–10) [8] ; *JV5* 18 (15–21) [15] on interscutal membrane. All ventral setae smooth.

Chelicera. Movable digit 16 (14–18) [18] long, with one tooth; fixed digit 16 (14–19) [19] long, with two teeth on anterior half, with *pilus dentilis*. Spermatodactyl heel-and-toe variant, shaft 13 (11–19) [19] long, heel rounded, foot 8 (8–8) [8] long.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): 2-3/2-2/2-1, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1;

leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: St IV (d) 18 (17–19) [17].

Specimens examined. CHINA: Dadong sea, Sanya City, Hainan Province, one female from unknown plant, 3.xi.1983, W. N. Wu (GIBAR).

TAIWAN: Fengshan District, Kaohisung City, one holotype female (AC-13067) one allotype male (AC-1068) from *Ananas comosus* (Bromeliaceae), 24.iii.1966, S. Ehara & H. S. Chien (NSMT); Fengshan District, Kaohisung City, one female two males paratype (ZIHU-3539) from *Ananas comosus* (Bromeliaceae), 24.iii.1966, S. Ehara & H. S. Chien (HUM); TARI, Wufeng Dist., Taichung City, six females five males from rice leaf sheath *Oryza sativa* (Poaceae), 14.xi.1978, K. C. Lo (TARL).

Distribution. Asia: China (Hainan (Wu *et al.* 1997c)), Philippines (Schicha & Corpuz-Raros 1992), Taiwan (Ehara 1970), Thailand (Ehara & Bhandhufalck 1977).

Remarks. Ehara (1970) described this species from *Ananas comosus* in Kaohsiung. Based on the illustration, the distance of preanal pore is the main diagnostic characters. This species can be identified by the distance of preanal pore wider than *N. baraki*.

This species belongs to lifestyle subtype III-d, in this subtype, phytoseiid species are found in restricted space of monocotyledonous plants. They are smaller and flatter body shapes; therefore, they can live in the restricted space, such as leaf sheath.

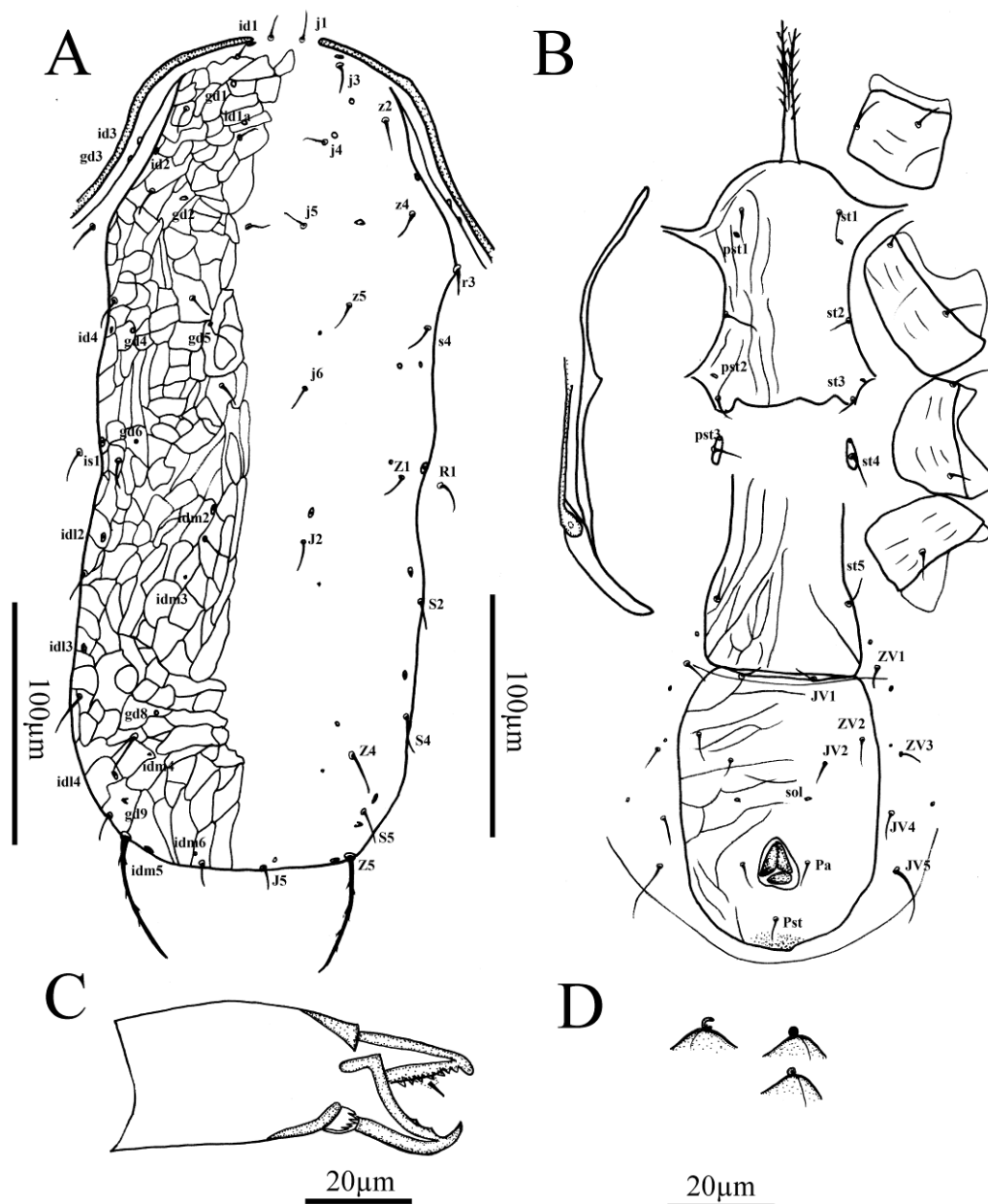


FIGURE 121. *Neoseiulus taiwanicus* (Ehara, 1970), Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

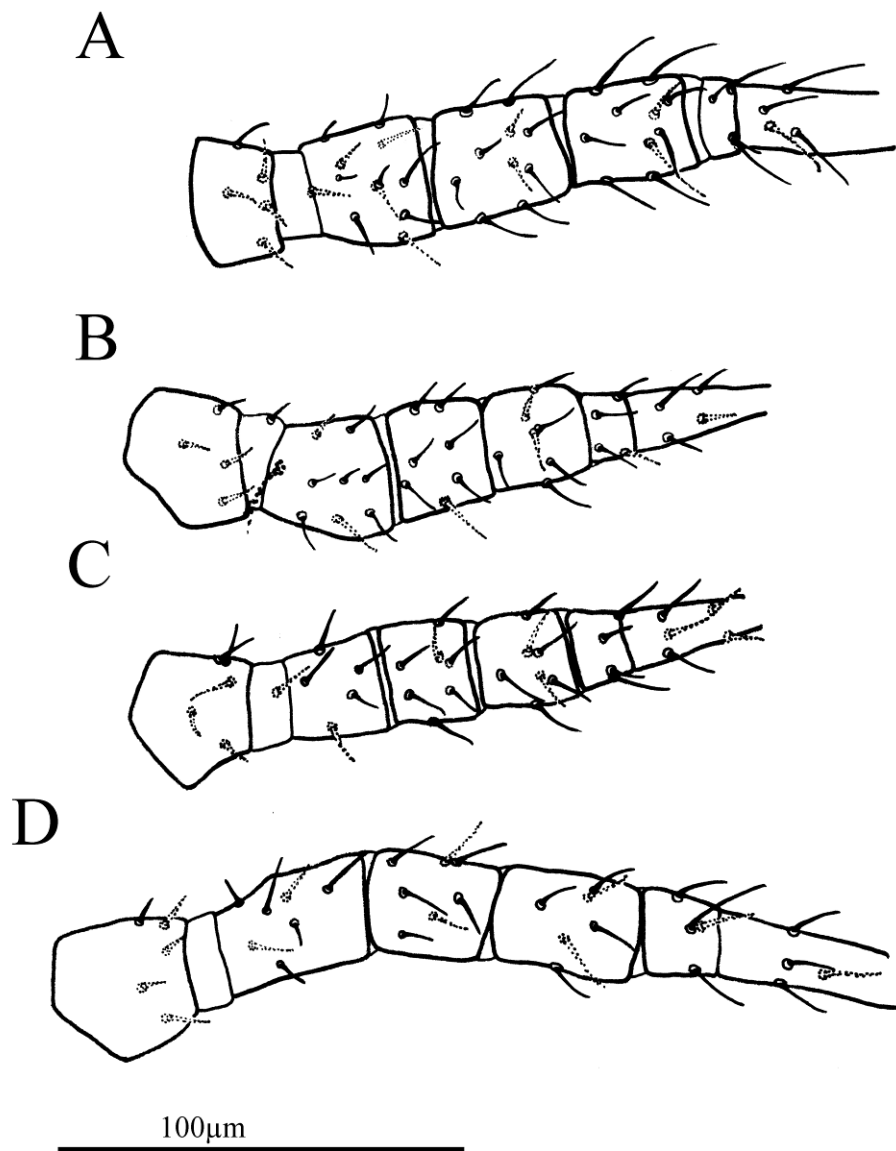


FIGURE 122. *Neoseiulus taiwanicus* (Ehara, 1970), Female, legs A. leg I dorsal view, B. leg II anterodorsal view, C. leg III dorsal view, D. leg IV posterodorsal view.

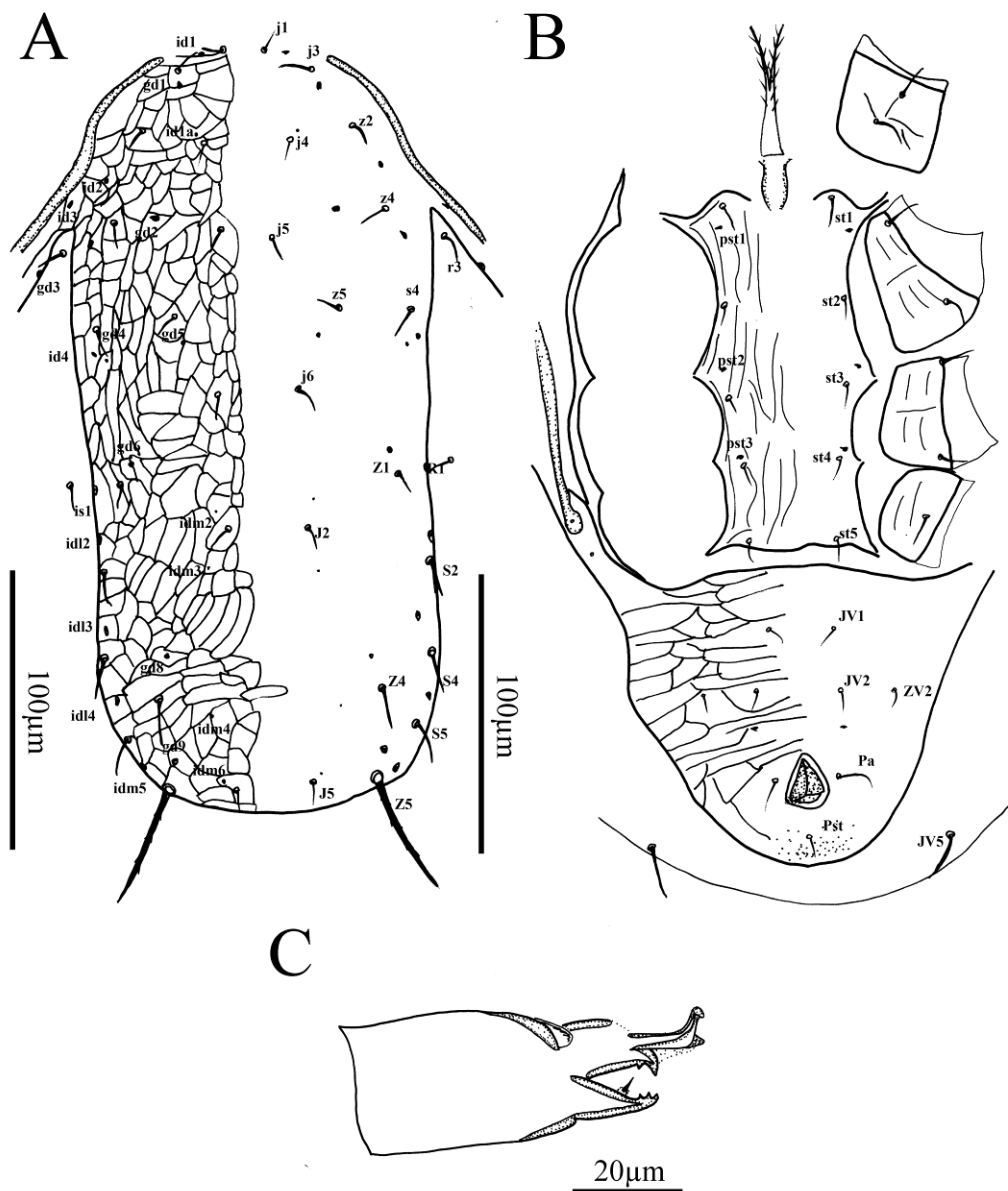
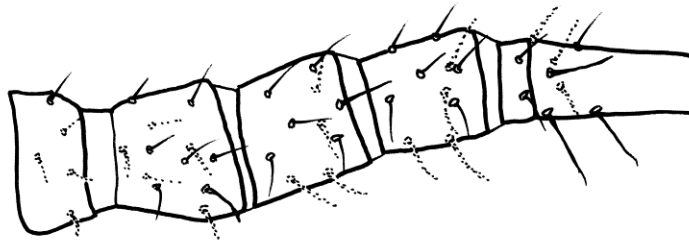


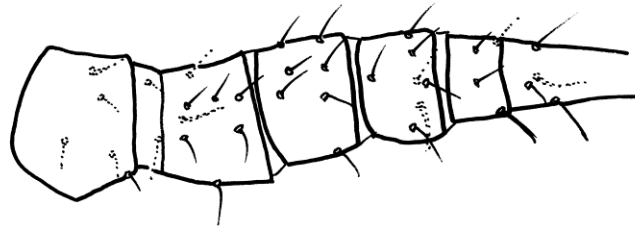
FIGURE 123. *Neoseiulus taiwanicus* (Ehara, 1970), Male, A. dorsal shield; B. ventral idiosoma; C. chelicera and spermatodactyl.



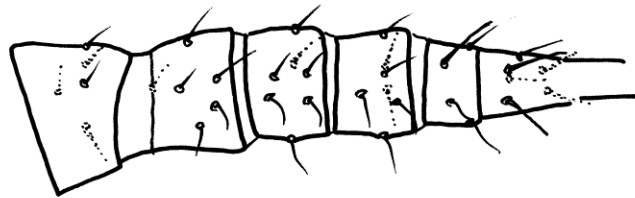
A



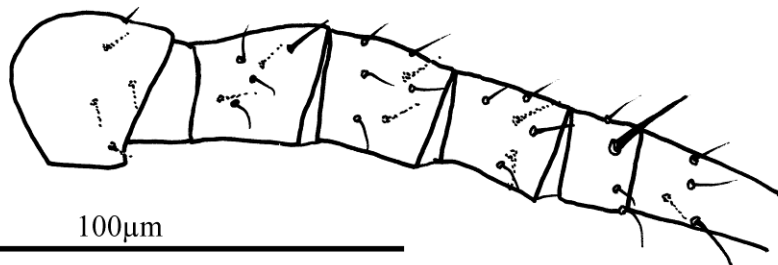
B



C



D



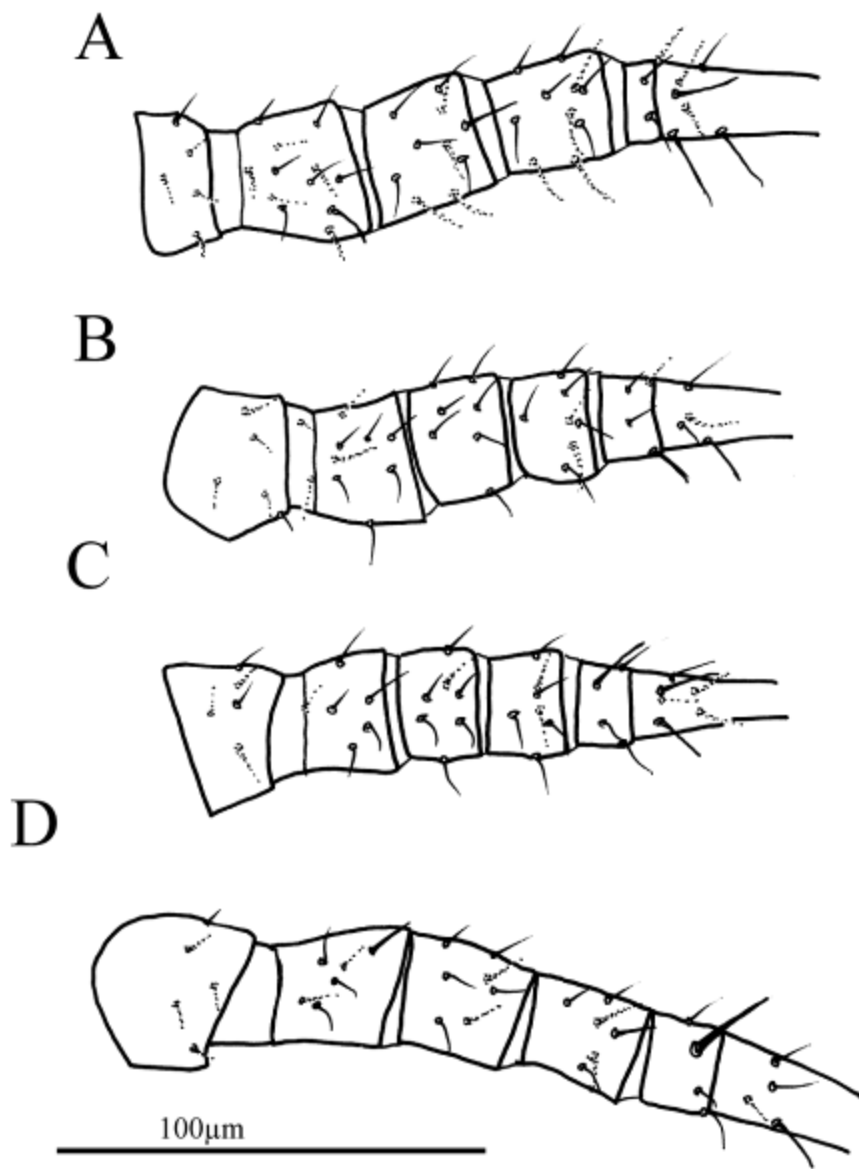


FIGURE 124. *Neoseiulus taiwanicus* (Ehara, 1970), Male, legs A. leg I dorsal view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV posterodorsal view.

Neoseiulus womersleyi (Schicha, 1975)

溫氏小新綏蟎



(Figures 125–128)

Amblyseius womersleyi Schicha, 1975: 101.

Amblyseius (*Amblyseius*) *womersleyi*.—Tseng, 1983: 54.

Amblyseius (*Neoseiulus*) *womersleyi*.—Ehara & Amano, 1998: 30.

Neoseiulus pseudolongispinosus (Xin, Liang & Ke, 1981): 75. (Synonymy according to Tseng 1983).

Female (n=9)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield smooth, anterolaterally reticulated, 340 (325–362) long, 185 (173–195) wide at level of *s*₄, 193 (171–212) wide at level of *S*₄; five pairs of solenostomes (*gd*₂, *gd*₄, *gd*₆, *gd*₈, *gd*₉), fourteen pairs of lyrifissures (*id*₁, *id*_{1a}, *id*₂, *id*₄, *id*₆, *idm*₂, *idm*₃, *idm*₄, *idm*₅, *idm*₆, *is*₁, *idl*₂, *idl*₃, *idl*₄); length of dorsal setae: *j*₁ 19 (14–24), *j*₃ 55 (42–63), *j*₄ 49 (42–60), *j*₅ 55 (50–64), *j*₆ 66 (56–78), *J*₂ 64 (54–71), *J*₅ 9 (8–12), *z*₂ 59 (53–70), *z*₄ 66 (56–81), *z*₅ 26 (22–30), *Z*₁ 68 (60–79), *Z*₄ 66 (57–76), *Z*₅ 83 (76–100), *s*₄ 74 (68–86), *S*₂ 71 (65–79), *S*₄ 61 (55–67), *S*₅ 43 (34–50), *r*₃ 52 (41–61), *R*₁ 55 (47–62). All setae long, serrate, except *j*₁, *J*₅, *z*₅ smooth.

Peritreme. Peritreme extending beyond to *j*₃ level, peritremal shield smooth, lightly sclerotized, with one pair of solenostome (*gd*₃) and one pair of lyrifissures (*id*₃).

Venter. Sternal shield smooth, posterior margin concave, wider than long, 59 (54–65) long, 86 (76–94) wide at *st*₃ level, with three pairs of setae *st*₁ 28 (24–37), *st*₂ 28 (23–32), *st*₃ 26 (24–28) and two pairs of lyrifissures (*pst*₁, *pst*₂). Exopodal shield at coxae II–IV. Metasternal platelets tear-shaped, with a pair metasternal setae, *st*₄ 27 (23–31), and one pair of lyrifissures (*pst*₃). Genital shield smooth, *st*₅ 27 (20–33), 70

(59–82) wide. Distances between *st1-st1* 52 (48–55), *st2-st2* 63 (60–67), *st3-st3* 75 (72–77), *st1-st3* 60 (56–66), *st5-st5* 63 (59–66). Ventrianal shield pentagonal, reticulated, 124 (112–134) long, 90 (85–96) wide at level of ZV2 and 76 (70–79) wide at level of anus; with three pairs of pre-anal setae, *JV1* 24 (17–28), *JV2* 24 (16–30), *ZV2* 21 (11–28), solenostome *gv3* crescentic, *Pa* 14 (10–18), *Pst* 16 (12–21) on shield. Setae *JV4* 24 (17–30), *JV5* 63 (52–77), *ZV1* 21 (11–28), *ZV3* 18 (12–27) on interscutal membrane. All ventral setae smooth, seta *JV5* serrated. Two pairs of metapodal plates 27 (23–30) long, 4 (2–6) wide, 12 (8–16) long, 3 (2–4) wide.

Spermatheca. Calyx of spermatheca saccular, 22 (19–25) long, 5 (4–6) wide atrium deeply forked at juncture with major duct.

Chelicera. Movable digit 26 (24–28) long, with three teeth; fixed digit 24 (23–27) long, anterior half with two teeth, posterior half with one tooth teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *St IV* (d) 74 (54–84).

Male (n=6)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3,4:ZV-1,3.

Dorsum. Dorsal shield smooth, laterally reticulated, 256 (238–275) long, 170 (161–176) wide at level of *s4*, 148 (141–156) wide at level of *S4*, with five pairs of solenostomes (*gd2*, *gd4*, *gd6*, *gd8*, *gd9*), fourteen pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *id6*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 17 (14–23), *j3* 39 (35–44), *j4* 33 (29–37), *j5* 41 (36–45), *j6* 46 (41–53), *J2* 51 (45–58), *J5* 8 (6–14), *z2* 44 (33–51), *z4* 46 (33–54), *z5* 24 (19–32), *Z1* 53 (44–60), *Z4* 56 (47–63), *Z5* 59 (53–65), *s4* 53 (46–60), *S2* 51 (46–57), *S4* 40 (33–48), *S5* 29 (24–34), *r3* 32 (27–37), *R1*

33 (27–38). All setae long, serrate, except *j1*, *J5*, *z5* smooth. Setae *r3* and *R1* inserted on dorsal shield.

Peritreme. Peritreme extending to *z4* level; peritremal shield lightly sclerotized.

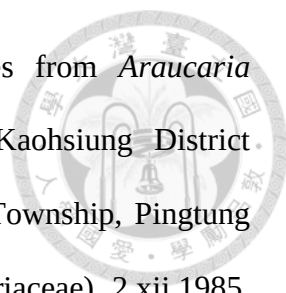
Venter. Sternogenital shield smooth, reticulated, posterior margin almost straight, longer than wide, 119 (112–131) long, 78 (69–84) wide at level *st2*, with five pairs of setae *st1* 22 (18–27), *st2* 21 (15–26), *st3* 20 (17–23), *st4* 19 (17–21), *st5* 17 (14–19), three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Exopodal shield at coxae II–IV. Distance between *st1-st1* 47 (42–49), *st2-st2* 54 (50–57), *st3-st3* 57 (55–61), *st4-st4* 48 (43–52), *st5-st5* 41 (36–49), *st1-st5* 103 (97–111). Exopodal shield at coxae II–IV. Ventrianal shield subtriangular, reticulated, 121 (101–121) long, 138 (133–143) wide at level of anterior corner and 54 (48–59) wide at level of anus, fused with peritremal shield cingulum; with three pairs of pre-anal setae, *JV1* 18 (15–22), *JV2* 16 (10–23), *ZV2* 18 (15–21), solenostome *gv3* crescentic, *Pa* 14 (12–17), *Pst* 14 (11–18); *JV5* 40 (35–44) on interscutal membrane. All ventral setae smooth.

Chelicera. Movable digit 18 (16–19) long, with two teeth; fixed digit 18 (15–20), with two teeth on anterior half, with *pilus dentilis*. Spermatodactyl T-shaped, shaft 14 (12–16) long, foot 22 (21–24) long.

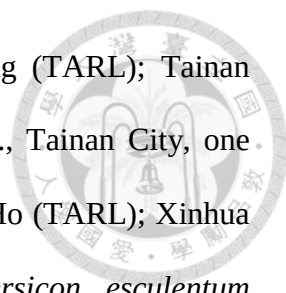
Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *St IV* (d) 61 (54–68).

Specimens examined. JAPAN: Tomigusuku, one female (ZIHU-3433-5) from *Verbena officinalis* (Verbenaceae), 22.iv.1966, K. Miyara, K. Tsudome, I. Tokashiki, S. Higashihirati, K. Uehara, S. Ehara (HUM).

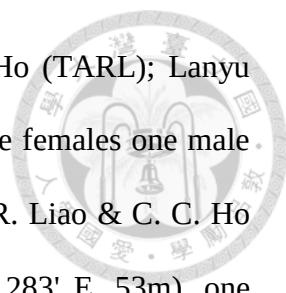
TAIWAN: Kaohsiung District Agricultural Research and Extension Station (KDAIS),



Changzhi Township, Pingtung County, five females two males from *Araucaria cunninghamii* (Araucariaceae), 2.xii.1985, C. C. Ho (TARI); Kaohsiung District Agricultural Research and Extension Station (KDAIS), Changzhi Township, Pingtung County, 13 females 2 males from *Araucaria cunninghamii* (Araucariaceae), 2.xii.1985, C. C. Ho (TARI); Shanfu Village, Liuqiu Township, Pingtung County, three females one male (89-Am-0800, 05, 06, 11) from *Mangifera indica* (Anacardiaceae), 16.iii.1989, C. C. Ho (TARL); Shanfu Village, Liuqiu Township, Pingtung County, seven females one male (89-Am-0795, 796, 797, 799, 807, 808, 809, 812) from *Solanum aculeatissimum* (Solanaceae), 16.iii.1989, C. C. Ho (TARL); Shanfu Village, Liuqiu Township, Pingtung County, one female (89-Am-0801) from *Plumbago zeylanica* (Plumbaginaceae), 16.iii.1989, C. C. Ho (TARL); Fenggui, Magong City, Penghu County, two females from *Oxalis corniculata* (Oxalidaceae), 22.iv.1989, C. C. Ho (TARL); Kinmen County, one female from *Sorghum bicolor* (Poaceae), 15.vii.1996, C. C. Ho (TARI); TARI, Wufeng Dist., Taichung City, one female (TAL090B203) from *Phalaenopsis* sp. (Orchidaceae), 30.i.2001, C. C. Ho (TARL); Zhuqi Township, Chiayi County, one female (TAL090D11) from *Setaria palmifolia* (Poaceae), 8.ii.2001, C. C. Ho (TARL); Sichongxi, Checheng Township, Pingtung County, one female one male (TAL090H220) from soil of *Ricinus communis* (Euphorbiaceae), 25.xii.2001, C. C. Ho (TARL); Kinmen County, one female (TAL091C279) from *Sida rhombifolia* (Malvaceae), 26.x.2002, C. C. Ho (TARL); Alishan, Alishan Township, Chiayi County, one female (TAL092S168) from soil of pine (Pinaceae), 30.v.2003, C. C. Ho (TARL); Haifeng Village, Pingtung City, Pingtung County, one female (TAL092I726) from soil of bamboo (Poaceae), 25.ix.2003, C. C. Ho (TARL); Heping Dist., Taichung City, one male (TAL092G649) from soil, 12.xii.2003, C. C. Ho (TARL); Endemic Species Research Institute, Jiji Township, Nantou County, one female (TAL093B009) from



Aristolochia kankauensis (Aristolochiaceae), 16.i.2004, H. S. Fang (TARL); Tainan District Agricultural Research and Extension Station, Xinhua Dist., Tainan City, one female (TAL095B204) from bamboo (Poaceae), 13.iv.2005, C. C. Ho (TARL); Xinhua Dist., Tainan City, one female (TAL094U096) from *Lycopersicon esculentum* (Solanaceae), 11.v.2005, C. C. Ho (TARL); Yuli Township, Hualien County, one female (TAL094B720) from *Broussonetia papyrifera* (Moraceae), 6.xii.2005, C. C. Ho (TARL); Historic Mountain Trail, Ludao Township, Taitung County, one female (TAL095C185) from *Miscanthus* sp. (Poaceae), 7.vi.2006, C. C. Ho (TARL); Historic Mountain Trail, Ludao Township, Taitung County, one female (TAL095C185) from *Angelica hirsutiflora* (Apiaceae), 7.vi.2006, C. C. Ho (TARL); Qingshan Village, Dongshan Dist., Tainan City, four females (HAL096B097, 98) from unknown plant, 30.i.2007, C. C. Ho (TARL); Zhiben, Taitung City, Taitung County, one female (HAL096D725) from *Asclepias curassavica* (Apocynaceae), 25.xii.2007, S. J. Chang (TARL); Donghe Township, Taitung County, two females (HAL097B069) from *Annona squamosa* (Annonaceae), 31.i.2008, C. C. Ho (TARL); Tianliaozi, Zhongpu Township, Chiayi County, one female (HAL097B461) from *Carica papaya* (Caricaceae), 7.ii.2008, C. C. Ho (TARL); Taitung County, one female (HAL097B196) from *Crotalaria pallida* (Fabaceae), 14.iv.2008, C. C. Ho (TARL); Sanmin Villange, Fuxing Dist., Taoyuan City, one female one male (no. 31-6, 8) from *Euphorbia pulcherrima* (Euphorbiaceae), 5.viii.2009, H.T. Fang & Y.H. Chiang (NTU); Liyuten Reservoir, Zhuolan Township, Miaoli County (24°20.433' N, 120°49.307' E, 335m), one female (no. 302-5) from *Euphorbia pulcherrima* (Euphorbiaceae), 27.i.2010, Y. H. Chiang (NTU); Hontou, Lanyu Island, Taitung County (22°0.798' N, 121°34.047' E, 31m), one female one male from unknown grass (Poaceae), 4.iv.2010, C. C. Ho (TARL); Shiaotientci, Lanyu Island, Taitung County, one female one male



(HAL099B174) from *Miscanthus* sp. (Poaceae), 4.iv.2010, C. C. Ho (TARL); Lanyu Township, Taitung County (22°00.881' N, 121°33.907' E, 39m), five females one male (no. 462-3, 4, 5, 6, 7, 8) from *Morus* sp. (Moraceae), 4.iv.2010, J. R. Liao & C. C. Ho (NTU); Sanwan Township, Miaoli County (24°36.850' N, 120°57.283' E, 53m), one male (no. 490-1) from *Citrus* sp. (Rutaceae), 19.iv.2010, J. R. Liao (NTU); Heping Road, Xiulin Township, Hualien County (24°18.781' N, 121°42.633' E, 698m), six females two males (no. 707-1, 2, 3, 4, 5, 6, 7, 8) from *Rhus chinensis* (Anacardiaceae), 1.viii.2010, J. R. Liao & S. F. Lin (NTU); Xigang Dist., Tainan City (23°07.146' N, 120°12.620' E, 9m), one female (no. 860-2) from *Luffa aegyptiaca* (Cucurbitaceae), 13.ix.2010, J. F. Hsieh, C. T. Chen & J. R. Liao (NTU); Fire and Water Spring, Baihe Dist., Tainan City, one male (HAL101B333) from *Miscanthus* sp. (Poaceae), 28.xi.2012, C. C. Ho (TARL); Neipu Township, Pingtung County (22°42'21.9" N, 120°38'21.8" E, 239m), three females (HAL101B338, 39, 40) from unknown plant, ??.2012, C. C. Ho (TARL); Ankeng, Xindian Dist., New Taipei City (24°56.437' N, 121°28.312' E, 69m), three females one male (no. 1212-4, 6, 7, 8) from *Carica papaya* (Caricaceae), 25.ix.2013, J. R. Liao (NTU); Zhuolan Township, Miaoli County, four females one male (no. 1225-2, 5, 7, 8, 9) from *Vitis vinifera* (Vitaceae), 23.x.2013, Jean Hsu (NTU); Tea Research and Extension Station, Yangmei Dist., Taoyuan City (24°54.292' N, 121°11.132' E, 243m), one male (no. 1686-1) from *Conyza sumatrensis* (Asteraceae), 11.v.2016, J. R. Liao (NTU).

Distribution. Asia: China (Guangdong (Chen *et al.* 1980), Japan (Amano 1994), South Korea (Ryu 1996), Taiwan (Tseng 1983). Oceania: Australia (Schicha 1975).

Remarks. Schicha (1975) examined the type of *N. longispinosus* and reported the differences between *N. womersleyi*. Seta L8 (S5) is short and smooth in *N. longispinosus* but longer and serrated in *N. womersleyi*. Distance between preanal pore

is closer in *N. longispinosus*, but wider in *N. womersleyi*. However, Xin *et al.* (1981) reported a species *N. pseudolongispinosus*, who considered this species is close to *N. longispinosus* and *N. womersleyi*, but provided several differences (e.g. seta S5 length same with *N. womersleyi* but distance of preanal pore same with *N. longispinosus*).

Ho (2005) re-evaluated the potential of biological control of this species, he considered this specie has several benefits: 1. control efficacy is same with *N. fallacis*; 2. staying on habitat plants when prey population low; 3. native natural enemy is suitable for the local weather rather than imported species (Ho & Chen 2001, 2002a, b; Ho 2005). Besides, Shih (2001) reported the automatic mass-rearing technique, and the phytoseiid commercial products had on the market in 2006.

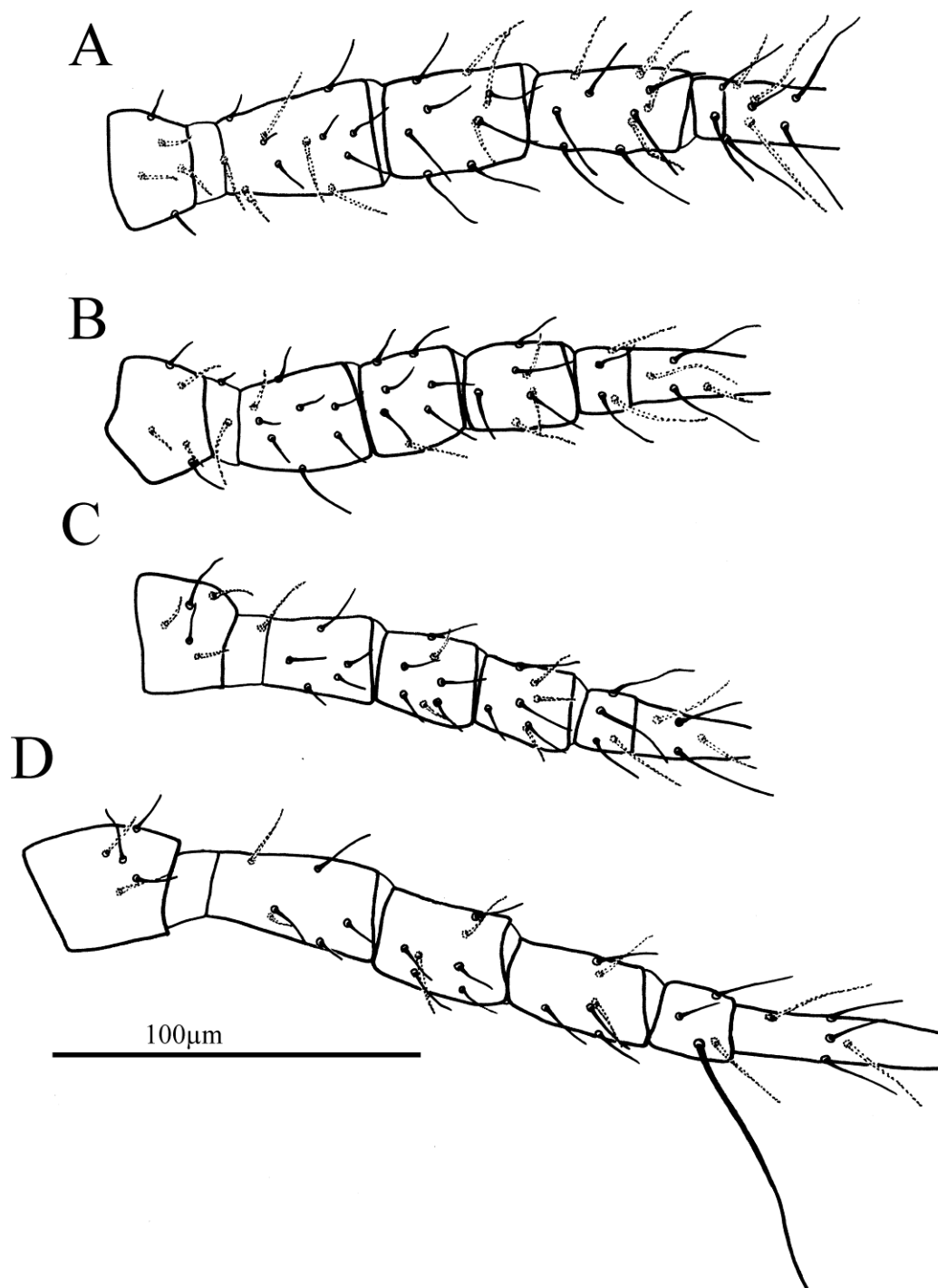


FIGURE 126. *Neoseiulus womersleyi* (Schicha, 1975), Female, legs A. leg I dorsal view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV anterior view.

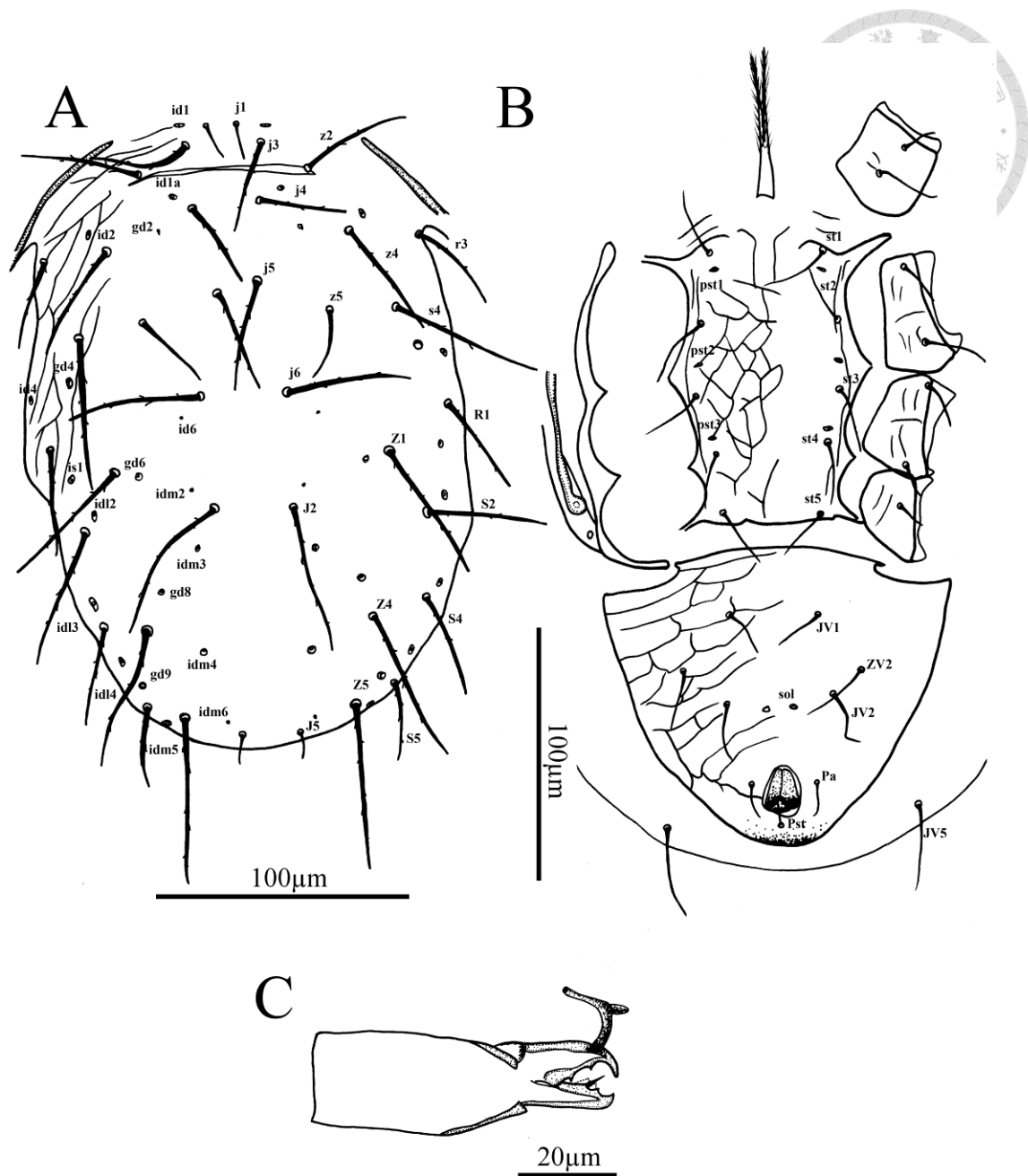


FIGURE 127. *Neoseiulus womersleyi* (Schicha, 1975), Male, A. dorsal shield; B. ventral idiosoma; C. chelicera and spermatodactyl.

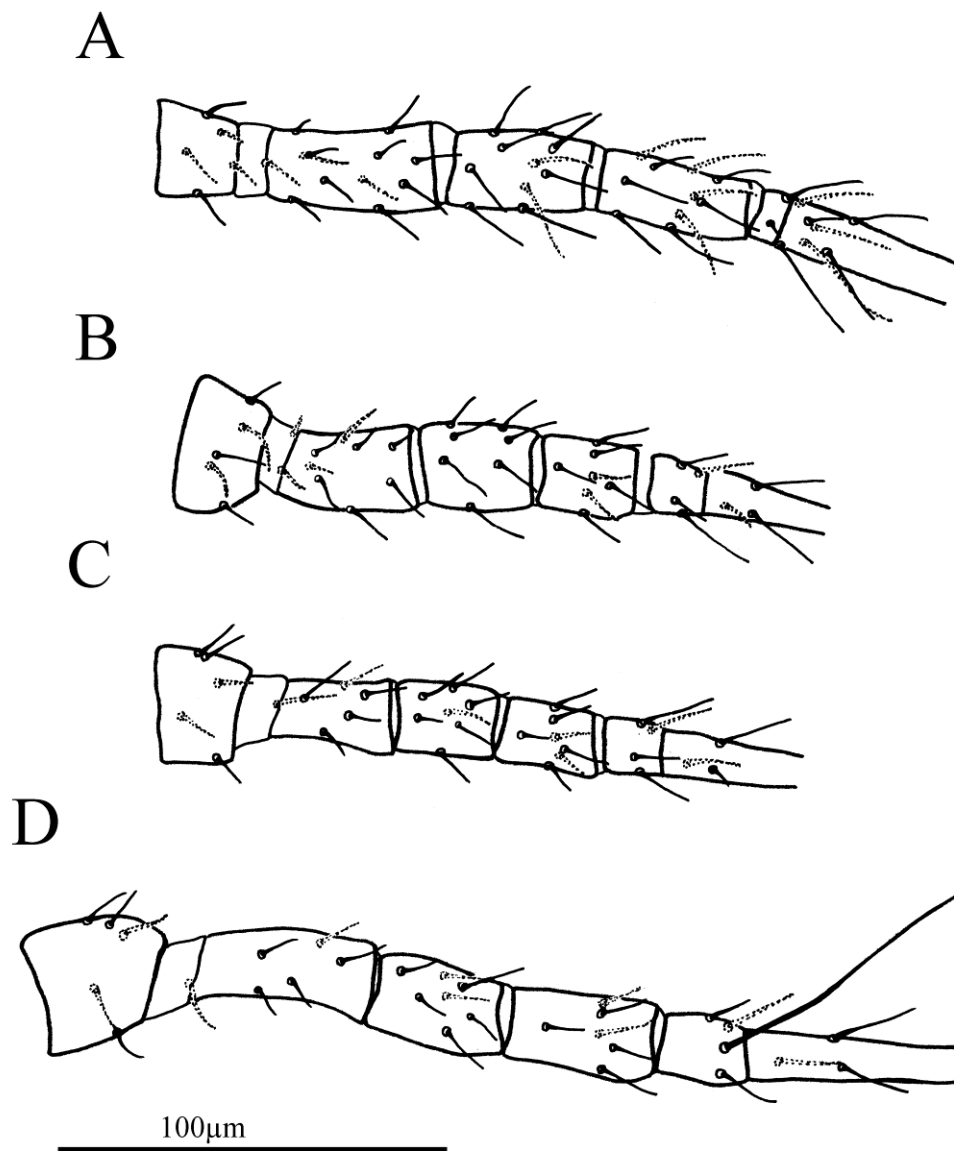


FIGURE 128. *Neoseiulus womersleyi* (Schicha, 1975), Male, legs A. leg I dorsal view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV posterodorsal view.

Tribe TYPHLODROMIPSINI Chant & McMurtry, 2005c

亦盲走蟎族

Typhlodromipsini Chant & McMurtry, 2005c: 318.



Type genus - *Typhlodromips* De Leon, 1965b: 23.

This tribe is characterized by Ge II and Ge III rarely without macrosetae; fixed digit of chelicera usually with more than 6 teeth; most species with these 2 characters together. Chant & McMurtry (2005c) provided a complicated review; proposed 8 genera belong to this tribe, including *Afrodromips* Chant & McMurtry, *Aristadromips* Chant & McMurtry, *Diaphoroseius* Chant & McMurtry, *Knopkirie* Beard, *Metadromips* Chant & McMurtry, *Phytodromips* Chant & McMurtry, *Scapulaseius* Karg & Oomen-Kalsbeek, *Typhlodromips* De Leon.

Genus *Scapulaseius* Karg & Oomen-Kalsbeek, 1987

肩綏蟎屬

Amblyseius (*Scapulaseius*) Karg & Oomen-Kalsbeek, 1987: 132.

Scapulaseius.—Chant & McMurtry, 2005c: 331.

newsami group Chant, 1959b: 95.

markwelli species group Schicha, 1987: 25.

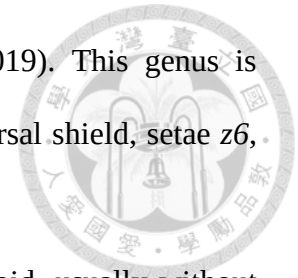
japonicus species group Schicha, 1987: 26.

japonicus species group Ehara & Amano, 1998: 26.

oguroi species group Wu & Ou, 1999: 103.

Type species - *Amblyseius* (*Scapulaseius*) *stilus* Karg & Oomen-Kalsbeek, 1987: 134.

There are 62 valid species in this genus (Demite *et al.* 2019). This genus is characterized by without significant waist at level of seta *R1* on dorsal shield, setae *z6*, *J1* absent.



Diagnosis – Idiosomal pattern 10A:9B/JV-3:ZV. Dorsal shield ovoid, usually without waist at *R1* level. Dorsal setae setiform, all setae short/minute except *Z5*, *S4* never greater than other lateral setae. Sternal shield wide as long, posterior margin straight, or concave, but few species with medium projection. Genital shield truncated posteriorly. Female ventrianal shield pentagonal, to vase-shaped, with 3 pair of preanal setae, *gv3* conspicuous. Peritreme usually extending to *j1* level. Spermatheca variable. Chelicera fixed digit usually with 6-12 teeth, movable digit with 1-3 teeth. Leg IV with 3 macrosetae, sometimes stout. Ge II with 7 setae. Male ventrianal shield triangular, with 3 pair of preanal setae, arranged in triangular pattern, spermatodactyl L-shaped, or with distinct heel and toe, or wand-shaped.

Key to the species in the genus *Scapulaseius* from Taiwan

1. Ventrianal shield broader *tienhsainensis* (Tseng, 1983)
 - Ventrianal shield pentagonal, or vase-shaped 2
2. Ventrianal shield vase-shaped 3
 - Ventrianal shield pentagonal 4
3. Calyx of spermatheca tube-shaped *cantonensis* (Schicha, 1982)
 - Calyx of spermatheca bell-shaped *vestificus* (Tseng, 1976)
4. Dorsal shield with lateral reticulated *okinawanus* (Ehara, 1967)
 - Dorsal shield with strongly reticulated *anuwati* (Ehara & Bhandhufalck, 1977)

Scapulaseius anuwati (Ehara & Bhandhufalck, 1977)

恩氏肩綏蟎



(Figures 129–132)

Amblyseius (Amblyseius) anuwati Ehara & Bhandhufalck, 1977: 63.

Amblyseius (Amblyseius) anuwanti [sic].—Wu, 1981: 205.

Typhlodromips anuwati.—Moraes *et al.*, 1986: 136.

Amblyseius anuwati.—Wu *et al.*, 1997c: 76.

Amblyseius (Neoseiulus) anuwati.—Ehara, 2002a: 30.

Female (n=8)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield nearly oval, without waist at level of *R1*, strongly reticulated; **317** 335 (317–348) long (*j1–J5* level) and **218** 225 (215–238) wide at level of *j6*, **195** 201 (189–220) wide at level of *S4*; six pairs of solenostomes on dorsal shield, (*gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), sixteen pairs of lyrifissures, (*id1*, *id1a*, *id2*, *id4*, *id6*, *idm1*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *idx*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* **10** 12 (10–15), *j3* **9** 12 (9–14), *j4* **6** 6 (5–7), *j5* **6** 5 (4–8), *j6* **6** 7 (4–9), *J2* **8** 9 (5–14), *J5* **6** 7 (3–9), *z2* **8** 9 (6–12), *z4* **6** 8 (6–12), *z5* **6** 6 (4–7), *Z1* **8** 9 (6–12), *Z4* **11** 15 (11–19), *Z5* **67** 71 (67–80), *s4* **10** 12 (10–15), *S2* **8** 10 (8–13), *S4* **9** 9 (6–12), *S5* **9** 10 (6–12), *r3* **9** 11 (9–14), *R1* **8** 10 (8–13). All setae smooth, except *Z5* serrated.

Peritreme. Peritreme extending to *j1* level; peritremal shield lightly sclerotized, with one pair of solenostomes (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, posterior margin irregular, much wider than long, **49** 58 (49–66) long, **76** 82 (76–88) wide, with three pairs of setae *st1* **16** 15 (12–18), *st2* **16** 16 (14–19), *st3* **14** 15 (13–18), and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae I–IV. Metasternal platelets tear-shaped, with one pair of metasternal setae, *st4*

13 15 (11–17), with one pair of lyrifissures (*pst3*). Genital shield smooth, with one pair of genital setae *st5* **13** 14 (12–16), **58** 76 (58–81) wide at level of genital setae. Distances between *st1-st1* **45** 52 (45–55), *st2-st2* **54** 61 (54–65), *st3-st3* **64** 70 (64–74), *st1-st3* **47** 52 (47–58), *st5-st5* **54** 64 (54–69). Ventrianal shield smooth, pentagonal with waist, **95** 106 (95–113) long, **95** 89 (84–95) wide at level of ZV2, **72** 75 (64–81) wide at level of anus; with three pairs of pre-anal setae, *JV1* **10** 10 (8–12), *JV2* **7** 8 (7–10), *ZV2* **9** 9 (7–10), solenostomes *gv3* crescentic; *Pa* **11** 11 (8–13), *Pst* **10** 13 (10–18) on shield. Setae *JV4* **8** 9 (8–11), *JV5* **17** 17 (12–20), *ZV1* **12** 10 (8–12), *ZV3* **9** 9 (8–10) on interscutal membrane. All setae smooth. Two pairs of metapodal plates **18** 19 (16–22) long, **5** 5 (4–6) wide, **10** 10 (9–12) long, **2** 2 (2–3) wide.

Spermatheca. Calyx funnel-shaped at the base, long, coiled, **24** 26 (22–33) long, **2** 2 (2–3) wide, atrium nodular, minor and major ducts visible.

Chelicera. Movable digit **19** 23 (19–26) long, with three teeth; fixed digit **18** 24 (18–28) long, anterior half with two teeth, posterior half with six teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* II (pd2) **11** 16 (11–20), *Sge* III (ad2) **22** 22 (20–26), *Sti* III (ad) **17** 18 (16–20), *St* III (ad) **11** 16 (11–19), *Sge* IV (ad2) **25** 33 (25–39), *Sti* IV (ad) **21** 24 (18–30), *St* IV (d) **29** 34 (29–37).

Male (n=4)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3,4:ZV-1,3.

Dorsum. Dorsal shield nearly oval, without waist at level of *R1*, strongly reticulated; 265 (256–277) long (*j1-J5* level) and 186 (176–200) wide at level of *j6*, 152

(138–158) wide at level of *S4*, six pairs of solenostomes on dorsal shield, (*gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), sixteen pairs of lyrifissures, (*id1*, *id1a*, *id2*, *id4*, *id6*, *idm1*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *idx*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 13 (9–15), *j3* 17 (14–19), *j4* 6 (5–6), *j5* 4 (4–5), *j6* 6 (5–7), *J2* 7 (5–9), *J5* 6 (6–6), *z2* 9 (6–12), *z4* 10 (8–13), *z5* 6 (4–9), *Z1* 7 (5–10), *Z4* 12 (10–13), *Z5* 49 (45–53), *s4* 12 (11–15), *S2* 10 (9–12), *S4* 9 (7–11), *S5* 7 (6–8), *r3* 10 (9–10), *R1* 8 (7–9). All setae smooth, except *Z5* serrated. Setae *r3* and *R1* inserted on dorsal shield.

Peritreme. Peritreme extending to *j1* level; peritremal shield lightly sclerotized, with one pair of solenostomes (*gd3*).

Venter. Sternogenital shield smooth, lateral slightly reticulated, posterior margin with slightly medium projection, longer than wide, 107 (100–110) long, 73 (68–76) wide at level of *st2*, with five pairs of setae, *st1* 13 (12–15), *st2* 10 (9–11), *st3* 10 (8–13), *st4* 11 (9–12), *st5* 11 (9–12), three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Exopodal shield at coxae I–IV. Distances between *st1*–*st1* 44 (39–46), *st2*–*st2* 52 (48–54), *st3*–*st3* 53 (52–54), *st4*–*st4* 40 (38–43), *st5*–*st5* 37 (36–38), *st1*–*st5* 96 (92–99). Exopodal shield at coxae II–IV. Ventrianal shield subtriangular, reticulated, 108 (99–115) long, 148 (145–154) wide at anterior corner, 61 (59–66) at level of anus, fused with peritremal shield cingulum; with three pairs of pre-anal setae, *JV1* 9 (8–11), *JV2* 8 (5–10), *ZV2* 9 (8–11), solenostomes *gv3* crescentic; *Pa* 11 (10–11), *Pst* 10 (9–11) on shield. Setae *JV5* 17 (13–21) on interscutal membrane. All setae smooth.

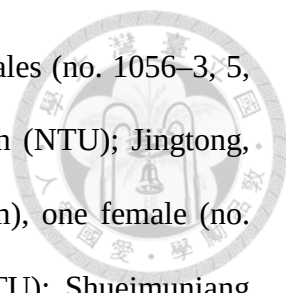
Chelicera. Movable digit 19 (17–21) long, with one tooth; fixed digit 20 (18–22) long, anterior half with two teeth, posterior half with five teeth, with *pilus dentilis*. Spermatodactyl L-shaped, shaft 16 (14–18) long, heel rounded, foot 12 (10–13) long, with expanded toe and lateral thorn-like projection.

Legs. *Legs*. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I,

2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* II (pd2) 12 (12–12), *Sge* III (ad2) 14 (11–17), *Sti* III (ad) 13 (11–15), *St* III (ad) 12 (9–15), *Sge* IV (ad2) 24 (20–27), *Sti* IV (ad) 16 (12–19), *St* IV (d) 27 (25–28).

Specimens examined. CHINA: Huidong County, Huizhou City, Guangdong Province, one female from unknown plant, 4.x.1988, W. N. Wu (GIBAR); Chebaling National Nature Reserve, Shaoguan City, Guangdong Province, one female from shrub, 24.iv.1991, W. N. Wu (GIBAR); Chebaling National Nature Reserve, Shaoguan City, Guangdong Province, one female from shrub, 24.iv.1991, W. N. Wu (GIBAR); Chebaling National Nature Reserve, Shaoguan City, Guangdong Province, one female from shrub, 23.iv.1991, W. N. Wu (GIBAR); Chebaling National Nature Reserve, Shaoguan City, Guangdong Province, one female from shrub, 25.vii.1991, W. N. Wu (GIBAR).

TAIWAN: Tonghou, Wulai Dist., New Taipei City (24°51.016' N, 121°34.166' E, 263m), one female (no. 334-1) from *Morus* sp. (Moraceae), 9.ii.2010, S.W.Kong, J. R. Liao (NTU); Luoma Road, Fuxing Dist., Taoyuan City (24°47.327' N, 121°20.328' E, 442m), one female (no. 653-5) from *Morus* sp. (Moraceae), 12.vii.2010, J. R. Liao & Y. H. Chiang (NTU); Beiyi Road, Pinglin Dist., New Taipei City (24°53.642' N, 121°44.301' E, 306m), two females (no. 929–1, 2) from *Boehmeria densiflora* (Urticaceae), 3.xi.2010, J. R. Liao (NTU); Yingshi, Datong Township, Yilan County (24°38.466' N, 121°33.369' E, 250m), five females (no. 1014–1, 2, 3, 4, 5) from *Lagerstroemia subcostata* (Lythraceae), 22.xii.2010, J. F. Hsieh (NTU); Zengwen Reservoir, Dapu Township, Chiayi County (23°13.812' N, 120°33.235' E, 301m), two females one male (no. 1044–1, 2, 3) from unknown plant, 11.i.2011, J. R. Liao (NTU);



Huisun Timberland, Guoxing Township, Nantou County, three females (no. 1056–3, 5, 7) from *Morus* sp. (Moraceae), 19.i.2011, J. R. Liao & J. F. Hsieh (NTU); Jingtong, Pingxi Dist., New Taipei City (25°01.370' N, 121°43.060' E, 275m), one female (no. 1177–11) from *Morus* sp. (Moraceae), 28.ii.2011, J. R. Liao (NTU); Shueimuniang Road, Guanxi Township, Hsinchu County (24°48.464' N, 121°11.428' E, 207m), one female (no. 1699–1) from *Rubus taiwanianus* (Rosaceae), 11.v.2016, J. R. Liao (NTU); Shueimuniang Road, Guanxi Township, Hsinchu County (24°48.464' N, 121°11.428' E, 207m), one female two males (no. 1702–1, 2, 7) from *Macaranga tanarius* (Euphorbiaceae), 11.v.2016, J. R. Liao (NTU).

THAILANDS: Prew, one holotype female (NSMT-AC13220) from *Coffea* sp. (Rubiaceae), 18.xi.1970, S. Ehara (NSMT); Prew, one paratype female (NSMT-AC13220) from *Coffea* sp. (Rubiaceae), 18.xi.1970, S. Ehara (NSMT).

Distribution. Asia: China (Fujian (Wu 1981), Hainan (Wu & Ou 2002), Jiangxi (Zhu & Chen 1983), Wuling Mountain Region (Wu & Lan 1992), Malaysia (Ehara 2002a), Taiwan (Tseng 1983), Thailand (Ehara & Bhandhufalck 1977).

Remarks. Ehara & Bhandhufalck (1977) described this species from *Coffea* sp. in Thailand. The present study compared type specimens and Taiwanese specimens, no significant differences were observed. Ehara & Bhandhufalck (1977) only reported fixed digit multidentate, but, it is impossible to examine teeth number of type specimens (NSMT-AC13220) due to position. Tseng (1983) reported that fixed digit with nine teeth, movable digit with two teeth. Wu *et al.* (1997; 2009) reported that fixed digit multidentate, movable digit with two to three teeth based on Chinese specimens. Oliveira *et al.* (2012) described this species without teeth number based on Thailand specimens. The present study reported that fixed digit with eight teeth, movable digit with three teeth. Therefore, the combination of teeth number is still uncertain until now.

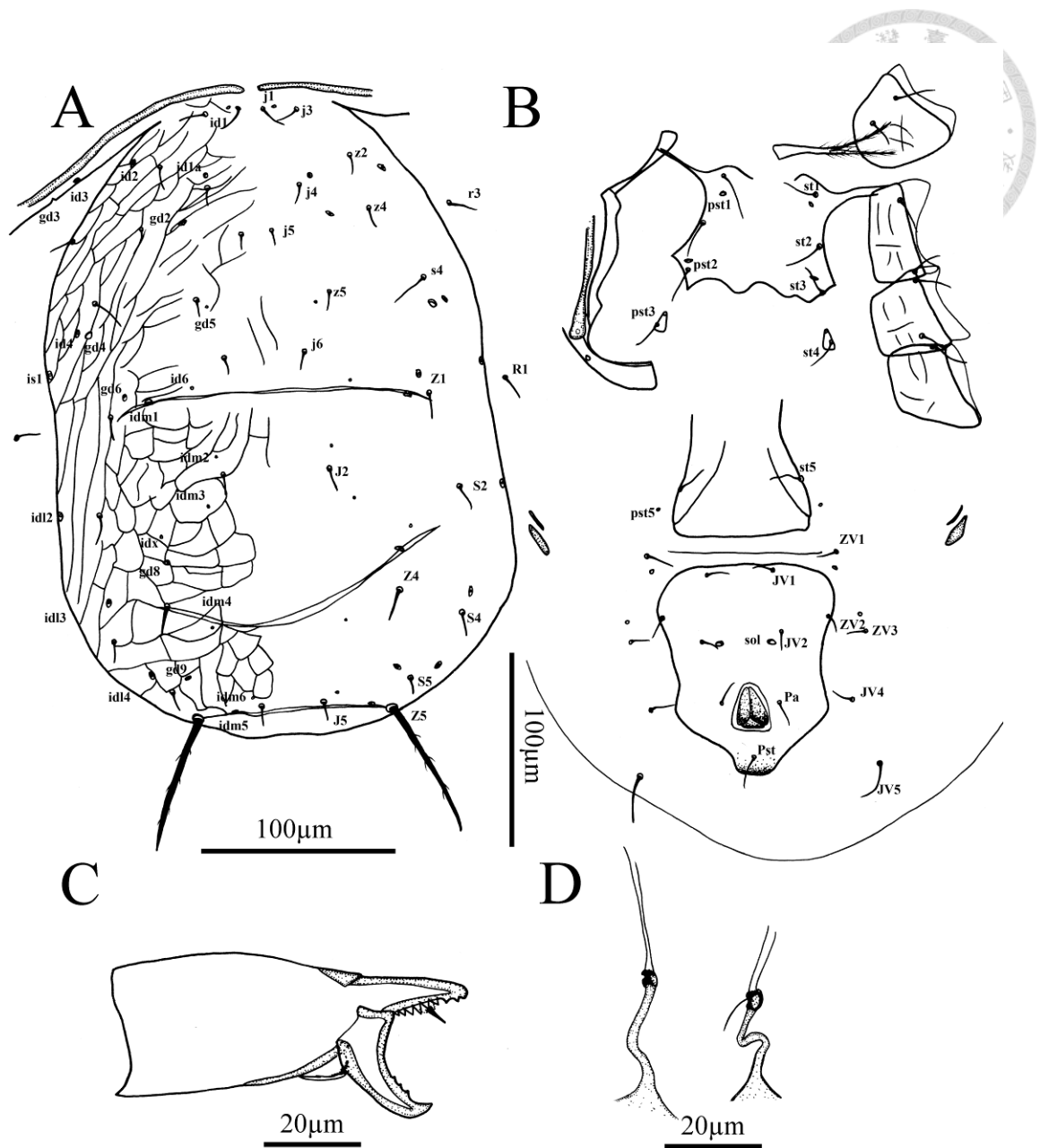


FIGURE 129. *Scapulaseius anuwati* (Ehara & Bhandhufalck, 1977), Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

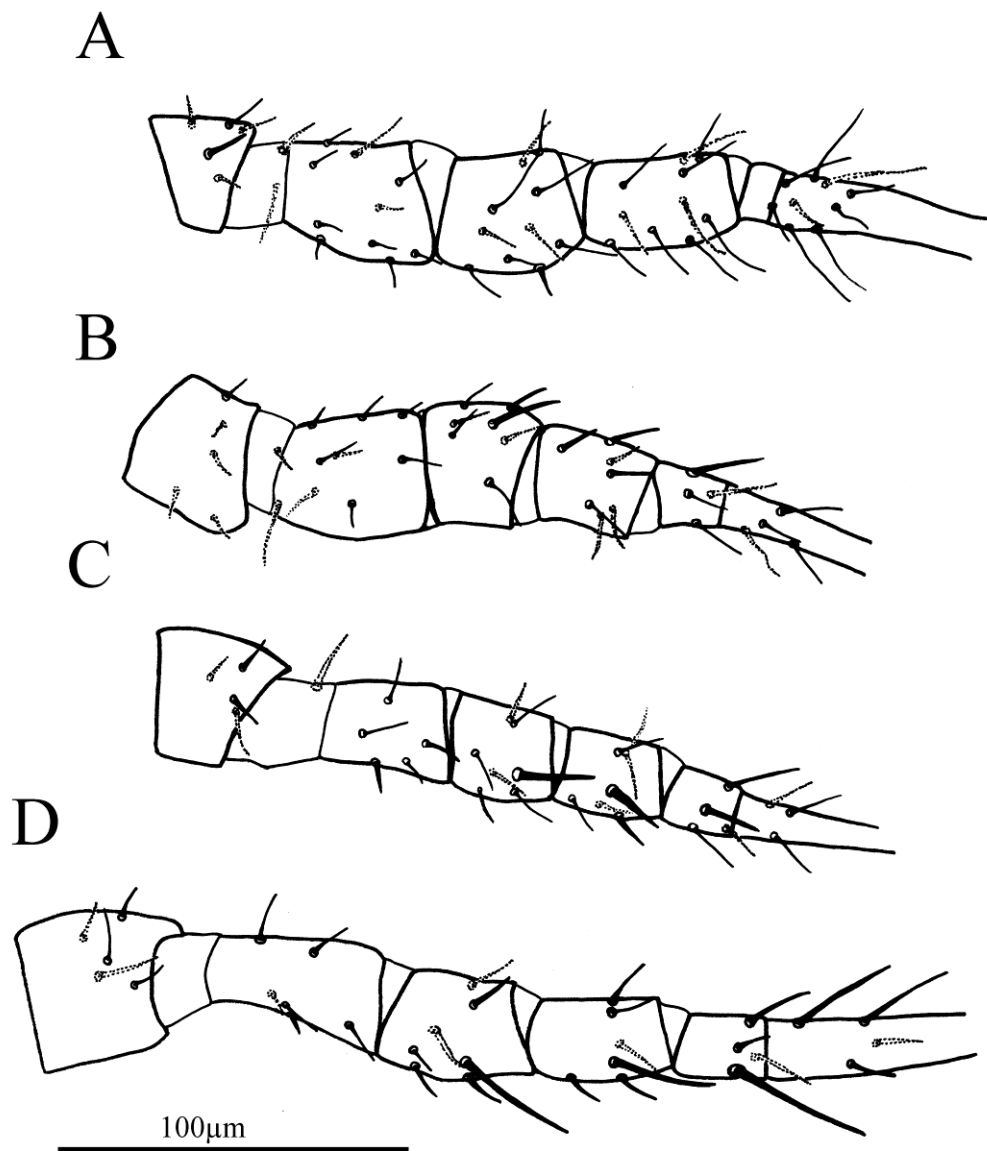


FIGURE 130. *Scapulaseius anuwati* (Ehara & Bhandhufalck, 1977), Female, legs A. leg I anterior view, B. leg II posterior view, C. leg III anterior view, D. leg IV anterior view.

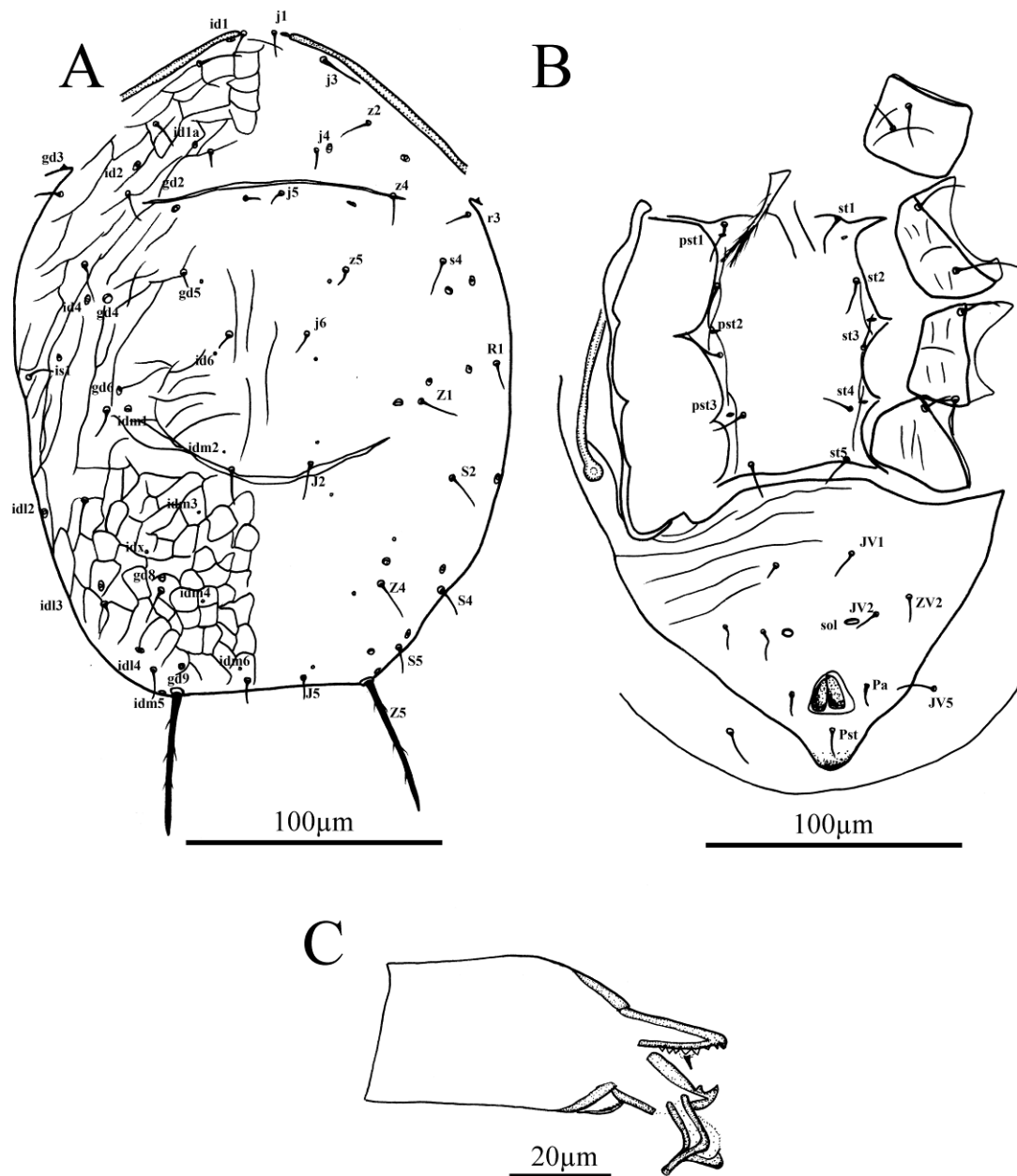


FIGURE 131. *Scapulaseius anuwati* (Ehara & Bhandhufalck, 1977), Male, A. dorsal shield; B. ventral idiosoma; C. chelicera and spermatodactyl.

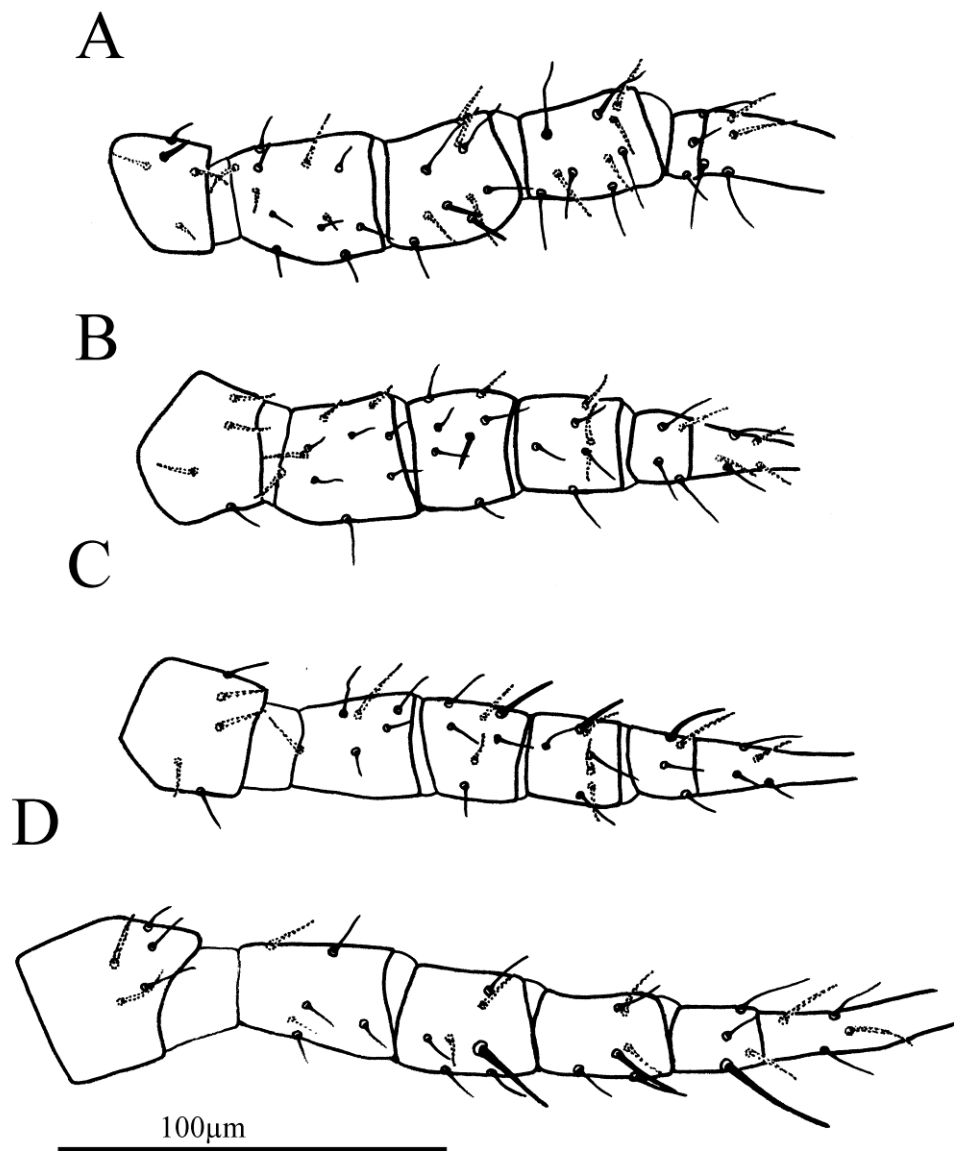


FIGURE 132. *Scapulaseius anuwati* (Ehara & Bhandhufalck, 1977), Male, legs A. leg I anterior view, B. leg II dorsal view, C. leg III posterior view, D. leg IV anterior view.

Scapulaseius cantonensis (Schicha, 1982)

廣東肩綏蟎



(Figures 133–136)

Amblyseius cantonensis Schicha, 1982: 48.

Female (n=10)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield nearly oval, without waist at level of *R1*, laterally reticulated; 361 (312–385) long (*j1*–*J5* level) and 255 (231–27) wide at level of *j6*, 231 (205–258) wide at level of *S4*; seven pairs of solenostomes on dorsal shield, (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), sixteen pairs of lyrifissures, (*id1*, *id1a*, *id2*, *id4*, *id6*, *idm1*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *idx*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 26 (21–31), *j3* 11 (9–16), *j4* 8 (6–9), *j5* 7 (6–9), *j6* 7 (6–11), *J2* 12 (9–15), *J5* 6 (4–8), *z2* 9 (7–10), *z4* 8 (7–10), *z5* 8 (6–11), *Z1* 10 (8–13), *Z4* 11 (9–15), *Z5* 54 (44–61), *s4* 15 (12–20), *S2* 11 (9–13), *S4* 11 (9–14), *S5* 9 (7–12), *r3* 11 (7–13), *R1* 11 (9–13). All setae smooth, except *Z5* serrated.

Peritreme. Peritreme extending to *j1* level; peritremal shield lightly sclerotized, with one pair of solenostomes (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, posterior margin irregular, much wider than long, 67 (60–73) long, 85 (77–97) wide, with three pairs of setae *st1* 23 (20–31), *st2* 23 (17–32), *st3* 21 (15–24), and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae I–IV. Metasternal platelets tear-shaped, with one pair of metasternal setae, *st4* 20 (15–25), with one pair of lyrifissures (*pst3*). Genital shield smooth, with one pair of genital setae *st5* 21 (14–26), 82 (73–92) wide at level of genital setae. Distances between *st1*–*st1* 58 (51–69), *st2*–*st2* 69 (60–78), *st3*–*st3* 71 (65–78), *st1*–*st3* 61 (56–80), *st5*–*st5* 71 (62–67). Ventrianal shield vase-shaped, smooth, 112 (106–119) long, 66 (60–71) wide at level of

ZV2, 76 (65–81) wide at level of anus; with three pairs of pre-anal setae, JV1 18 (13–22), JV2 17 (14–20), ZV2 13 (10–17), solenostomes *gv3* crescentic; *Pa* 14 (12–16), *Pst* 16 (13–20) on shield. Setae JV4 10 (8–13), JV5 30 (23–36), ZV1 13 (9–16), ZV3 10 (8–11) on interscutal membrane. All setae smooth. Two pairs of metapodal plates 25 (21–30) long, 5 (3–6) wide, 11 (8–13) long, 2 (1–3) wide.

Spermatheca. Calyx cup-shaped with distal half only lightly sclerotized, 4 (3–5) long, 5 (4–6) wide, atrium connected to the calyx, minor and major ducts visible.

Chelicera. Movable digit 27 (25–29) long, with three teeth; fixed digit 27 (26–29) long, anterior half with two teeth, posterior half with six teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/1-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/1-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* I (pd2) 25 (23–30), *Sge* II (pd2) 30 (25–34), *Sge* III (ad2) 39 (32–47), *Sti* III (ad) 28 (22–38), *St* III (ad) 23 (19–28), *Sge* IV (ad2) 61 (53–76), *Sti* IV (ad) 42 (36–50), *St* IV (d) 55 (47–61).

Male (n=5)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3,4:ZV-1,3.

Dorsum. Dorsal shield nearly oval, without waist at level of *R1*, reticulated; 259 (246–275) long (*j1*–*J5* level) and 194 (184–202) wide at level of *j6*, 157 (148–167) wide at level of *S4*, seven pairs of solenostomes on dorsal shield, (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), sixteen pairs of lyrifissures, (*id1*, *id1a*, *id2*, *id4*, *id6*, *idm1*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *idx*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 22 (18–24), *j3* 29 (28–32), *j4* 6 (4–8), *j5* 5 (3–6), *j6* 5 (5–6), *J2* 8 (7–9), *J5* 6 (5–6), *z2* 8 (7–10), *z4* 9 (8–12), *z5* 7 (5–8), *Z1* 8 (6–10), *Z4* 8 (7–10), *Z5* 45 (41–48), *s4* 13 (12–14), *S2* 8 (7–9), *S4* 7 (6–8), *S5* 7 (5–8), *r3* 11 (7–14), *R1* 9 (7–11). All setae smooth, except *Z5* serrated. Setae *r3* and *R1*

inserted on dorsal shield.

Peritreme. Peritreme extending to *j3* level; peritremal shield lightly sclerotized.

Venter. Sternogenital shield smooth, longer than wide, 116 (104–129) long, 76 (72–81) wide at level of *st2*, with five pairs of setae, *st1* 17 (13–21), *st2* 16 (14–19), *st3* 15 (14–17), *st4* 14 (12–17), *st5* 13 (10–15), three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Exopodal shield at coxae I–IV. Distances between *st1-st1* 45 (41–46), *st2-st2* 56 (52–60), *st3-st3* 53 (51–54), *st4-st4* 40 (36–43), *st5-st5* 30 (27–33), *st1-st5* 105 (100–108). Exopodal shield at coxae II–IV. Ventrianal shield subtriangular, reticulated, 104 (95–110) long, 152 (142–157) wide at anterior corner, 56 (54–61) at level of anus, fused with peritremal shield cingulum; with three pairs of pre-anal setae, *JV1* 11 (9–15), *JV2* 12 (10–13), *ZV2* 9 (7–12), solenostomes *gv3* crescentic; *Pa* 10 (9–11), *Pst* 11 (11–12) on shield. Setae *JV5* 19 (15–25) on interscutal membrane. All setae smooth.

Chelicera. Movable digit 21 (19–24) long, with one tooth; fixed digit 22 (20–24) long, anterior half with one tooth, posterior half with seven teeth, with *pilus dentilis*. Spermatodactyl L-shaped, shaft 13 (13–14) long, heel rounded, foot 7 (6–8) long, with expanded toe and lateral thorn-like projection.

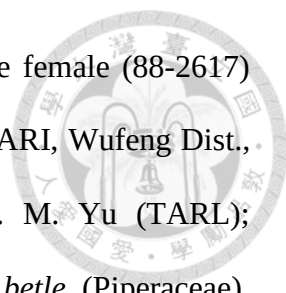
Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/1-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/1-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* I (pd2) 22 (19–25), *Sge* II (pd2) 22 (21–25), *Sge* III (ad2) 30 (24–33), *Sti* III (ad) 22 (19–24), *St* III (ad) 20 (18–23), *Sge* IV (ad2) 43 (37–53), *Sti* IV (ad) 32 (27–38), *St* IV (d) 45 (40–52).

Specimens examined. CHINA: Xinglong town, Wanning City, Hainan Province, one female from unknown plant, unknown plant, W. N. Wu (GIBAR); Mt. Baiyun, Baiyun District, Guangzhou City, Guangdong Province, one female paratype

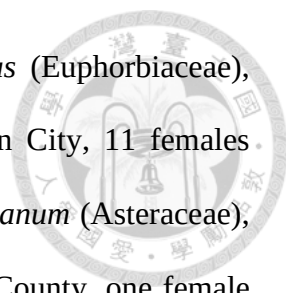
(ASCT00028131) from *Citrus sinensis* (Rutaceae), x.1979, unknown (ASCT); Huidong County, Huizhou City, Guangdong Province, one female from unknown plant, 4.x.1988, W. N. Wu (GIBAR); Entomology Branch, Foserster, N.S.W., one paratype male (ASCT00029126) from *Eucalyptus* sp. (Myrtaceae), 15.ii.1978, E. Schicha (ASCT).

JAPAN: Higashi-yashiki, Taketomi Island, one female (NSMT-AC11286) from *Hibiscus tiliaceus* (Malvaceae), 12.xi.2001, H. Amano (NSMT).

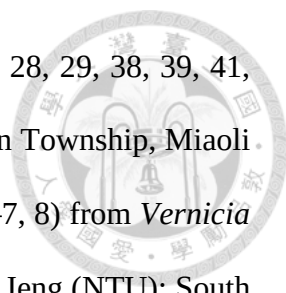
TAIWAN: NCHU, South Dist., Taichung City, two females from unknown plant, 12.x.1985, C. C. Ho (TARL); Mingjian Township, Nantou County, three females one male from *Cordia dichotoma* (Boraginaceae), 16.x.1985, C. C. Ho (TARL); Mingjian Township, Nantou County, one female from *Ampelopsis brevipedunculata* (Vitaceae), 16.x.1985, C. C. Ho (TARL); Dahu Township, Miaoli County, one female from *Ampelopsis brevipedunculata* (Vitaceae), 1.xii.1985, C. C. Ho (TARL); Fenglin Township, Hualien County, one female from *Malvaviscus arboreus* (Malvaceae), 1.iv.1987, C. C. Ho (TARL); Chuxiang Village, Lugu Township, Nantou County, three females one male from *Camellia sinensis* (Theaceae), 27.xi.1987, C. C. Ho (TARL); Chuxiang Village, Lugu Township, Nantou County, one female from *Camellia sinensis* (Theaceae), 24.xii.1987, C. C. Ho (TARL); Chuxiang Village, Lugu Township, Nantou County, one female from *Camellia sinensis* (Theaceae), 6.i.1988, C. C. Ho (TARL); TARI, Wufeng Dist., Taichung City, seven females from *Lycium chinense* (Solanaceae), 24.ii.1988, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, one female (TAL077B199) from *Lycium chinense* (Solanaceae), 24.ii.1988, C. C. Ho (TARL); Baihe Dist., Tainan City, one female from *Citrus x sinensis* (Rutaceae), 16.iii.1988, S. M. Yu (TARL); Chuxiang Village, Lugu Township, Nantou County, one female from *Camellia sinensis* (Theaceae), 25.iii.1988, S. K. Yueh (TARL); Dongshih Dist., Taichung City, one female (88-1923) from *Boehmeria densiflora* (Urticaceae),



31.iii.1988, S. M. Yu (TARL); Dongshih Dist., Taichung City, one female (88-2617) from *Citrus x sinensis* (Rutaceae), 15.vi.1988, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, six females from unknown plant, 12.x.1988, S. M. Yu (TARL); Yongjing Township, Changhua County, one female from *Piper betle* (Piperaceae), 30.i.1989, Y. J. Wang (TARL); Wuhe Village, Ruisui Township, Hualien County, seven females five males (89-Am-0334, 335, 336, 337, 338, 339, 340, 345, 476, 489), 20.ii.1989, Y. J. Wang (TARL); Hegang Village, Ruisui Township, Hualien County, three females (89-Am-0540, 42, 43) from *Prunus salicina* (Rosaceae), 21.ii.1989, Y. J. Wang (TARL); Ludao Township, Taitung County, two females (89-Am-1232, 37) from *Acalypha grandis* (Euphorbiaceae), 3.vi.1989, C. C. Ho (TARL); Ludao Township, Taitung County, one female from *Hibiscus tiliaceus* (Malvaceae), 3.vi.1989, C. C. Ho (TARL); Zhongliao Township, Nantou County, one female from *Dendrocalamus latiflorus* (Poaceae), 14.viii.1989, C. C. Ho (TARL); Puxin, Yangmei Dist., three females from unknown plant, 20.xii.1989, C. C. Ho (TARL); Liuqiu Township, three females from *Mangifera indica* (Anacardiaceae), 16.iii.1989, C. C. Ho (TARL); Ludao Township, Taitung County, four females one male from *Pemphis acidula* (Lythraceae), 8.iv.1990, C. C. Ho (TARL); Liuqiu Township, one male from *Vitex negundo* (Verbenaceae), 25.vii.1990, C. C. Ho (TARL); Haiduan Township, Taitung County, one female from *Zea mays* (Poaceae), 15.v.1991, C. C. Ho (TARL); Fushan, Yuanshan Township, Yilan County, one male from unknown plant, 30.v.1991, C. C. Ho (TARL); Liugu, Wufeng Dist., Taichung City, one female (TAL081C040) from unknown plant, 30.ix.1992, C. C. Ho (TARL); Guanziling, Baihe District, Tainan City, two females (TAL094B386, 87) from *Mallotus japonicus* (Euphorbiaceae), 8.xi.2005, C. C. Ho (TARL); Yuli Township, Hualien County, one female (TAL094C686) from *Mangifera indica* (Anacardiaceae), 6.xii.2005, C. C. Ho (TARL); Guanziling, Baihe District,



Tainan City, two females (TAL094B736) from *Mallotus japonicus* (Euphorbiaceae), 19.xii.2005, C. C. Ho (TARL); Guanziling, Baihe District, Tainan City, 11 females (HAL099B027, 28, 29, 38, 39, 41, 42, 43) from *Ageratum houstonianum* (Asteraceae), 9.i.2010, C. C. Ho (TARL); Yunshui, Zhongpu Township, Chiayi County, one female (HAL097B824) from unknown plant, 20.xi.2008, C. C. Ho (TARL); Guanziling, Baihe District, Tainan City, three females (HAL099B059, 60) from *Miscanthus* sp. (Poaceae), 9.i.2010, C. C. Ho (TARL); Guanziling, Baihe District, Tainan City, one female (HAL099B064) from unknown plant, 9.i.2010, C. C. Ho (TARL); Memorial bronze statue, Xindian Dist., New Taipei City (24°56.691' N, 121°32.773' E, 3m), one female (no. 314–3) from *Lantana camara* (Verbenaceae), 28.i.2010, J. R. Liao (NTU); Xiaocukeng, Xindian Dist., New Taipei City (24°56.393' N, 121°32.715' E, 37m), one female (no. 316–6) from *Boehmeria densiflora* (Urticaceae), 28.i.2010, J. R. Liao (NTU); Yujing Dist., Tainan City (23°08.237' N, 120°25.995' E, 69m), three females (no. 363-1, 2, 3) from *Cordia dichotoma* (Boraginaceae), 21.ii.2010, J. R. Liao (NTU); Lanyu Island, Taitung County (22°04.513' N, 121°30.477' E, 80m), four females (no. 440–1, 2, 3, 4) from *Mallotus japonicus* (Euphorbiaceae), 3.iv.2010, J. R. Liao & C. C. Ho (NTU); Lanyu Island, Taitung County (22°4.506' N, 121°30.475' E, 89m), one female (HAL099B175) from unknown plant, 3.iv.2010, C. C. Ho (TARL); Lanyu Island, Taitung County (22°4.506' N, 121°30.475' E, 89m), three females (HAL099B177, 79) from *Acalypha wilkesiana* (Euphorbiaceae), 3.iv.2010, C. C. Ho (TARL); Hongtuo Water Plant, Lanyu Island, Taitung County (22°02.0442' N, 121°33.040' E, 39m), three females (no.457–1, 2, 3) from *Leucosyke quadrinervia* (Urticaceae), 4.iv.2010, J. R. Liao & C. C. Ho (NTU); Hongtuo Water Plant, Lanyu Island, Taitung County (22°02.0442' N, 121°33.040' E, 39m), four females (no.459–1, 2, 3, 4) from *Debregeasia orientalis* (Urticaceae), 4.iv.2010, J. R. Liao & C. C. Ho (NTU);



Guanziling, Baihe District, Tainan City, 11 females (HAL099B027, 28, 29, 38, 39, 41, 42, 43) from bamboo (Poaceae), 9.vii.2010, C. C. Ho (TARL); Shitan Township, Miaoli County (24°34.957' N, 120°56.583' E, 158m), two females (no. 492–7, 8) from *Vernicia fordii* (Euphorbiaceae), 19.iv.2010, J. R. Liao, Y. H. Chiang & M. J. Jeng (NTU); South Cross Island Highway, Liugui Dist., Kaohsiung City (23°04.247' N, 120°39.304' E, 473m), three females (no. 958–4, 5, 6) from *Morus* sp. (Moraceae), 20.xi.2010, J. R. Liao (NTU); Fanlu Township, Chiayi County (23°20.779' N, 120°36.966' E, 391m), one female (no. 1036–7) from *Trema orientalis* (Cannabaceae), 11.i.2011, J. R. Liao (NTU); Zengwen Reservoir, Dapu Township, Chiayi County (23°13.812' N, 120°33.235' E, 301m), three females (no. 1041–1, 3, 4) from *Swietenia macrophylla* (Meliaceae), 11.i.2011, J. R. Liao (NTU); Zengwen Reservoir, Dapu Township, Chiayi County (23°13.812' N, 120°33.235' E, 301m), five females (no. 1042–2, 3, 4, 5, 6) from *Prunus serrulata* (Rosaceae), 11.i.2011, J. R. Liao (NTU); Zengwen Reservoir, Dapu Township, Chiayi County (23°13.812' N, 120°33.235' E, 301m), five females (no. 1043–1) from *Ficus benhalensis* (Moraceae), 11.i.2011, J. R. Liao (NTU); Ankeng, Xindian Dist., New Taipei City, one female (no. 1503-1) from *Saurauia tristyla* (Actinidiaceae), 14.v.2015, J. R. Liao (NTU); Ankeng, Xindian Dist., New Taipei City, one female (no. 1504–1) from *Celtis sinensis* (Cannabaceae), 14.v.2015, J. R. Liao (NTU); Mt. Luyi, Jiashian Dist., Kaohsiung City (23°04.703' N, 120°34.727' E, 314m), two females (no. 1615–1, 2) from *Cordia dichotoma* (Boraginaceae), 12.iii.2016, J. R. Liao (NTU); Shueimuniang Road, Guanxi Township, Hsinchu County (24°48.464' N, 121°11.428' E, 207m), one female (no. 1703–2, 5) from *Morus alba* (Moraceae), 11.v.2016, J. R. Liao (NTU).

Distribution. China (Guangdong (Schicha1982b), Hong Kong (Ehara & Lee 1971)), Japan (Ehara & Amano 2002), Taiwan (present study), Thailand (Ehara &

Bhandhufalck 1977).



Remarks. Evans (1953) described a new species *Typhlodromus newsami* (now *Scapulaseius newsami*) based on Malaya specimens which fed on tetranychid mites. Swirski & Shechter (1961) reported this species distributed in Hong Kong, and Ehara & Lee (1971) also described this species based on Hong Kong specimens. This Hong Kong and also China populations were found as an effective predator for *Panonychus citri* in citrus orchards. Schicha (1982) reported the Chinese *newsami* should be misidentified based on comparison with the type specimens. He described a new species *A. cantonensis* (now *S. cantonensis*) based on Chinese specimens. This species is characterized by calyx of spermatheca tubular, but saccular in *newsami*. The present study examined the type specimens of *S. cantonensis*, and confirmed the descriptions and illustration by Schicha (1982). Based on the result, the previous records of *S. newsami* in Taiwan are probably all belonging to *S. cantonensis*. The present study also examined all Taiwan collection, and no specimens belong to *S. newsami*. Therefore, all *S. newsami* records should be misidentified.

McMurtry *et al.* (2013) reported *S. newsami* is belonging to lifestyle subtype III-b generalist predators living on glabrous leaves. This species has potential to be an effective natural enemy of *Panonychus citri* in China (Wu *et al.* 2010) Because of the misidentification of *S. newsami* and *S. cantonensis*, the Chinese potential biological control species is *S. cantonensis*.

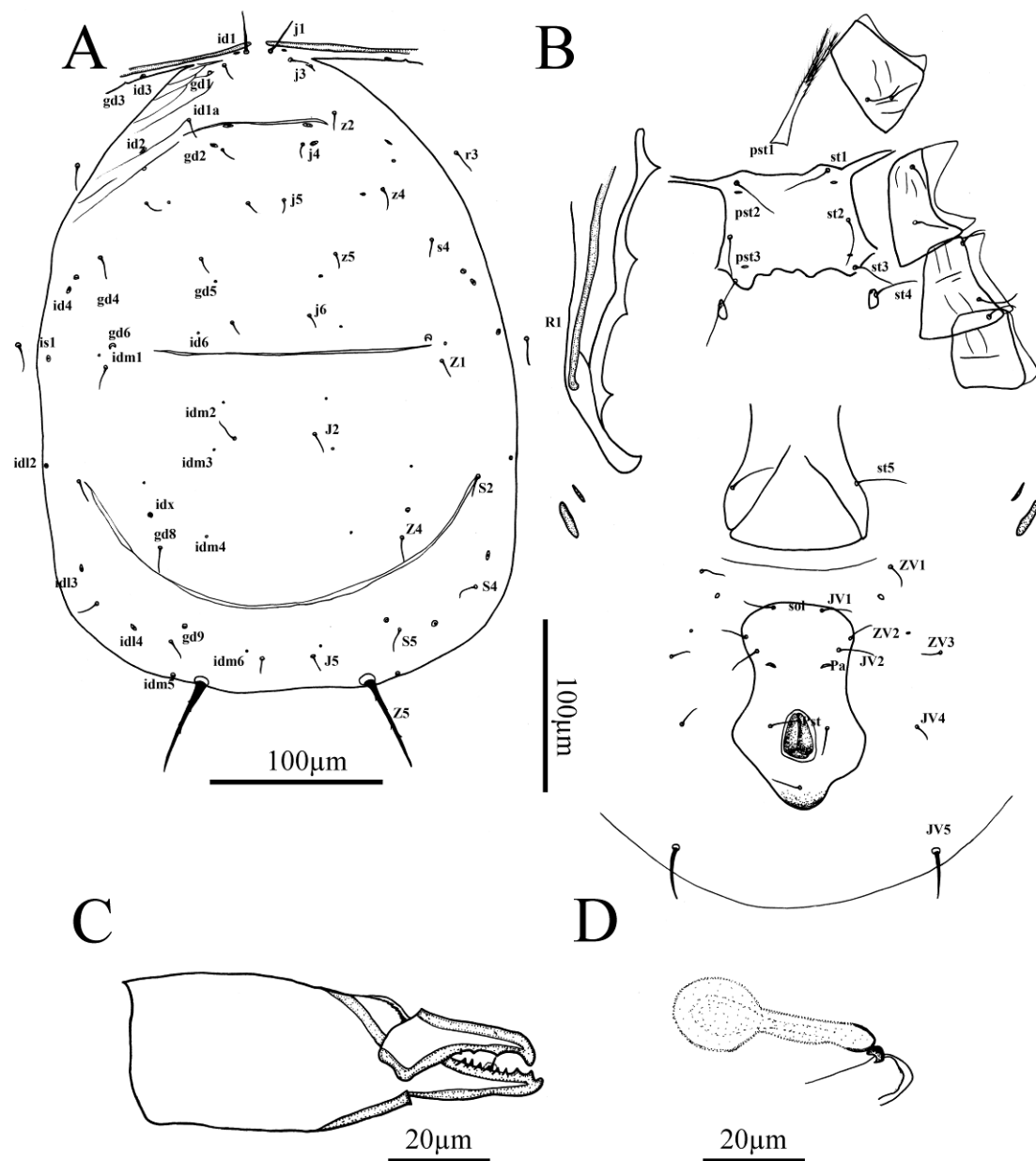


FIGURE 133. *Scapulaseius cantonensis* (Schicha, 1982), Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

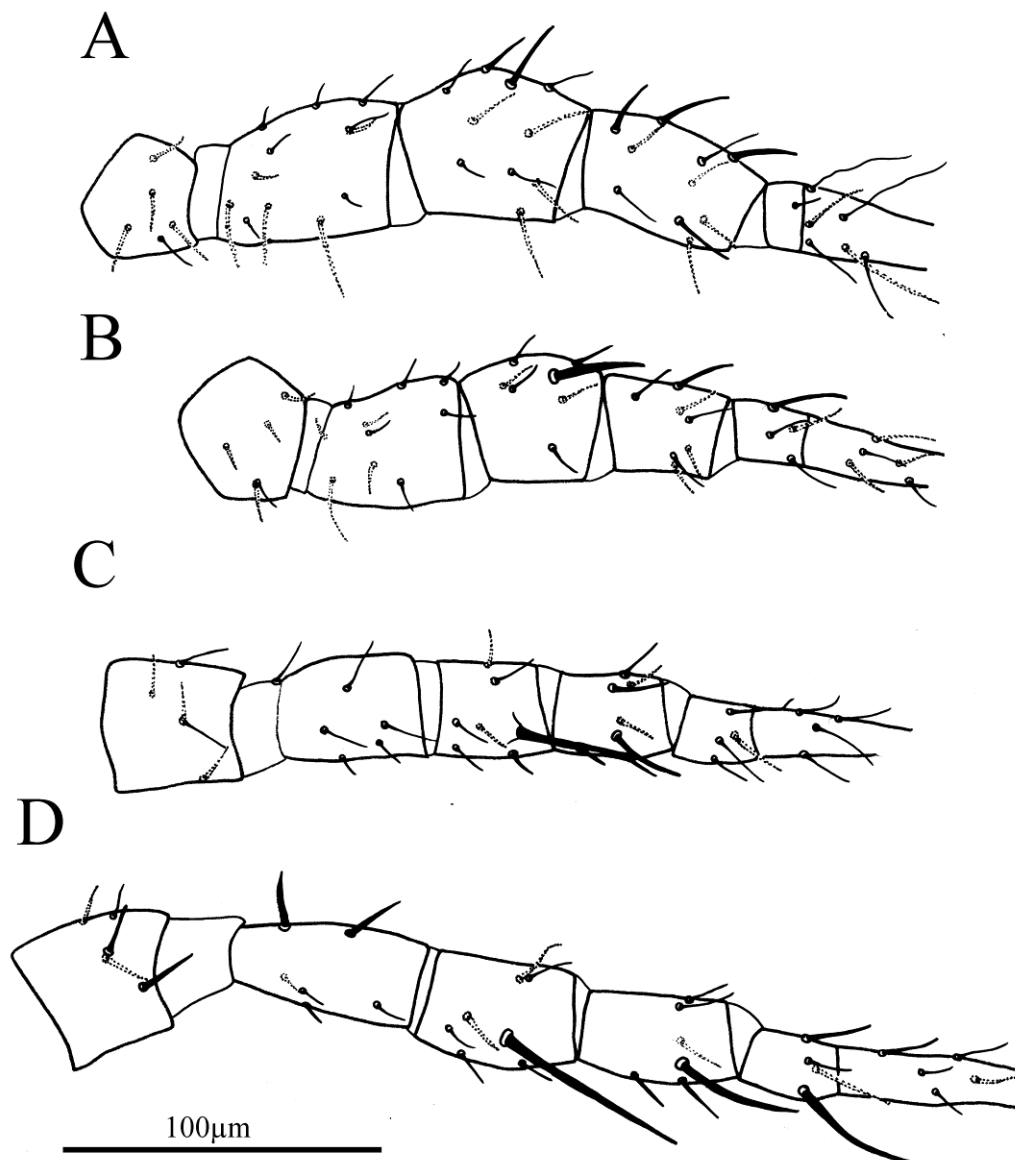


FIGURE 134. *Scapulaseius cantonensis* (Schicha, 1982), Female, legs A. leg I posterior view, B. leg II posterior view, C. leg III anterior view, D. leg IV anterior view.

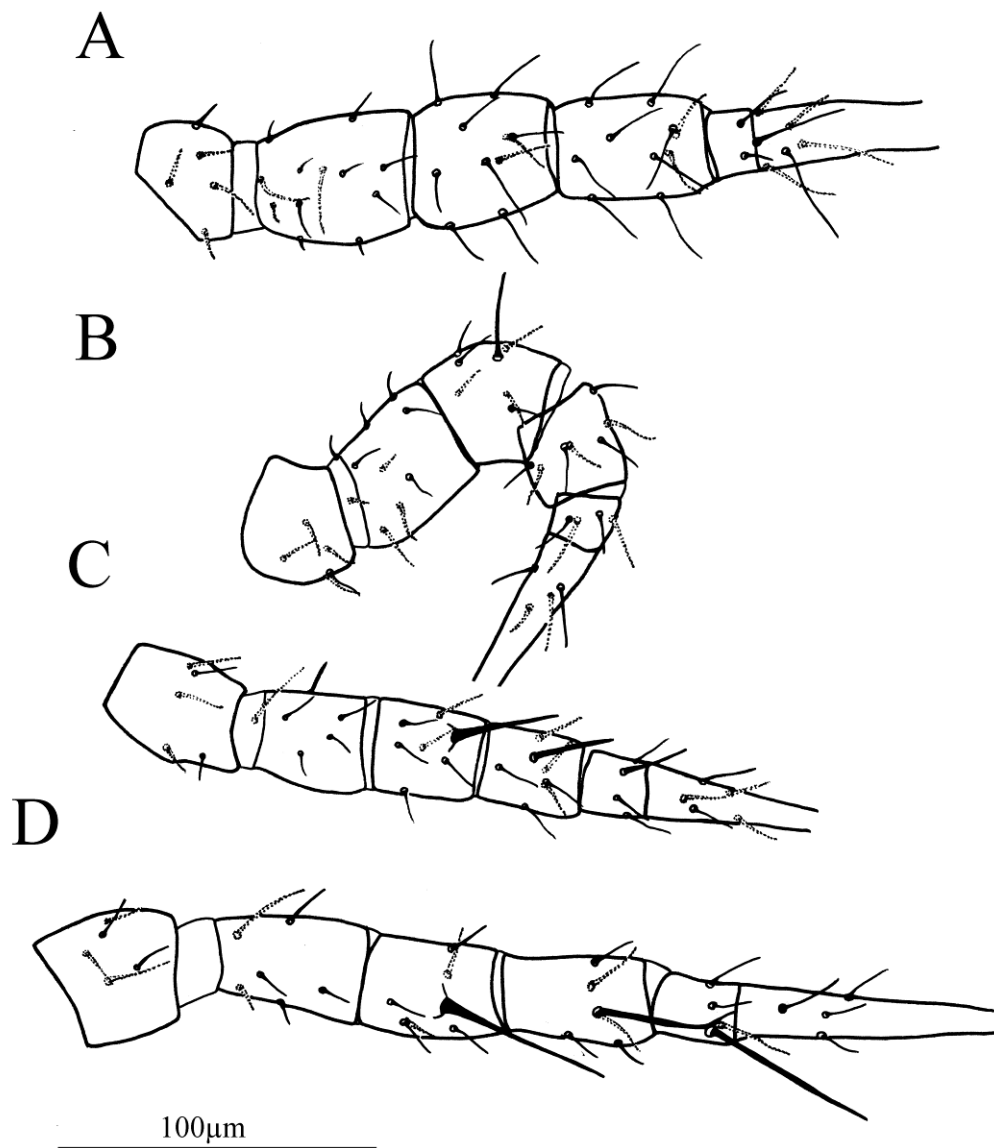


FIGURE 136. *Scapulaseius cantonensis* (Schicha, 1982), Male, legs A. leg I dorsal view, B. leg II posterior view, C. leg III dorsal view, D. leg IV anterior view.

Scapulaseius okinawanus (Ehara, 1967)

沖繩肩綫蟎



(Figures 137–140)

Amblyseius (*Amblyseius*) *okinawanus* Ehara, 1967b: 72.

Amblyseius okinawanus.— Lo, 1970: 10.

Neoseiulus okinawanus.— Moraes *et al.*, 1986: 91.

Amblyseius (*Neoseiulus*) *okinawanus*.—Ehara & Amano, 1998: 37.

Amblyseius okinawaenus [sic].—Jung *et al.*, 2003: 187.

Female (n=10)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield nearly oval, without waist at level of *R1*, laterally reticulated; **301** 335 (301–387) long (*j1*–*J5* level) and **192** 213 (192–236) wide at level of *j6*, **190** 210 (180–231) wide at level of *S4*; seven pairs of solenostomes on dorsal shield, (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), fifteen pairs of lyrifissures, (*id1*, *id1a*, *id2*, *id4*, *id6*, *idm1*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* **17** 19 (17–23), *j3* **15** 16 (14–21), *j4* **8** 7 (5–10), *j5* **6** 6 (4–8), *j6* **6** 7 (4–11), *J2* **9** 9 (5–11), *J5* **8** 7 (6–9), *z2* **10** 10 (8–14), *z4* **9** 10 (8–15), *z5* **8** 7 (4–10), *Z1* **9** 10 (8–17), *Z4* **28** 37 (28–46), *Z5* **72** 86 (72–99), *s4* **19** 19 (14–24), *S2* **15** 15 (10–19), *S4* **13** 14 (10–19), *S5* **10** 13 (9–17), *r3* **10** 11 (8–16), *R1* **9** 9 (8–12). All setae smooth, except *Z4*, *Z5* serrated.

Peritreme. Peritreme extending to *j1* level; peritremal shield lightly sclerotized, with one pair of solenostomes (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, posterior margin straight, wider than long, **55** 62 (55–73) long, **72** 79 (72–83) wide, with three pairs of setae *st1* **19** 19 (17–22), *st2* **18** 17 (15–22), *st3* **19** 16 (13–19), and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae I–IV. Metasternal platelets tear-shaped, with one pair of metasternal setae, *st4* **14**

15 (12–19), with one pair of lyrifissures (*pst3*). Genital shield smooth, with one pair of genital setae *st5* **15** 16 (14–19), **64** 75 (64–88) wide at level of genital setae. Distances between *st1-st1* **42** 49 (42–52), *st2-st2* **52** 58 (52–62), *st3-st3* **57** 62 (57–72), *st1-st3* **50** 56 (50–72), *st5-st5* **55** 63 (55–67). Ventrianal shield pentagonal, smooth, **99** 109 (99–125) long, **84** 93 (84–100) wide at level of ZV2, **64** 74 (64–81) wide at level of anus; with three pairs of pre-anal setae, *JV1* **13** 12 (11–13), *JV2* **9** 10 (7–13), *ZV2* **9** 11 (9–13), solenostomes *gv3* crescentic; *Pa* **11** 13 (10–16), *Pst* **9** 13 (9–16) on shield. Setae *JV4* **9** 11 (8–13), *JV5* **25** 28 (25–31), *ZV1* **11** 12 (10–17), *ZV3* **9** 9 (6–11) on interscutal membrane. All setae smooth. Two pairs of metapodal plates **17** 18 (16–21) long, **5** 5 (4–6) wide, **8** 9 (7–11) long, **1** 2 (1–2) wide.

Spermatheca. Calyx funnel-shaped, **17** 15 (12–18) long, **8** 10 (6–14) wide, atrium connected to the calyx, minor and major ducts visible.

Chelicera. Movable digit **24** 26 (24–30) long, with three teeth; fixed digit **24** 25 (23–27) long, anterior half with two teeth, posterior half with six teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* III (ad2) **19** 22 (19–25), *Sti* III (ad) **16** 20 (16–21), *St* III (ad) **16** 20 (16–21), *Sge* IV (ad2) **31** 30 (27–34), *Sti* IV (ad) **22** 24 (20–27), *St* IV (d) **53** 58 (53–70).

Male (n=5)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3,4:ZV-1,3.

Dorsum. Dorsal shield nearly oval, without waist at level of *R1*, reticulated; 251 (242–265) long (*j1-J5* level) and 170 (164–186) wide at level of *j6*, 150 (145–159) wide

at level of *S4*, seven pairs of solenostomes on dorsal shield, (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), fifteen pairs of lyrifissures, (*id1*, *id1a*, *id2*, *id4*, *id6*, *idm1*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 11 (8–17), *j3* 17 (14–19), *j4* 6 (4–8), *j5* 5 (3–6), *j6* 6 (5–8), *J2* 6 (5–8), *J5* 6 (4–9), *z2* 10 (6–11), *z4* 9 (5–11), *z5* 5 (4–6), *Z1* 7 (5–12), *Z4* 29 (26–33), *Z5* 56 (50–62), *s4* 12 (9–15), *S2* 11 (9–12), *S4* 11 (7–14), *S5* 12 (7–17), *r3* 10 (8–12), *R1* 10 (8–12). All setae smooth, except *Z4*, *Z5* serrated. Setae *r3* and *R1* inserted on dorsal shield.

Peritreme. Peritreme extending to *j1* level; peritremal shield lightly sclerotized, with one pair of solenostomes (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternogenital shield smooth, lateral slightly reticulated, posterior margin with slightly medium projection, longer than wide, 114 (104–127) long, 68 (58–81) wide at level of *st3*, with five pairs of setae, *st1* 12 (12–13), *st2* 13 (11–15), *st3* 12 (11–16), *st4* 11 (9–16), *st5* 11 (10–12), three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Exopodal shield at coxae I–IV. Distances between *st1-st1* 42 (40–45), *st2-st2* 51 (48–54), *st3-st3* 49 (48–50), *st4-st4* 38 (34–40), *st5-st5* 33 (30–34), *st1-st5* 98 (93–100). Exopodal shield at coxae II–IV. Ventrianal shield subtriangular, reticulated, 102 (93–115) long, 136 (129–141) wide at anterior corner, 55 (48–68) at level of anus, fused with peritremal shield cingulum; with three pairs of pre-anal setae, *JV1* 9 (7–11), *JV2* 9 (7–11), *ZV2* 9 (8–11), solenostomes *gv3* crescentic; *Pa* 8 (7–9), *Pst* 11 (9–13) on shield. Setae *JV5* 21 (18–27) on interscutal membrane. All setae smooth.

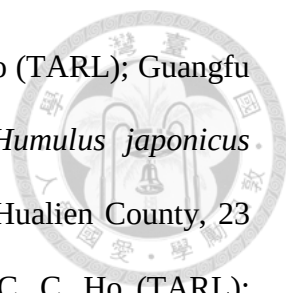
Chelicera. Movable digit 19 (17–20) long, with one tooth; fixed digit 19 (18–21) long, anterior half with one tooth, posterior half with seven teeth, with *pilus dentilis*. Spermatodactyl L-shaped, shaft 14 (14–14) long, heel rounded, foot 9 (8–9) long, with expanded toe and lateral thorn-like projection.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2,

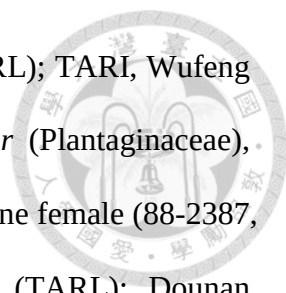
2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* III (ad2) **15** (13–17), *Sti* III (ad) **13** (10–14), *St* III (ad) 11 (9–14), *Sge* IV (ad2) 23 (19–25), *Sti* IV (ad) 19 (16–21), *St* IV (d) 46 (42–52).

Specimens examined. JAPAN: Tomigusuku, one holotype female (ZIHU-3433) from *Verbena officinalis* (Verbenaceae), 22.iv.1966, K. Miyara, K. Tsudome, I. Tokashiki, S. Higashihirati, K. Uehara, S. Ehara (HUM); Tomigusuku, one female one allotype one paratype males (ZIHU-3433-1) from *Verbena officinalis* (Verbenaceae), 22.iv.1966, K. Miyara, K. Tsudome, I. Tokashiki, S. Higashihirati, K. Uehara, S. Ehara (HUM); Tomigusuku, five paratype females (ZIHU-3433-2, 3, 4, 5, 6) from *Verbena officinalis* (Verbenaceae), 22.iv.1966, K. Miyara, K. Tsudome, I. Tokashiki, S. Higashihirati, K. Uehara, S. Ehara (HUM).

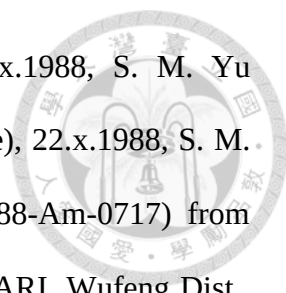
TAIWAN: Mingjian Township, Nantou County, three females (85-1038) from *Arachis hypogea* (Fabaceae), 16.x.1985, C. C. Ho (TARL); Mingjian Township, Nantou County, five females (85-1043, 44, 45) from *Morus alba* (Moraceae), 16.x.1985, C. C. Ho (TARL); Mingjian Township, Nantou County, one female (85-1041) from *Ampelopsis brevipedunculata* (Vitaceae), 16.x.1985, C. C. Ho (TARL); Dongpu, Xinyi Township, Nantou County, one female (85-1001) from *Achyranthes aspera* (Amaranthaceae), 18.x.1985, C. C. Ho (TARL); Mingjian Township, Nantou County, three females (85-1163) from *Morus alba* (Moraceae), 26.x.1985, C. C. Ho (TARL); Mt. Jiaoban, Fuxing Dist., Taoyuan City, one female from *Trema orientalis* (Cannabaceae), 5.iv.1986, C. C. Ho (TARL); Yongjing Township, Changhua County, five females (86-2057) from *Cayratia japonica* (Vitaceae), 16.vii.1986, C. C. Ho (TARL); Guanxi Township, Hsinchu County, five females from *Ageratum* sp. (Asteraceae), 18.ii.1987, C. C. Ho (TARL); Guangfu Township, Hualien County, one female one male (87-0370, 71)



from *Crassocephalum crepidioides* (Asteraceae), 1.iv.1987, C. C. Ho (TARL); Guangfu Township, Hualien County, two females (87-0335, 36) from *Humulus japonicus* (Cannabaceae), 2.iv.1987, C. C. Ho (TARL); Guangfu Township, Hualien County, 23 females (87-0335, 36) from *Morus alba* (Moraceae), 24.iv.1987, C. C. Ho (TARL); TARI, Wufeng Dist., Taichung City, one female from *Zea mays* (Poaceae), 4.vii.1987, C. C. Ho (TARL); TARI, Wufeng Dist., Taichung City, two females from *Ziziphus jujuba* (Rhamnaceae), 2.xi.1987, C. C. Ho (TARL); Chuxiang Village, Lugu Township, Nantou County, two females from *Ageratum houstonianum* (Asteraceae), 13.xi.1987, C. C. Ho (TARL); Chuxiang Village, Lugu Township, Nantou County, one female from *Alternanthera nodiflora* (Amaranthaceae), 13.xi.1987, C. C. Ho (TARL); Neihu Dist., Taipei City, one female from *Hedyotis diffusa* (Rubiaceae), 13.xi.1987, C. C. Ho (TARL); Chuxiang Village, Lugu Township, Nantou County, one female from *Camellia sinensis* (Theaceae), 11.xii.1987, C. C. Ho (TARL); Yanpu Township, Pingtung County, two females (88-0289, 90) from *Morus alba* (Moraceae), 21.i.1988, C. C. Ho (TARL); Ruisui Township, Hualien County, one female (88-0185) from *Morus alba* (Moraceae), 22.i.1988, C. C. Ho (TARL); Yanpu Township, Pingtung County, three females from *Morus alba* (Moraceae), 21.i.1988, C. C. Ho (TARI); TARI, Wufeng Dist., Taichung City, one female (88-0612) from *Lycium chinense* (Solanaceae), 24.ii.1988, S. M. Yu (TARL); Dounan Township, Yunlin County, one female (88-0044) from *Morus alba* (Moraceae), 27.ii.1988, C. S. Lian (TARL); TARI, Wufeng Dist., Taichung City, one female (TAL077B088) from *Crassocephalum rubens* (Asteraceae), 9.iii.1988, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, two females (TAL077B139, 40) from *Hyptis rhomboides* (Lamiaceae), 31.v.1988, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, one female (88-2433) from *Lactuca formosana* (Asteraceae), 31.v.1988, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, three females (88-2454, 55, 57)



from *Malvaviscus arboreus* (Malvaceae), 31.v.1988, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, one female (88-2398) from *Plantago major* (Plantaginaceae), 1.vi.1988, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, one female (88-2387, 88) from *Solanum nigrum* (Solanaceae), 1.vi.1988, S. M. Yu (TARL); Dounan Township, Yunlin County, two females one male from *Morus alba* (Moraceae), 7.vi.1988, C. C. Ho (TARL); TARI, Wufeng Dist., Taichung City, two females (TAL077B104, 06) from *Cucumis sativus* (Cucurbitaceae), 13.vi.1988, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, two females (TAL077B102, 03) from *Brassica oleracea* (Brassicaceae), 13.vi.1988, S. M. Yu (TARL); Dongshih Dist., Taichung City, one female (88-2615) from *Citrus x sinensis* (Rutaceae), 15.vi.1988, S. M. Yu (TARL); Miaoli County, 11 females from *Morus alba* (Moraceae), 20.vi.1988, C. C. Ho (TARL); Hualien County, two females from *Morus alba* (Moraceae), 21.vi.1988, C. C. Ho (TARL); Dounan Township, Yunlin County, five females from *Morus alba* (Moraceae), 30.ix.1988, C. C. Ho (TARL); TARI, Wufeng Dist., Taichung City, four females (88-Am-0691, 692, 701, 708) from *Sida rhombifolia* (Malvaceae), 12.x.1988, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, one female (88-Am-0706) from *Tridax procumbens* (Asteraceae), 12.x.1988, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, four females (88-Am-0732, 34, 36, 37) from unknown plant, 12.x.1988, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, one female (88-Am-0898) from *Punica granatum* (Lythraceae), 12.x.1988, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, one female (TAL077B094) from *Ageratum houstonianum* (Asteraceae), 12.x.1988, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, one female (TAL077B110) from *Ziziphus mauritiana* (Rhamnaceae), 14.x.1988, M. T. Lin (TARL); Neihu Dist., Taipei City, one female from *Crassocephalum crepidioides* (Asteraceae), 14.x.1988, C. C. Ho (TARL); TARI, Wufeng Dist., Taichung City, one



female (88-Am-0699) from *Emilia sonchifolia* (Asteraceae), 17.x.1988, S. M. Yu (TARL); Hualien County, four females from *Morus alba* (Moraceae), 22.x.1988, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, one female (88-Am-0717) from *Platostoma palustre* (Lamiaceae), 24.x.1988, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, one female (88-Am-0721) from unknown plant, 24.x.1988, S. M. Yu (TARL); TARI, Wufeng Dist., Taichung City, one male (88-Am-0725) from *Mimosa pudica* (Fabaceae), 24.xi.1988, S. M. Yu (TARL); Dongshi Forest Garden, Dongshi Dist., Taichung City, three females (89-Am-0006, 8, 9) from *Polygonum persicaria* (Polygonaceae), 4.i.1989, Y. J. Wang (TARL); Longtan Dist., Taoyuan City, one female from *Erigeron coulteri* (Asteraceae), 14.ii.1989, Y. J. Wang (TARL); Taoyuan City, one female (89-Am-0566) from *Gnaphalium affine* (Asteraceae), 14.ii.1989, M. T. Lin (TARL); Yongkang Dist., two females (89-Am-0355, 56) from *Xanthium strumarium* var. *japonica* (Asteraceae), 15.ii.1989, Y. J. Wang (TARL); Dahu Township, Miaoli County, one female (89-Am-1146) from unknown plant, 9.v.1989, Y. J. Wang (TARL); Dahu Township, Miaoli County, three females (89-Am-1138, 41, 44) from *Rumex japonicus* (Polygonaceae), 9.v.1989, Y. J. Wang (TARL); Ludao Township, Taitung County, two females (89-Am-1118, 25) from *Melastoma candidum* (Melastomataceae), 3.vi.1989, C. C. Ho (TARL); Ludao Township, Taitung County, one female one male from unknown plant, 8.iii.1990, C. C. Ho (TARL); Ludao Township, Taitung County, one male from *Acalypha grandis* (Euphorbiaceae), 8.iii.1990, C. C. Ho (TARL); TARI, Wufeng Dist., Taichung City, two female from *Ageratum houstonianum* (Asteraceae), 5.iii.1990, S. K. W. (TARL); Chiayi County, one female from *Cayratia japonica* (Vitaceae), 2.vi.1992, C. C. Ho (TARI); Matsu Senior High School, Nangan Township, Lienchiang County, one female (TAL090K275) from *Citrullus vulgaris* (Cucurbitaceae), 24.vii.2001, C. C. Ho (TARL); Endemic Species

Research Institute, Jiji Township, Nantou County, one male (TAL093B008) from *Asclepias curassavica* (Apocynaceae), 16.i.2004, H. S. Fang (TARL); Dongshih Forest Garden, Dongshih Dist., Taichung City, one female (HAL096B801) from *Prunus persica* (Rosaceae), 22.v.2005, C. C. Ho (TARL); Dongzijiao, Zhongpu Township, Chiayi County, one female (HAL099B684) from *Setaria palmifolia* (Poaceae), 12.vii.2010, C. C. Ho (TARL); Beihe Dist., Tainan City, one female (HAL101B336) from *Mallotus paniculatus* (Euphorbiaceae), 28.xi.2012, C. C. Ho (TARL).

Distribution. Asia: China (Fujian (Wu 1981), Guangdong (Chen *et al.* 1980), Guangxi (Wu, 1982), Guizhou (Wu 1982), Hainan (Wu & Ou 2002), Jiangsu (Wu 1982), Jiangxi (Wu 1982), Wuling Mountain Region (Wu & Lan 1992), Hong Kong (Ehara & Lee 1971)), Indonesia (Ehara 2002b), Japan (Ehara 1972), Papua New Guinea (McMurtry & Moraes 1985), Russia (Primorsky Territory (Wainstein 1979)), South Korea (Ryu & Lee 1992), Taiwan (Lo 1970), Thailand (Ehara & Bhandhufalck 1977)

Remarks. Ehara (1967) described this species from *Verbena officinalis* in Okinawa. The present study collected many specimens during the investigation in Taiwan and neighboring islands (e.g. Ludao). Some individuals were observed from economic plants (e.g. *Citrus* sp.), but most of them were found on non-economic herbaceous plants (e.g. *Ageratum houstonianum* is the major habitat plant during the survey).

This species is similar to *S. oguroi*, but differs from seta Z4 length shorter (longer than the distance between setae Z4 and Z5 in *oguroi*); differs from *Sge* IV slightly longer than *Sti* IV (*Sge* IV much longer than *Sti* IV in *oguroi*).

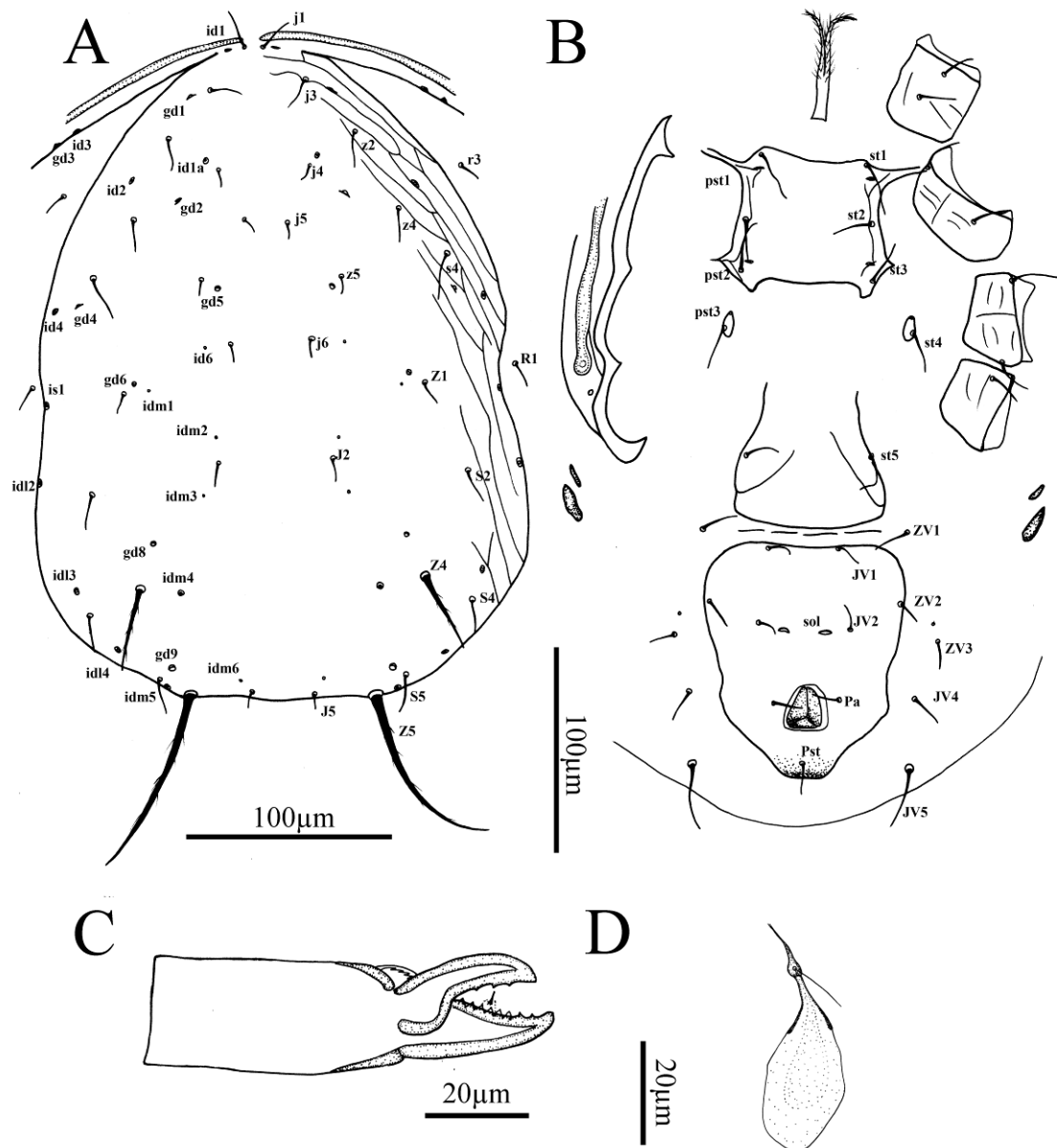


FIGURE 137. *Scapulaseius okinawanus* (Ehara, 1967), Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

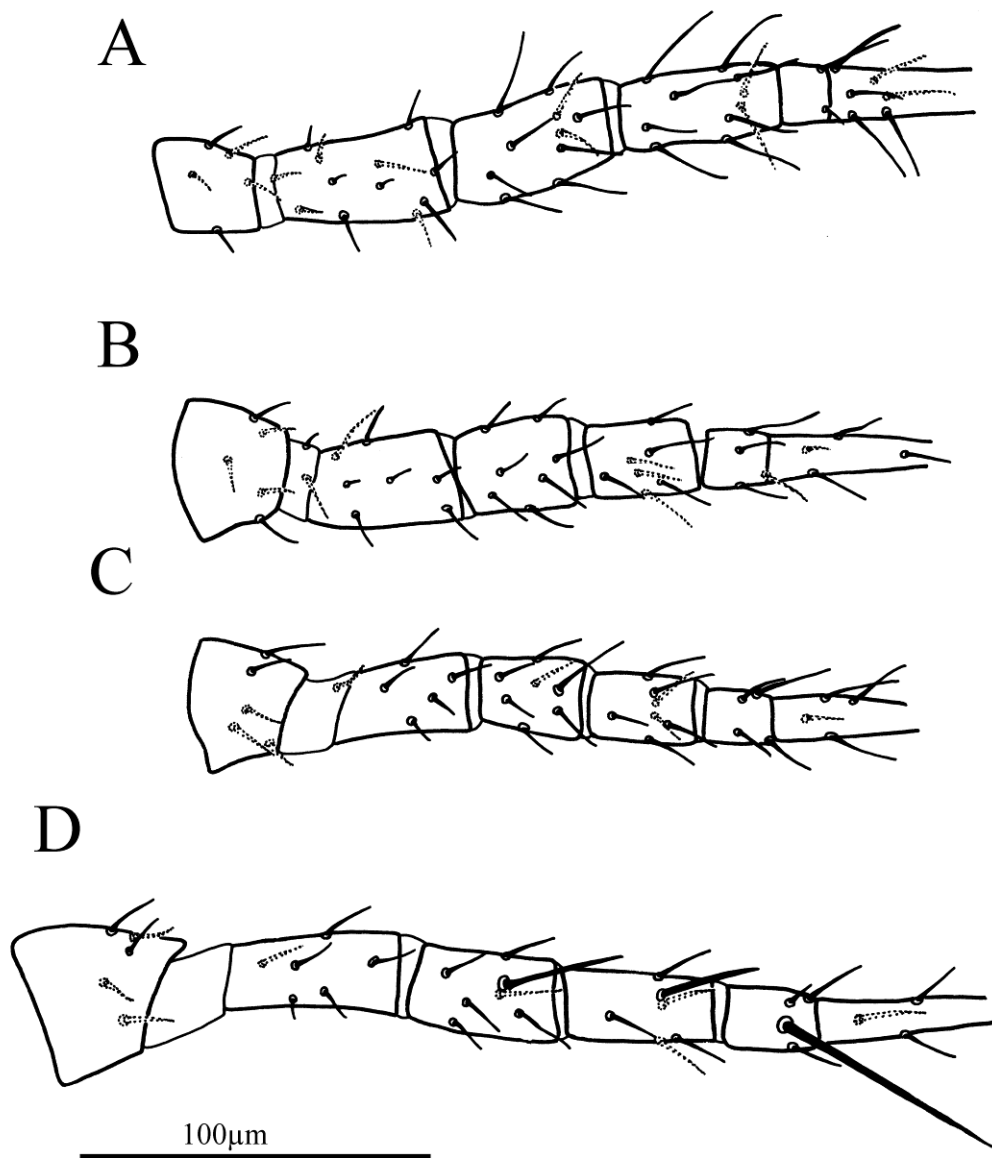


FIGURE 138. *Scapulaseius okinawanus* (Ehara, 1967), Female, legs A. leg I dorsal view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV dorsal view.

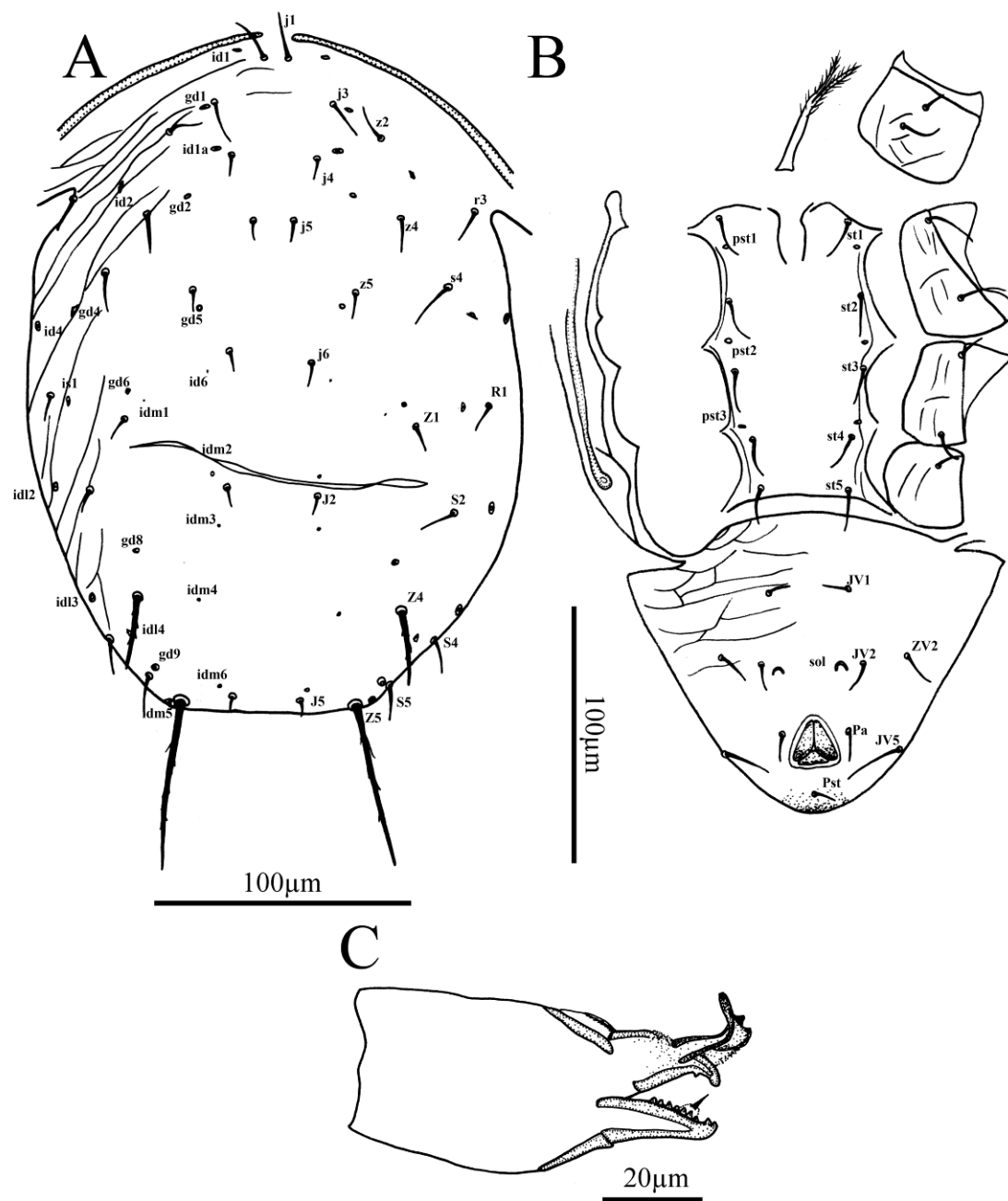


FIGURE 139. *Scapulaseius okinawanus* (Ehara, 1967), Male, A. dorsal shield; B. ventral idiosoma; C. chelicera and spermatodactyl.

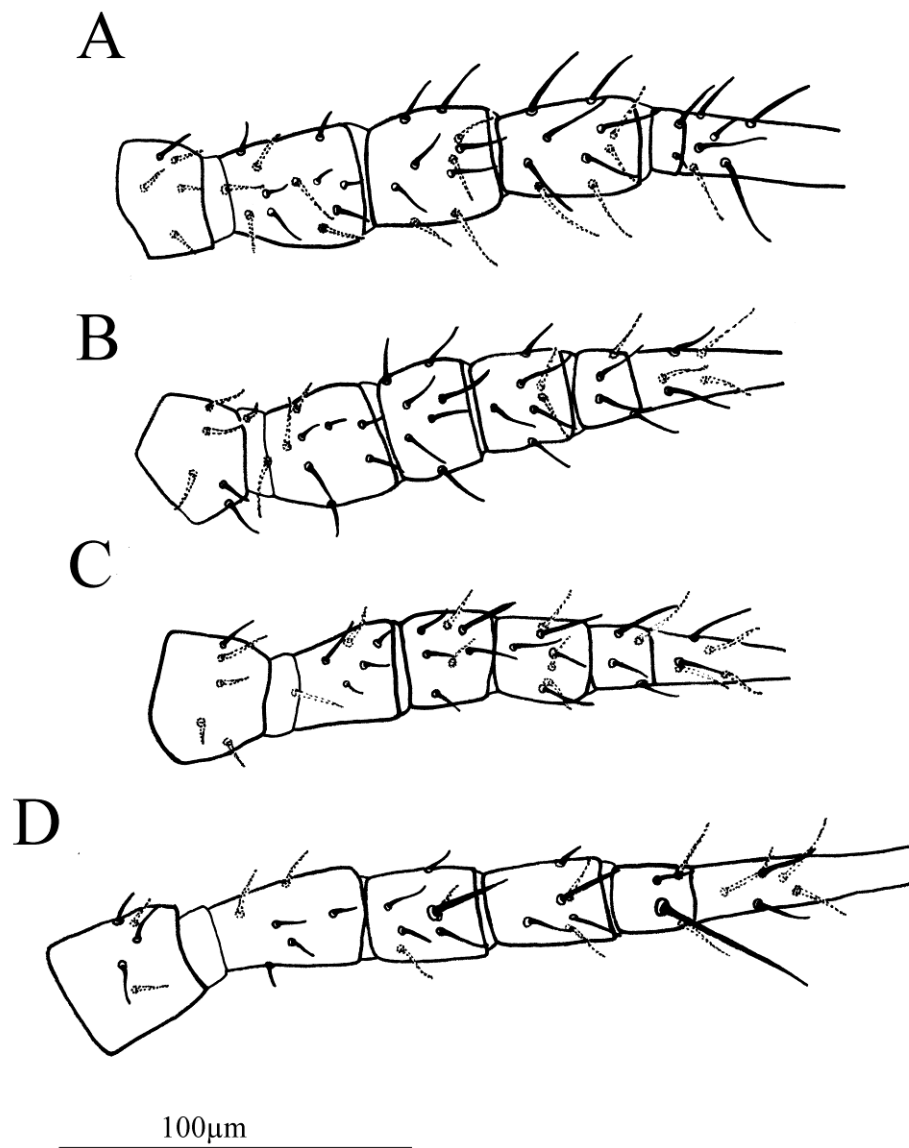


FIGURE 140. *Scapulaseius okinawanus* (Ehara, 1967), Male, legs A. leg I dorsal view, B. leg II dorsal view, C. leg III anterodorsal view, D. leg IV dorsal view.

Scapulaseius tienhsainensis (Tseng, 1983)

天祥肩綏蟎



(Figures 141–144)

Amblyseius (*Amblyseius*) *tienhsainensis* Tseng, 1983: 46.

Neoseiulus tiensainensis [sic].—Chant & McMurtry, 2007: 31.

Typhlodromips tienhsainensis.—Liao *et al.*, 2013: 77.

Female (n=8)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield nearly oval, without waist at level of *R1*, strongly reticulated; 324 (306–340) long (*j1*–*J5* level) and 211 (201–219) wide at level of *j6*, 200 (185–213) wide at level of *S4*; seven pairs of solenostomes on dorsal shield (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), fourteen pairs of lyrifissures, (*id1*, *id2*, *id4*, *idm1*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *idx*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 17 (13–23), *j3* 21 (18–25), *j4* 11 (8–13), *j5* 9 (5–12), *j6* 11 (8–13), *J2* 12 (8–14), *J5* 8 (7–10), *z2* 10 (7–12), *z4* 11 (8–12), *z5* 10 (8–12), *Z1* 13 (10–16), *Z4* 27 (24–34), *Z5* 74 (68–82), *s4* 23 (19–29), *S2* 18 (15–23), *S4* 16 (13–20), *S5* 11 (8–15), *r3* 13 (9–15), *R1* 13 (11–15). All setae smooth, except *Z5* serrated.

Peritreme. Peritreme extending to *j1* level; peritremal shield lightly sclerotized, with one pair of solenostomes (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, posterior margin straight, much wider than long, 54 (46–63) long, 79 (73–84) wide, with three pairs of setae *st1* 16 (13–19), *st2* 14 (12–17), *st3* 15 (12–18), and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae II–IV. Metasternal platelets tear-shaped, with one pair of metasternal setae, *st4* 13 (11–14), with one pair of lyrifissures (*pst3*). Genital shield reticulated, with one pair of genital setae *st5* 13 (9–16), 80 (75–85) wide at level of genital setae. Distances between *st1*–*st1*

48 (45–52), *st2-st2* 57 (54–60), *st3-st3* 64 (60–66), *st1-st3* 53 (48–59), *st5-st5* 65 (62–70). Ventrianal shield broader, reticulated, 112 (105–117) long, 116 (103–122) wide at level of *ZV2*, 74 (63–88) wide at level of anus; with three pairs of pre-anal setae, *JV1* 10 (7–13), *JV2* 10 (7–12), *ZV2* 10 (7–12), solenostomes *gv3* crescentic; *Pa* 13 (10–16), *Pst* 14 (11–18) on shield. Setae *JV4* 11 (8–14), *JV5* 31 (27–40), *ZV1* 12 (8–14), *ZV3* 11 (8–14) on interscutal membrane. All setae smooth. Two pairs of metapodal plates 19 (13–22) long, 7 (4–9) wide, 9 (8–11) long, 3 (1–5) wide.

Spermatheca. Calyx saccular, 21 (19–24) long, 11 (9–14) wide, atrium nodular, minor and major ducts visible.

Chelicera. Movable digit 24 (23–27) long, with three teeth; fixed digit 22 (20–24) long, anterior half with two teeth, posterior half with five teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/2-1, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* III (ad2) 22 (18–24), *Sti* III (ad) 17 (15–19), *St* III (ad) 19 (17–22), *Sge* IV (ad2) 37 (30–45), *Sti* IV (ad) 28 (25–33), *St* IV (d) 45 (41–50).

Male (n=1)

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield nearly oval, without waist at level of *R1*, strongly reticulated; 264 long (*j1-J5* level) and 183 wide at level of *j6*, 169 wide at level of *S4*, seven pairs of solenostomes on dorsal shield (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), fourteen pairs of lyrifissures, (*id1*, *id2*, *id4*, *idm1*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *idx*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 12, *j3* 19, *j4* 6, *j5* 8, *j6* 6, *J2* 10, *J5* 6, *z2* 7, *z4* 9, *z5* 6, *Z1* 10, *Z4* 22, *Z5* 49, *s4* 23, *S2* 13, *S4* 12, *S5* 6, *r3* 8, *R1* 8. All setae smooth, except *Z5* serrated. Setae *r3* and *R1* inserted on dorsal shield.

Peritreme. Peritreme extending to *j1* level; peritremal shield lightly sclerotized.

Venter. Sternogenital shield, reticulated, longer than wide, 106 long, 70 wide at level of *st5*, with five pairs of setae, *st1* 9, *st2* 12, *st3* 9, *st4* 9, *st5* 8, three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Distances between *st1-st1* 44, *st2-st2* 48, *st3-st3* 47, *st4-st4* 43, *st5-st5* 36, *st1-st5* 97. Exopodal shield at coxae II–IV. Ventrianal shield subtriangular, reticulated, 112 long, 151 wide at anterior corner, 56 at level of anus, fused with peritremal shield cingulum; with three pairs of pre-anal setae, *JV1* 9, *JV2* 7, *ZV2* 13, solenostomes *gv3* crescentic; *Pa* 11, *Pst* 14 on shield. Setae *JV5* 24 on interscutal membrane. All setae smooth.

Chelicera. Movable digit 18 long, with one tooth; fixed digit 17 long, anterior half with two teeth, posterior half with five teeth, with *pilus dentilis*. Spermatodactyl L-shaped, shaft 21 long, heel rounded, foot 9 long, with expanded toe and lateral thorn-like projection.

Legs. *Legs*. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/2-1, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* III (ad2) 18, *Sti* III (ad) 17, *St* III (ad) 20, *Sge* IV (ad2) 31, *Sti* IV (ad) 21, *St* IV (d) 42.

Specimens examined. Meifeng, Renai Township, Nantou County, three females from *Lactuca formosana* (Asteraceae), 17.x.1985, C. C. Ho (TARL); Dongpu, Xinyi Township, Nantou County, five females one male from *Lactuca formosana* (Asteraceae), 18.x.1985, C. C. Ho (TARL); Mt. Anma, Heping Dist., Taichung City, one female from unknown plant, 9.iv.1990, C. C. Ho (TARL); Taigang, Jianshi Township, Hsinchu County, one female (HAL097B555) from *Miscanthus floridulus* (Poaceae), 23.vii.2008, C. C. Ho (TARL); Taigang, Jianshi Township, Hsinchu County

(24°36.588' N, 121°17.024' E, 1071m), one female (no. 1272–1) from *Prunus* sp. (Rosaceae), 17.iv.2014, J. R. Liao (NTU); Tatajia, Xinyi Township, Nantou County (23°28'49" N, 120°53'10" E, 2612m), five females (no. 2472–1, 2, 3, 4, 5) from *Yushania niitakayamensis* (Poaceae), 28.xii.2018, J. R. Liao (NTU).

Distribution. Asia: Taiwan (Tseng, 1983).

Remarks. Tseng (1983) described this species based on only holotype female from 6flower in Tienhsainen (h = 2000m) (Tienhsainen should be Tianxiang now, but the altitude only 480m). The place is probably Ci'en in Taroko National Park which is in 2000m altitude. Liao *et al.* (2017b) reported that specimens were lost. Although Tseng provided simple description and illustration, some specimens found in mountain area which congruent with original description during the investigation. Besides, there are some specimens collected in Taroko National Park, the locality is close with type locality.

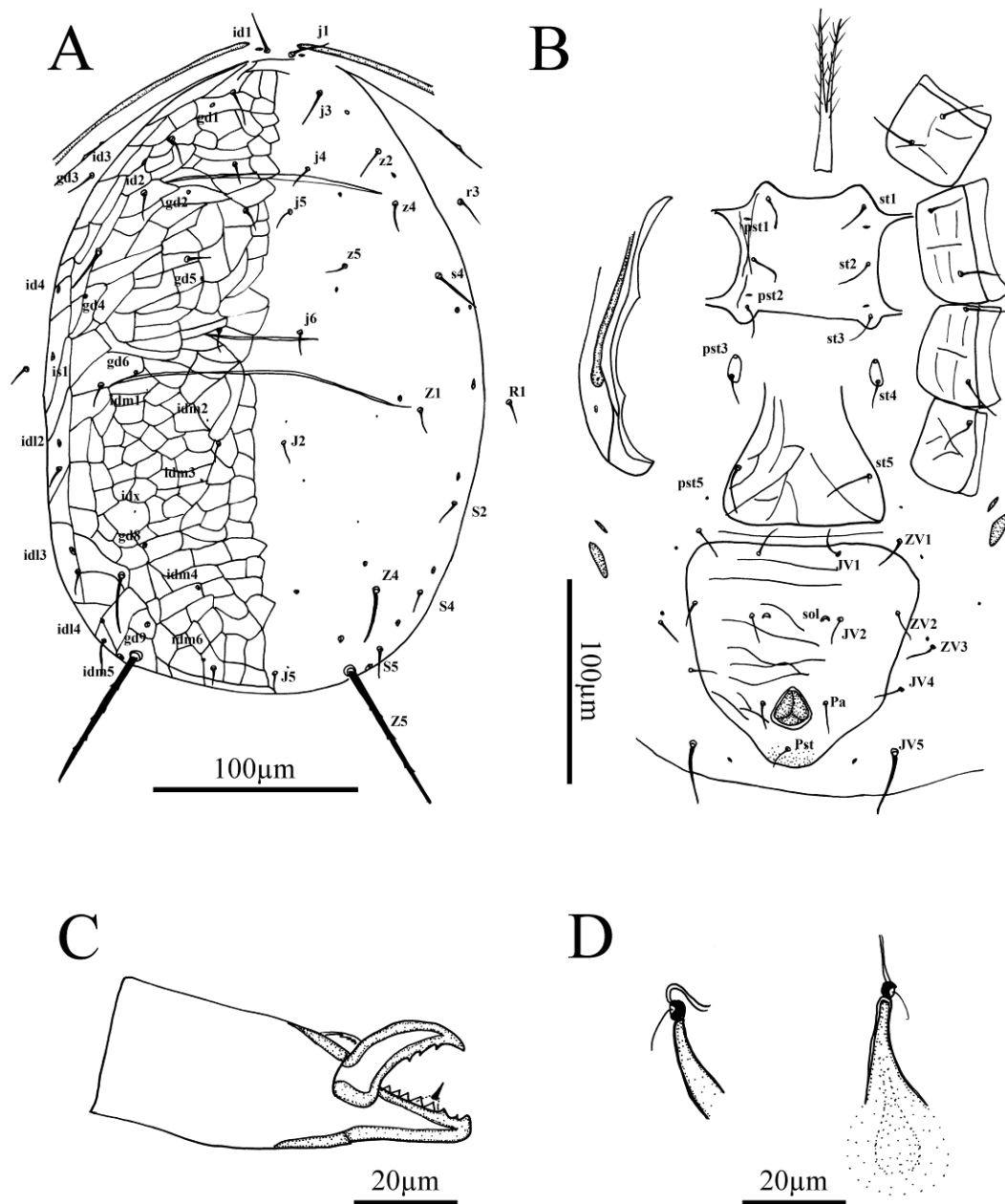


FIGURE 141. *Scapulaseius tienhsainensis* (Tseng, 1983), Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

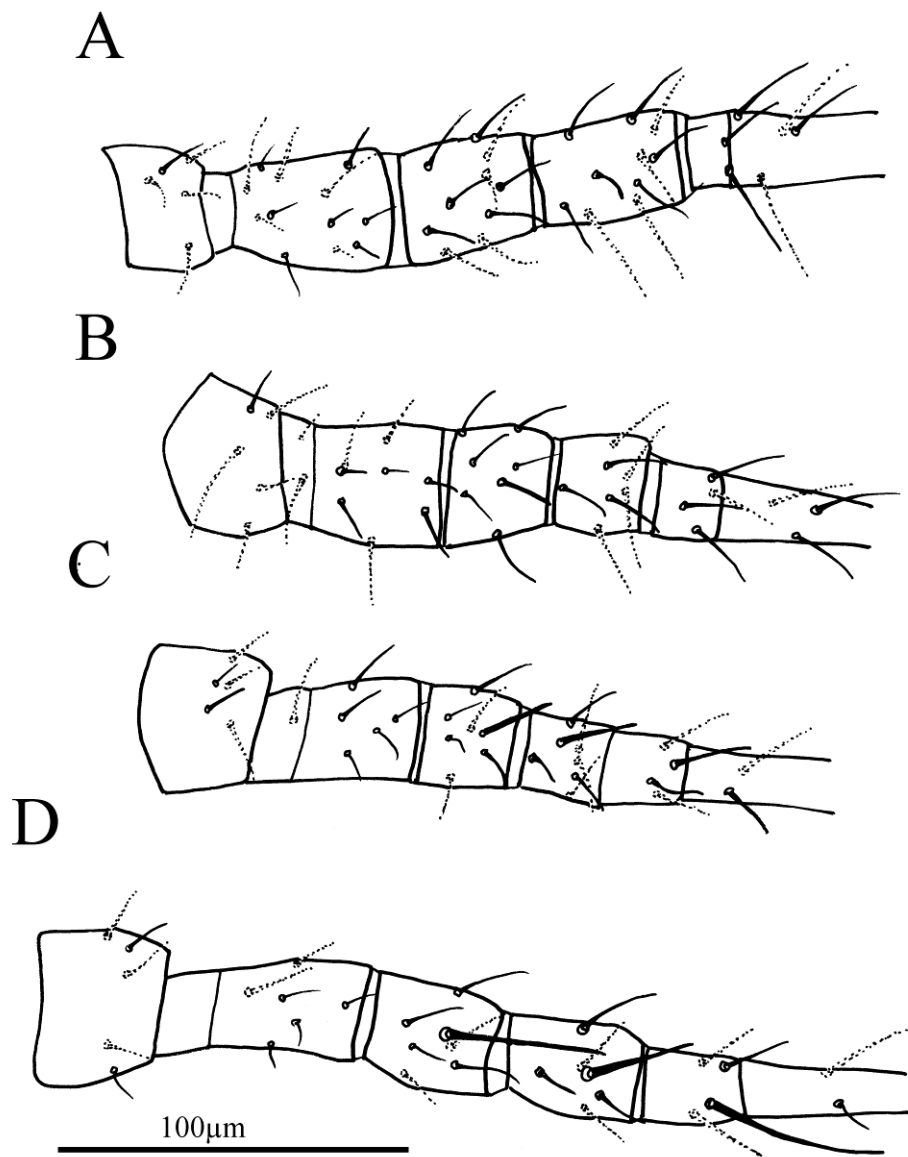


FIGURE 142. *Scapulaseius tienhsainensis* (Tseng, 1983), Female, legs A. leg I anterodorsal view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV posterodorsal view.

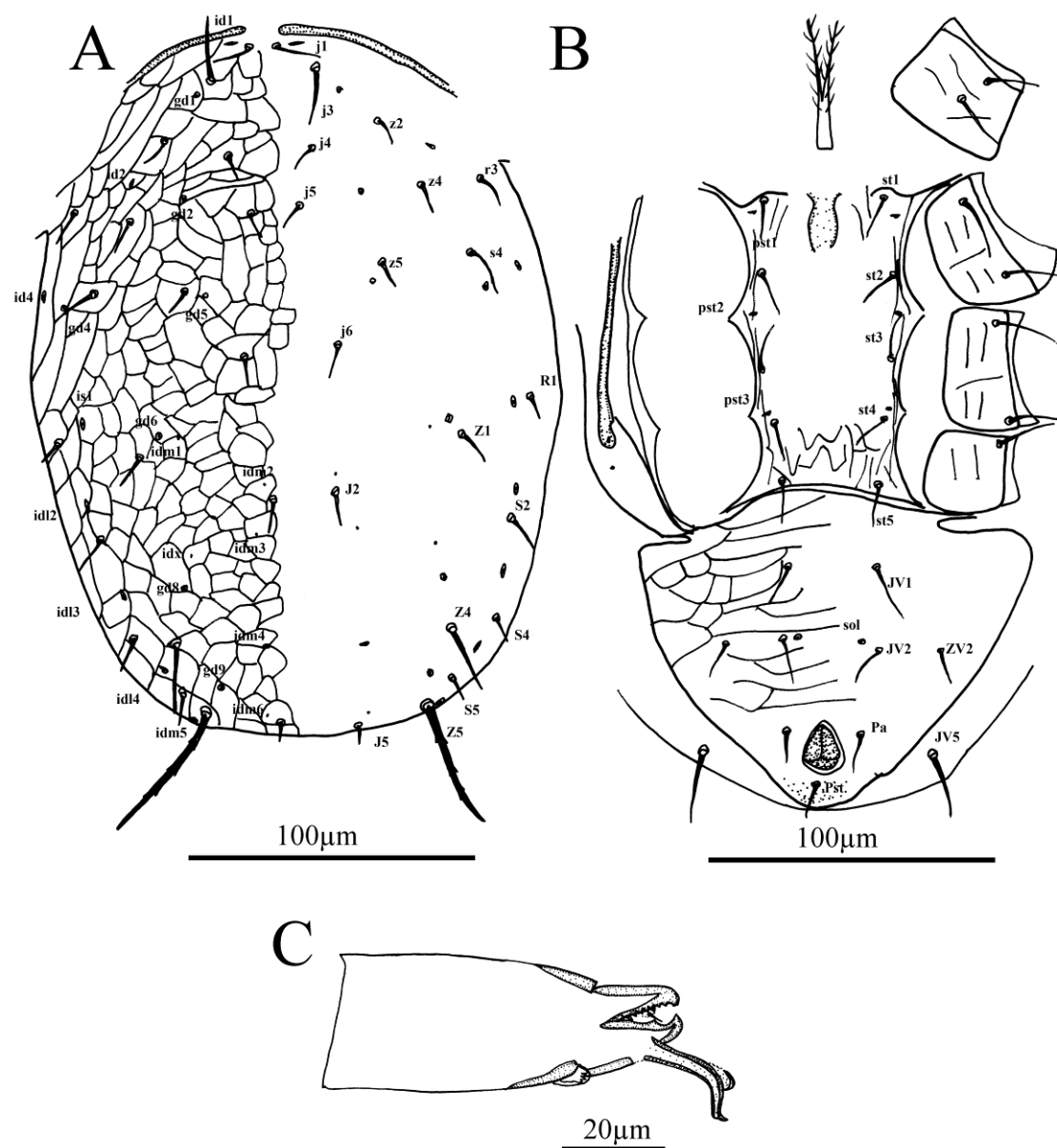


FIGURE 143. *Scapulaseius tienhsainensis* (Tseng, 1983), Male, A. dorsal shield; B. ventral idiosoma; C. chelicera and spermatodactyl.

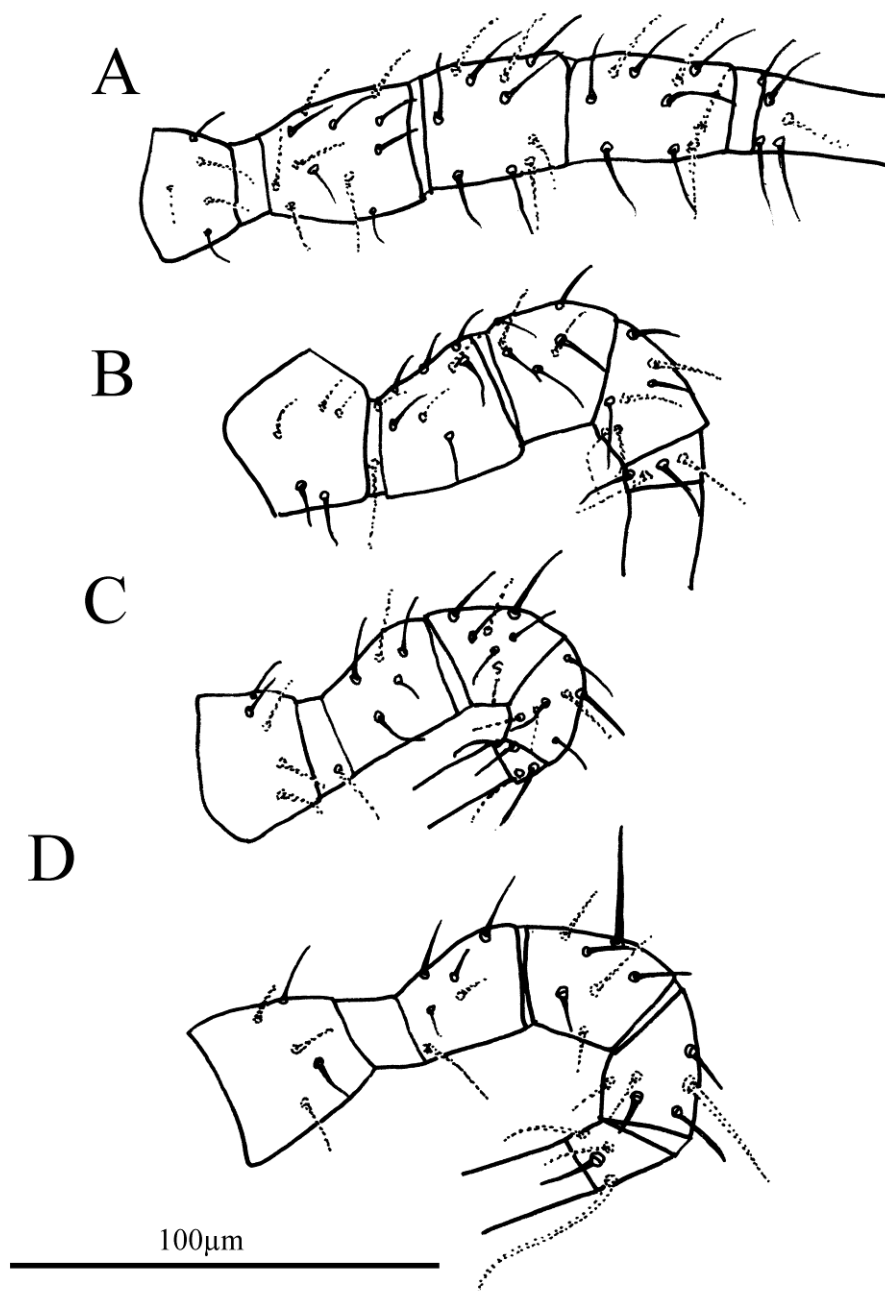


FIGURE 144. *Scapulaseius tienhsainensis* (Tseng, 1983), Male, legs A. leg I posterodorsal view, B. leg II posterior view, C. leg III posterodorsal view, D. leg IV posterior view.

Scapulaseius vestificus (Tseng, 1976)

紡織肩綫蟎



(Figures 145)

Amblyseius (*Amblyseius*) *vestificus* Tseng, 1976: 113.

Typhlodromips vestificus.—Moraes *et al.*, 1986: 151.

Scapulaseius vestificus.—Chant & McMurtry, 2005c: 337.

Female

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3:ZV.

Dorsum. Dorsal shield smooth, anterolaterally reticulated (only in description but not in illustration), 373.2 long, 244 wide; length of dorsal setae: *j1* 27.5, *j3* 12.5, *j4* 10, *j5* 10, *j6* 12.5, *J2* 12.5, *J5* 7, *z2* 12.5, *z4* 12.5, *z5* 12.5, *Z1* ?, *Z4* 17.5, *Z5* 52.5, *s4* 17.5, *S2* 17.5, *S4* 17.5, *S5* 17.5, *r3* ?, *R1* 12.5. All setae smooth.

Peritreme. Peritreme extending to *j1* level.

Venter. Sternal shield as long as wide, with three pairs of setae. Metasternal platelets tear-shaped, with a pair metasternal setae *st4*. Genital shield smooth, one pair of genital seta *st5*. Ventrianal shield vase-shaped, 115 long, 75 wide; with three pairs of pre-anal setae, solenostome *gv3* crescentic. Setae *JV5* 52.5 on interscutal membrane. All ventral setae smooth. Two pairs of metapodal plates 30 long, 5 wide, 10 long, 1.5 wide.

Spermatheca. Calyx of spermatheca funnel-shaped with atrium, major duct visible.

Chelicera. Fixed digit with 8 teeth; movable digit unidentate.

Legs. Macrosetae: three macrosetae on leg IV, *Sge* IV, *Sti* IV, *St* IV.

Male

A lightly sclerotized mite. Idiosomal setal pattern: 10A:9B/JV-3,4:ZV-1,3.

Dorsum. Dorsal shield smooth, with slightly waist, smooth, 254.4 long, 196 wide; All setae smooth.

Peritreme. Peritreme extending between *j1*.

Venter. Sternogenital shield with five pairs of setae. Ventrianal shield subtriangular, with slightly reticulated, 115 long, 112.5 wide; with three pairs of pre-anal setae, solenostome *gv3* crescentic. Setae *JV5* on interscutal membrane. All ventral setae smooth.

Chelicera. Unknown.

Legs. Unknown.

Specimens examined. No specimens.

Distribution. Asia: Taiwan (Tseng 1976).

Remarks. Tseng (1976) described this species based on eight females one male from three different plants (e.g. *Alpinia speciosa*, *Cordia dechostoma* (misspelling of *Cordia dichostoma*), *Morus* sp.) in three different localities (two in Chiayi County, one in Hualien County). Liao *et al.* (2017b) reported that specimens were lost. It is impossible to identify the species status due to previous descriptions and illustrations were ambiguous. Tseng (1976) provided a macroseta table that mentioned tibia I without macroseta, tarsus I with two macrosetae. This circumstance is unusual; it is probably misidentified macroseta by the author.

Besides, the present study surveyed the type locality of this species, only found *S. cantonensis* in Chiayi and Hualien. One collection data of *S. cantonensis* “Mingjian Township, Nantou County, three females one male from *Cordia dichotoma* (Boraginaceae), 16.x.1985, C. C. Ho (TARL)” is from *Cordia dichotoma*. Therefore, the present study suspect *S. vestificus* is junior synonym of *S. cantonensis*, the further confirmation is needed.

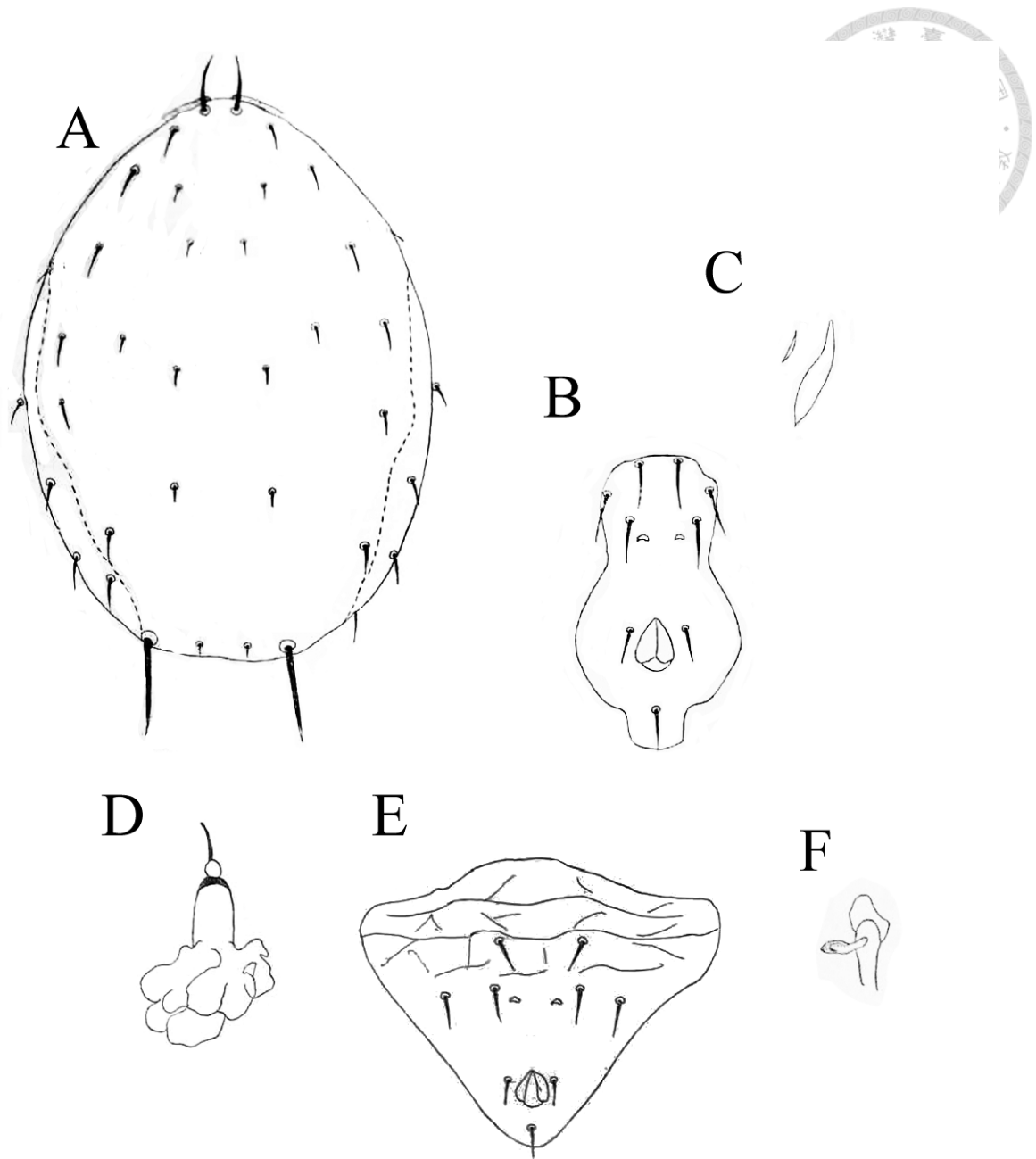


FIGURE 145. *Scapulaseius vestificus* (Tseng, 1976), (after Tseng 1976), A. dorsal shield, B. ventral idiosoma, C. metapodal shields, D. spermatheca, E. male ventrianal shield, F. spermatodactyl.

Subfamily PHYTOSEIINAE Berlese, 1913

植綏蟎亞科



Phytoseiini Berlese, 1913: 3.

Phytoseiinae.—Vitzthum, 1941: 768.

Chantiini Pritchard & Baker, 1962: 211. Type genus - *Chantia* Pritchard & Baker, 1962: 236.

Chantiinae.—Chant and Yoshida-Shaul, 1986a: 2025.

Type genus - *Phytoseius* Ribaga, 1904: 177.

This subfamily is characterized by setae *z3* and *s6* never both absent, and *Z1*, *S2*, *S4*, *S5* absent. Chant & McMurtry (1994) reported three genera, including *Chantia* Pritchard & Baker, *Phytoseius* Ribaga, *Platyseiella* Muma.

Genus *Phytoseius* Ribaga, 1904

植綏蟎屬

Phytoseius Ribaga, 1904: 177.

Phytoseius (*Phytoseius*).—Wainstein, 1959: 1361.

Phytoseius (*Dubininellus*).—Wainstein, 1959: 1361. Type species - *Phytoseius* (*Dubininellus*) *corniger* Wainstein, 1959.

Dubininellus.—Muma, 1961: 293.

Phytoseius (*Pennaseius*) Pritchard & Baker, 1962: 223. Type species - *Phytoseius* (*Pennaseius*) *amba* Pritchard & Baker, 1962.

Pennaseius.—Schuster & Pritchard, 1963: 299.



Typhlodromus (Phytoseius).—van der Merwe, 1968: 100.

Phytoseius (Euryseius) Wainstein, 1970: 1726. Type species - *Phytoseius purseglovei*.

De Leon, 1965: 13.

horridus species group Denmark, 1966: 83.

P. fotheringhamae species group Schicha, 1987: 35.

P. hawaiiensis species group Schicha, 1987: 36.

P. woolwichensis species group Schicha, 1987: 36.

plumifer species group Chant & Yoshida-Shaul, 1992a: 12.

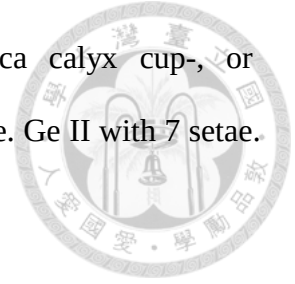
purseglovei species group Chant & Yoshida-Shaul, 1992a: 12.

Type species - *Gamasus plumifer* Canestrini & Fanzago, 1876: 130. By subsequent designation (Vitzthum, 1941).

There are 210 valid species in this genus (Demite *et al.* 2019). The genus is comprised by 3 species groups, including *plumifer* Chant & Yoshida-Shaul, *purseglovei* Chant & Yoshida-Shaul, *horridus* Denmark, which is distinguished by setae *J2* and *R1* present/absent.

Diagnosis – Idiosomal pattern 12A:5A/JV-3,4:ZV (*plumifer* species group), or 12A:4A/JV-3,4:ZV (*purseglovei* species group), 12A:3A with three caudoventral setal pattern: JV-3,4:ZV, JV-3:ZV, JV-3,4:ZV-3 (*horridus* species group). Dorsal shield lightly sclerotized. Dorsal setae *s4*, *Z4*, *Z5* significant longer, sometimes strong and heavily serrated. Sternal shield posterior margin straight, concave. Genital shield truncated posteriorly. Female ventrianal shield much longer than wide, with slightly waist, with 3 pair of preanal setae, *gv3* conspicuous, *JV5* sometimes serrated. Peritreme

usually extending to *j1* level, sometimes *j3* level. Spermatheca calyx cup-, or goblet-shaped. Chelicera with few teeth. Leg IV with 1-4 macrosetae. Ge II with 7 setae. Male ventrianal shield triangular.



Key to species in the genus *Phytoseius* from Taiwan

1. Setae *J2*, *R1* present..... *plumifer* species group Chant & Yoshida-Shaul
.....2
- Setae *J2*, *R1* absent..... *horridus* species group Denmark
.....3
2. Dorsal shield with incision at level of seta *r3*
..... *hongkongensis* Swirski & Shechter, 1961
- Dorsal shield without incision at level of seta *r3*
..... *minutus* Narayanan, Kaur & Ghai, 1960
3. Seta *s4* much longer than *s6* *crinitus* Swirski & Shechter, 1961
- Seta *s4* slightly longer or shorter than *s6*.....4
4. Seta *s4* slightly shorter than *s6* *rugatus* Tseng, 1976
- Seta *s4* longer than *s6*5
5. Ge IV with a macroseta *coheni* Swirski & Shechter, 1961
- Ge IV without macroseta..... *sonunensis* Ryu & Ehara, 1993

***Phytoseius coheni* Swirski & Shechter, 1961**

柯氏植綏蟎



(Figures 146–149)

Phytoseius (*Dubininellus*) *macropilis coheni*.—Swirski & Shechter, 1961: 104.

Phytoseius (*Phytoseius*) *macropilis coheni*.—Ehara, 1966: 26.

Phytoseius (*Dubininellus*) *coheni*.—Swirski & Golan, 1967: 226.

Phytoseius coheui [sic].—Tseng, 1984: 773.

Phytoseius (*Phytoseius*) *coheni*.—Moraes *et al.*, 1986: 219.

Phytoseius hawaiiensis Prasad, 1968a: 1460. (Synonymy according to Denmark & Evans 2011)

Phytoseius huangi Ehara, 1970: 62. (Synonymy according to Ehara 2002b)

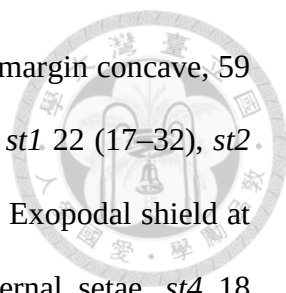
Phytoseius jianfengensis Chen *et al.*, 1980: 15. (Synonymy according to Wu 1997)

Female (n=10)

A lightly sclerotized mite. Idiosomal setal pattern: 12A:3A/JV-3,4:ZV.

Dorsum. Dorsal shield distinctly reticulated throughout; rugose, longer than wide, 285 (267–320) long, 155 (139–171) wide at level of s4, 150 (118–167) wide at level of S4, seta r3 inserted on dorsal shield; six pairs of solenostomes (*gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), fifteen pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *id6*, *idm1*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of dorsal setae: *j1* 25 (19–28), *j3* 21 (18–23), *j4* 6 (4–8), *j5* 6 (4–9), *j6* 8 (5–11), *J5* 5 (3–7), *z2* 9 (5–13), *z3* 25 (21–32), *z4* 9 (7–11), *z5* 6 (4–8), *Z4* 60 (49–73), *Z5* 73 (62–83), *s4* 83 (68–98), *S2* 75 (57–83), *r3* 36 (31–45). Setae *j1*, *j3*, *z3*, *Z4*, *Z5*, *s4*, *s6*, *r3* longer, thickened and serrated, other short and smooth. Setae *r3* inserted on dorsal shield.

Peritreme. Peritreme extending to *j1* level, peritremal shield smooth, lightly sclerotized, with one pair of solenostome (*gd3*) and one pair of lyrifissures (*id3*).



Venter. Sternal shield smooth, much wider than long, posterior margin concave, 59 (51–65) long, 77 (66–87) wide at *st3* level, with three pairs of setae *st1* 22 (17–32), *st2* 22 (14–27), *st3* 20 (16–26) and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae I–IV. Metasternal platelets tear-shaped, with a pair metasternal setae, *st4* 18 (13–25), and one pair of lyrifissures (*pst3*). Genital shield smooth, posteriorly truncate, *st5* 20 (14–27), 69 (64–85) wide. Distances between *st1-st1* 51 (46–55), *st2-st2* 61 (54–67), *st3-st3* 72 (61–79), *st1-st3* 55 (51–59), *st5-st5* 64 (59–70). Ventrianal shield smooth, much longer than wide, with waist, 97 (86–107) long, 43 (39–49) wide at level of ZV2 and 50 (43–60) wide at level of anus; with three pairs of pre-anal setae, *JV1* 13 (9–18), *JV2* 11 (8–16), *ZV2* 14 (11–17); *Pa* 12 (9–16), *Pst* 13 (11–16) one shield. Setae *JV5* 51 (42–60), *ZV1* 15 (10–20), *ZV3* 11 (7–15) on interscutal membrane. All ventral setae smooth, except seta *JV5* thickened and serrated. Two pairs of metapodal plates 28 (22–34) long, 4 (2–5) wide, 9 (6–10) long, 2 (1–3) wide.

Spermatheca. Calyx of spermatheca goblet-shaped, flaring distally, 8 (6–9) long, 9 (7–11) wide, and atrium nodular, major and minor ducts visible.

Chelicera. Movable digit 22 (19–23) long, with one tooth; fixed digit 22 (21–24) long, anterior half with two teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): 2-3/2-2/1-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* IV (ad2) 18 (16–21), *Sti* IV (ad) 41 (34–48), *Sbta* IV (d) 25 (21–30). *Sdta* IV (d) 22 (19–26). Macrosetae apically shovel-shaped with expanded blade.

Male (n=5)

A lightly sclerotized mite. Idiosomal setal pattern: 12A:3A/JV-3,4:ZV-1,3.

Dorsum. Dorsal shield distinctly reticulated throughout; rugose, longer than wide, 227 (212–240) long, 142 (127–155) wide at level of *s4*, 110 (93–119) wide at level of *S4*; six pairs of solenostomes (*gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), fifteen pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *id6*, *idm1*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 19 (17–22), *j3* 20 (17–21), *j4* 5 (5–6), *j5* 5 (4–6), *j6* 6 (5–7), *J5* 5 (3–6), *z2* 9 (6–11), *z3* 22 (20–23), *z4* 8 (7–9), *z5* 7 (6–8), *Z4* 32 (28–37), *Z5* 40 (37–42), *s4* 47 (43–56), *s6* 45 (38–53), *r3* 29 (24–35), Setae *j1*, *j3*, *z3*, *Z4*, *Z5*, *s4*, *s6*, *r3* longer, thickened and serrated, other short and smooth. Setae *r3* inserted on dorsal shield.

Peritreme. Peritreme extending to *j1* level; peritremal shield lightly sclerotized.

Venter. Sternogenital shield smooth, posterior margin almost straight, much longer than wide, 110 (108–111) long, 83 (75–86) wide at level *st2*, with five pairs of setae *st1* 17 (14–22), *st2* 18 (16–19), *st3* 17 (15–20), *st4* 16 (14–19), *st5* 13 (11–15), three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Exopodal shield at coxae I–IV. Distance between *st1-st1* 46 (44–49), *st2-st2* 53 (46–56), *st3-st3* 62 (59–68), *st4-st4* 51 (49–53), *st5-st5* 41 (38–45), *st1-st5* 95 (92–97). Exopodal shield at coxae II–IV. Ventrianal shield subtriangular, reticulated, 91 (79–97) long, 129 (112–143) wide at level of anterior corner and 63 (52–73) wide at level of anus, fused with peritremal shield cingulum; with three pairs of pre-anal setae, *JV1* 10 (6–11), *JV2* 9 (8–13), *ZV2* 10 (9–2); solenostomes *gv3* small and rounded, *Pa* 10 (7–14), *Pst* 11 (8–14) on shield; *JV5* 18 (17–19) on interscutal membrane. All ventral setae smooth.

Chelicera. Movable digit 15 (11–16) long, with one tooth; fixed digit 15 (14–16), with two teeth on anterior half, with *pilus dentilis*. Spermatodactyl L-shaped, shaft 11 (11–14) long, heel rounded, foot 8 (7–9) long.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): 2-3/2-2/1-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1;

leg III, 1-2/1-1/0-1, 1-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* IV (ad2) 9 (6–14), *Sti* IV (ad) 16 (14–18), *Sbta* IV (d) 22 (18–27). *Sdta* IV (d) 19 (16–21). Macrosetae apically shovel-shaped with expanded blade.

Specimens examined. CHINA: Jianfengling, Hainan Province, one female from tree bark, 15.v.1988, W. N. Wu (GIBAR).

TAIWAN: Fengshan District, Kaohsiung City, one holotype (NSMT-13070, holotype of *P. huangi* Ehara) female from *Pithecolobium dulce* (Leguminosae), 2.iv.1966, S. Ehara (NSMT); Lintou Park, Huxi Township, Penghu County, one female from *Lantana camara* (Verbenaceae), 21.iv.1989, C. C. Ho (TARL); Dashe Dist., Kaohsiung City, two females from *Ziziphus mauritiana* (Rhamnaceae), 4.vii.1991, C. C. Ho (TARI).

Distribution. Africa: Mauritius (Schicha 1984b). Asia: China (Fujian (Wu 1981), Guangdong (Waite & Gerson 1994), Hainan (Chen *et al.* 1980), Hong Kong (Swirski & Shechter 1961), Wuling Mountain Region (Wu & Lan 1992a)), India (Gupta 1971a), Indonesia (Ehara 2002b), Japan (Ehara & Amano 2002), Malaysia (Ehara 2002a), Philippines (Swirski & Golan 1967), Singapore (Corpuz-Raros 1995b), Taiwan (Lo 1970), Thailand (Ehara & Bhandhufalck 1977). North America: USA (Denmark & Evans 2011). Oceania: Australia (Schicha 1980), Hawaii (Denmark & Evans 2011), Papua New Guinea (Schicha & Gutierrez 1985).

Remarks. Swirski & Shechter (1961) described this species from Hong Kong. They reported this species has 3 teeth on fixed digit, 1 tooth on movable digit; the present study found 2 teeth on fixed digit, 1 tooth on movable digit. Besides, Taiwanese specimens showed the lengths of setae *s4*, *s6*, *Z4*, *Z5* longer than original description. Also, the lengths of macrosetae *Sge* IV is same with *Sdta* IV in original description but

Sge IV is shorter than *Sdta* IV in Taiwanese specimens. Denmark & Evans (2011) reported *P. hawaiiensis* as junior synonym of *P. coheni* without explanation. This study still kept this synonymy until further examination of type specimens in future.

This species is usually observed on the plant with hairy leave, the lifestyle should be subtype III-a. Additionally, stronger dorsal setae are found in this species, these characters are considered as advantages for living in these hairy leave.

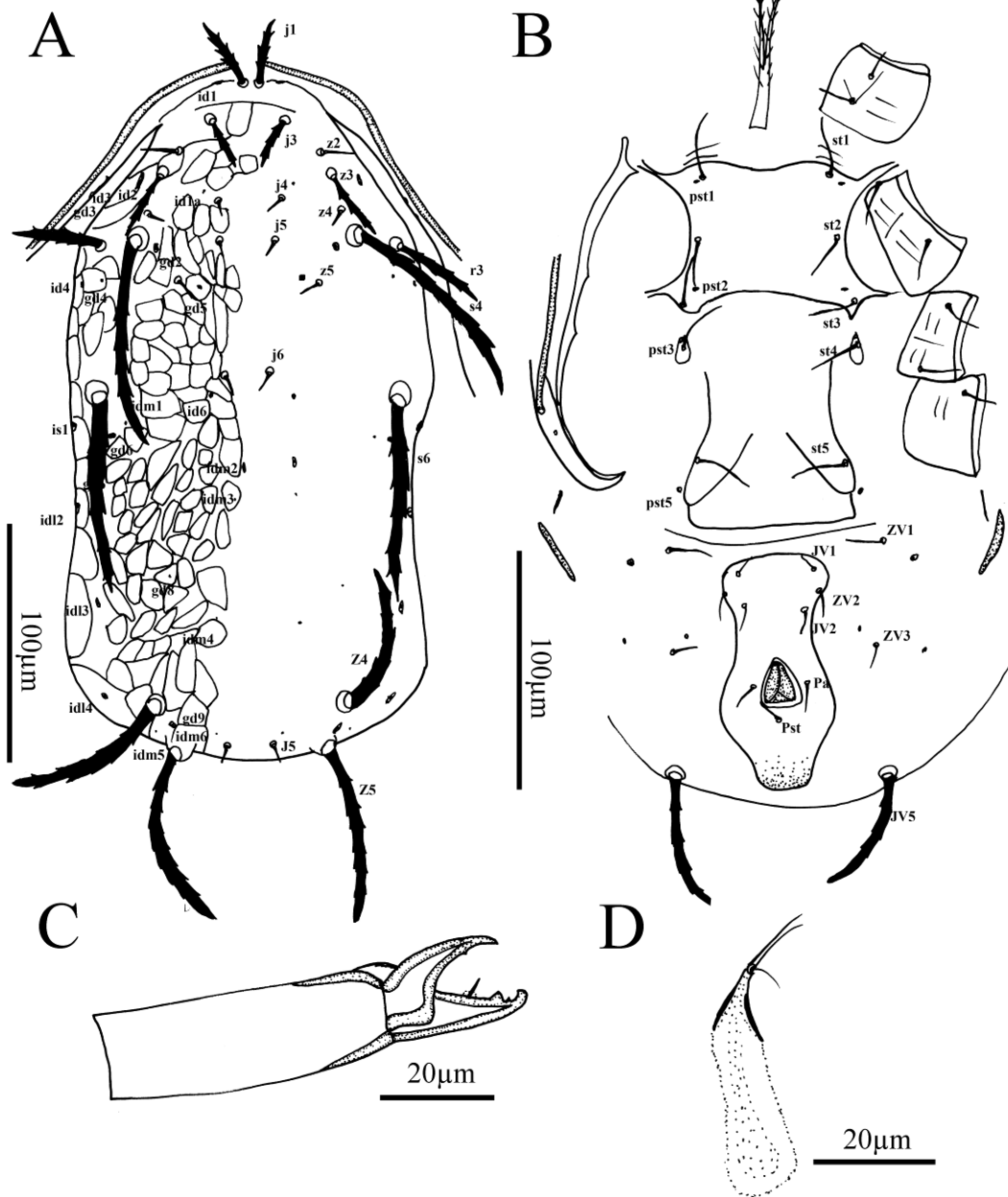


FIGURE 146. *Phytoseius coheni* Swirski & Shechter, 1961, Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

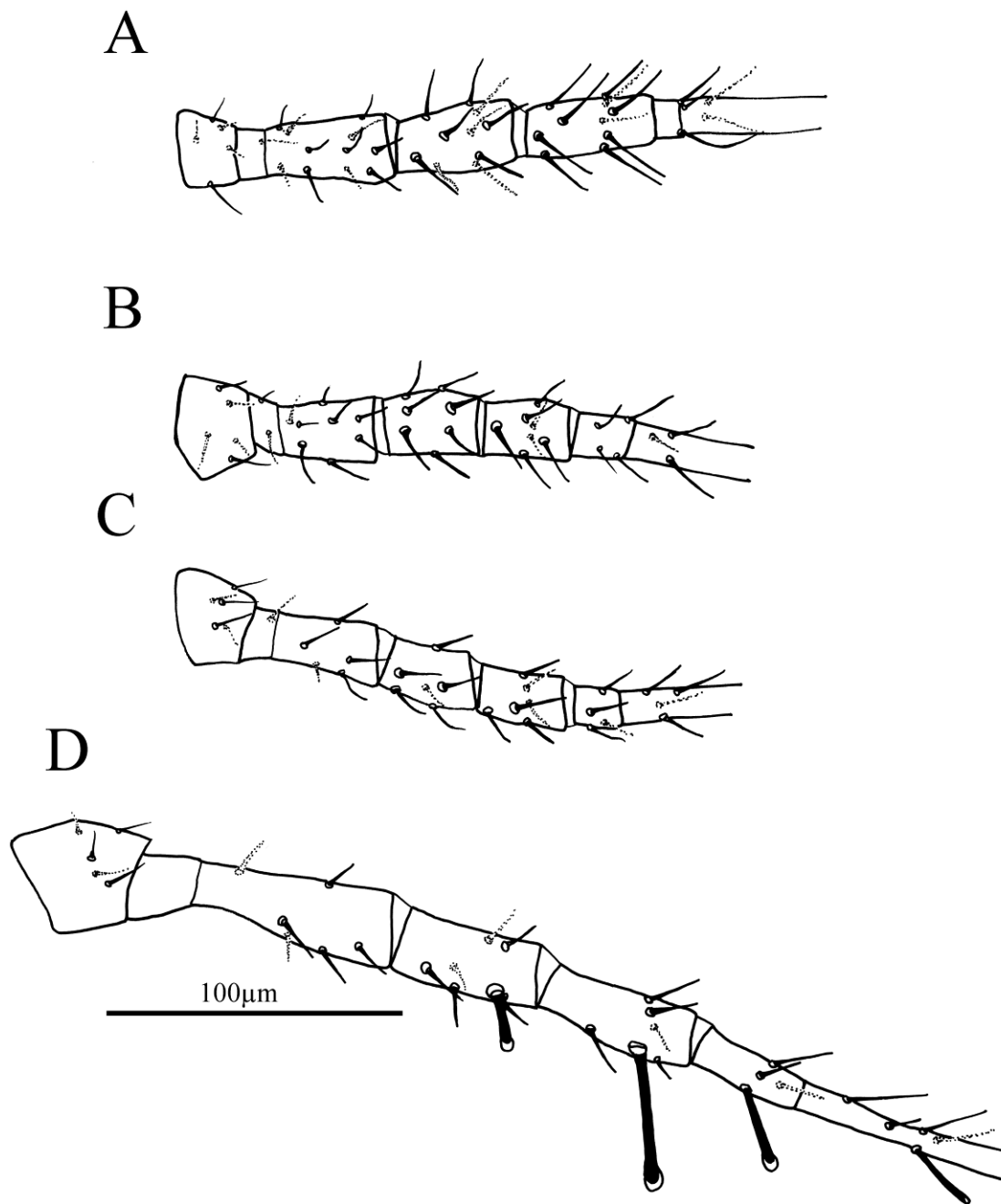


FIGURE 147. *Phytoseius coheni* Swirski & Shechter, 1961, Female, legs A. leg I anterodorsal view, B. leg II dorsal view, C. leg III anterior view, D. leg IV anterior view.

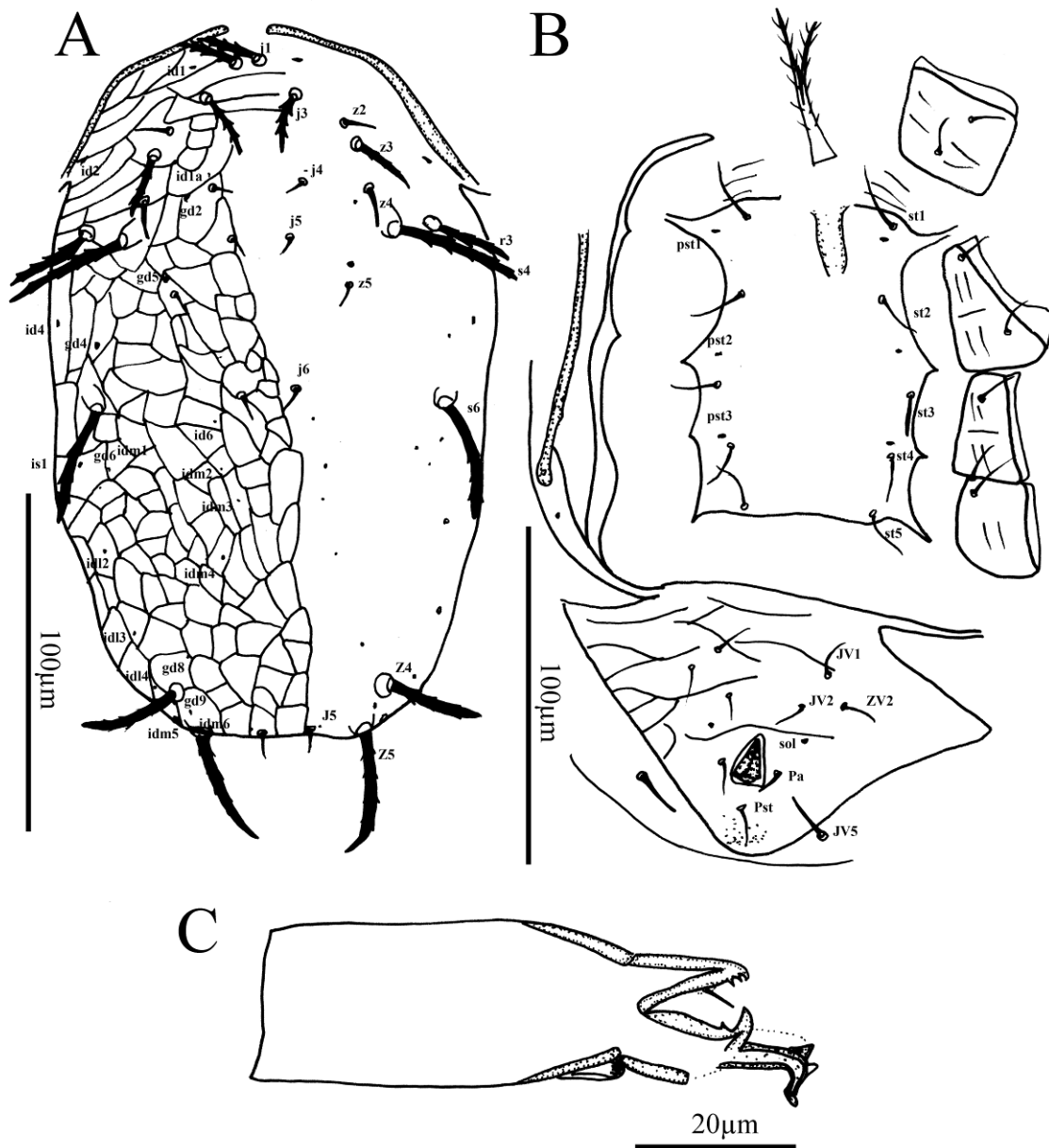


FIGURE 148. *Phytoseius coheni* Swirski & Shechter, 1961, Male, A. dorsal shield; B. ventral idiosoma; C. chelicera and spermatodactyl.

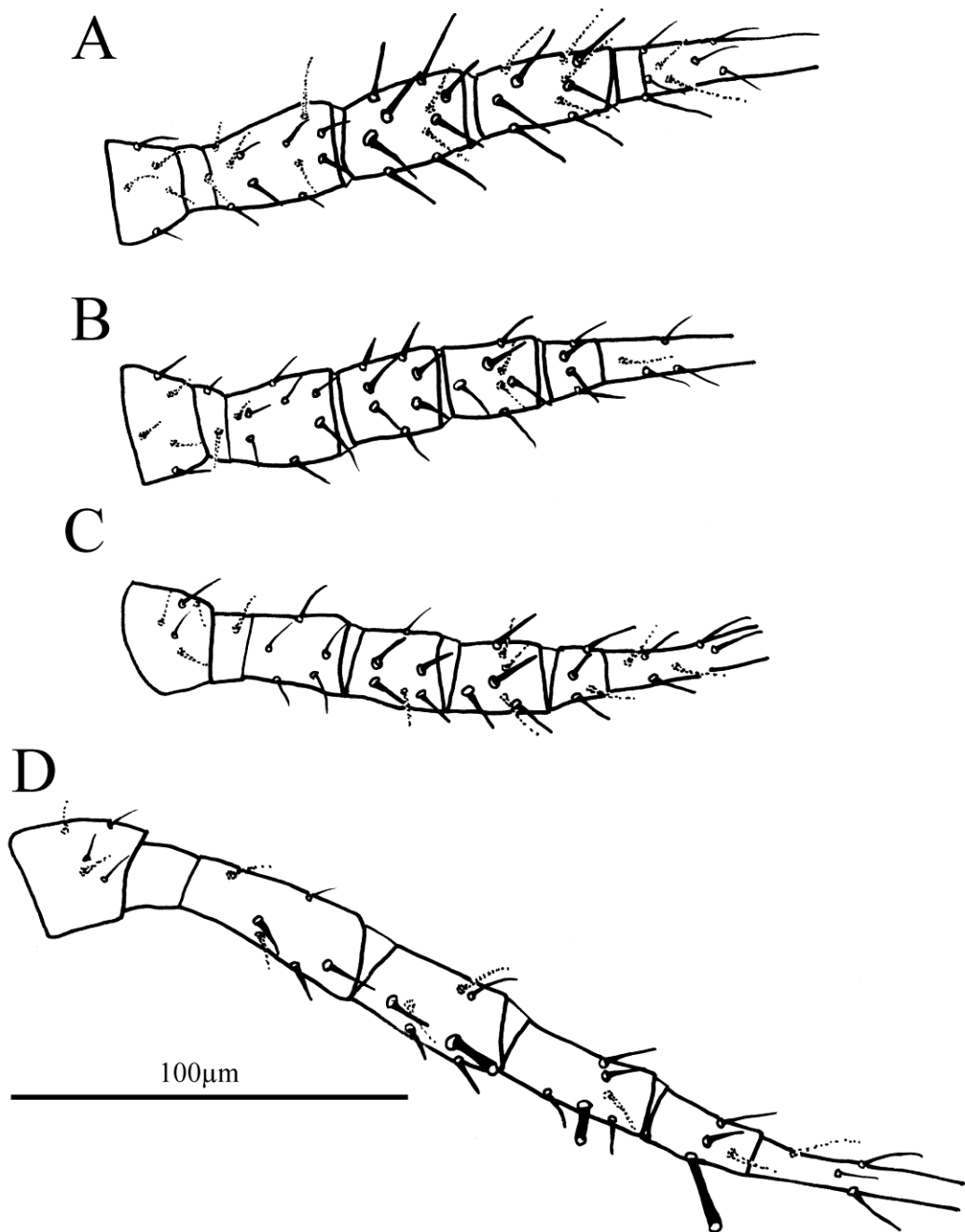


FIGURE 149. *Phytoseius coheni* Swirski & Shechter, 1961, Male, legs A. leg I dorsal view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV anterior view.

***Phytoseius crinitus* Swirski & Shechter, 1961**

長毛植綏蟎



(Figures 150–151)

Phytoseius (*Dubininellus*) *crinitus* Swirski & Shechter, 1961: 102.

Phytoseius (*Phytoseius*) *crinitus*.—Ehara, 1966: 26.

Female (n=10)

A lightly sclerotized mite. Idiosomal setal pattern: 12A:3A/JV-3,4:ZV.

Dorsum. Dorsal shield distinctly reticulated throughout; rugose, much longer than wide, 309 (291–327) long, 164 (136–177) wide at level of *s4*, 166 (144–184) wide at level of *S4*, seta *r3* inserted on dorsal shield; five pairs of solenostomes (*gd4*, *gd5*, *gd6*, *gd8*, *gd9*), fourteen pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *id6*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of dorsal setae: *j1* 28 (24–30), *j3* 38 (30–46), *j4* 6 (4–7), *j5* 6 (5–7), *j6* 6 (5–11), *J5* 6 (4–7), *z2* 9 (7–10), *z3* 28 (22–33), *z4* 9 (7–10), *z5* 6 (4–8), *Z4* 94 (83–102), *Z5* 78 (65–90), *s4* 119 (111–128), *s6* 81 (65–93), *r3* 44 (39–48). Setae *j1*, *j3*, *z3*, *Z4*, *Z5*, *s4*, *s6*, *r3* longer and serrated, other short and smooth. Setae *r3* inserted on dorsal shield.

Peritreme. Peritreme extending to *j1* level, peritremal shield smooth, lightly sclerotized, with one pair of solenostome (*gd3*) and one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, wider than long, posterior margin straight, 66 (61–73) long, 80 (62–94) wide at *st3* level, with three pairs of setae *st1* 23 (18–28), *st2* 22 (18–28), *st3* 18 (16–22) and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae II–IV. Metasternal platelets tear-shaped, with a pair metasternal setae, *st4* 19 (14–26), and one pair of lyrifissures (*pst3*). Genital shield smooth, posteriorly truncate, *st5* 21 (16–27), 70 (62–76) wide. Distances between *st1-st1* 54 (50–61), *st2-st2* 65 (56–76), *st3-st3* 68 (56–74), *st1-st3* 58 (49–64), *st5-st5* 62 (58–67). Ventrianal shield

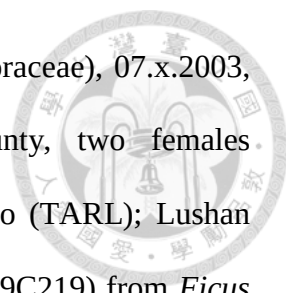
smooth, much longer than wide, with waist, 96 (77–106) long, 40 (34–47) wide at level of ZV2 and 51 (39–60) wide at level of anus; with three pairs of pre-anal setae, *JV1* 12 (10–16), *JV2* 11 (9–16), *ZV2* 11 (9–15), *Pa* 11 (9–12), *Pst* 12 (10–15) on shield. Setae *JV5* 49 (42–54), *ZV1* 13 (9–16), *ZV3* 9 (8–11) on interscutal membrane. All ventral setae smooth, except seta *JV5* thickened and serrated. One pair of metapodal plates 30 (27–35) long, 3 (2–5) wide.

Spermatheca. Calyx of spermatheca cup-shaped, flaring distally, 3 (2–5) long, 10 (7–11) wide, and atrium nodular, major and minor ducts visible.

Chelicera. Movable digit 21 (19–22) long, with one tooth; fixed digit 21 (17–24) long, anterior half with two teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* IV (ad2) 15 (10–19), *Sti* IV (ad) 52 (47–54), *Sbta* IV (d) 26 (23–29). *Sdta* IV (d) 25 (16–30). Macrosetae apically shovel-shaped with expanded blade.

Specimens examined. Dingbao, Jinning Township, Kinmen County, one female (TAL089E307) from *Psidium guajava* (Myrtaceae), 26.x.2000, C. C. Ho (TARL); Fuxing Village, Nangan Township, Lienchiang County, one female (TAL091F046) from soil, 5.vi.2002, C. C. Ho (TARL); Kinmen County, seven females one male (TAL091C262, 263, 264, 265, 266) from *Celtis sinensis* (Cannabaceae), 26.x.2002, C. C. Ho (TARL); Kinmen County, three females (TAL0091C299) from soil of *Hibiscus tiliaceus* (Malvaceae), 26.x.2002, C. C. Ho (TARL); Huiminongzhuang, Jinhu Township, Kinmen County, one female (TAL092O055) from *Lantana camara* (Verbenaceae), 7.x.2003, C. C. Ho (TARL); Huiminongzhuang, Jinhu Township,



Kinmen County, one female (TAL092O040) from *Morus alba* (Moraceae), 07.x.2003, C. C. Ho (TARL); Houtou, Lieyu Township, Kinmen County, two females (TAL092O274, 279) from bamboo (Poaceae), 09.x.2003, C. C. Ho (TARL); Lushan Hot Spring, Ren'ai Township, Nantou County, one female (HAL099C219) from *Ficus pumila* var. *awkeotsang* (Moraceae), 29.xi.2010, C. C. Ho (TARL); Shakadang Trail, Xiulin Township, Hualien County (24°10'22" N 121°37'02" E, 160 m), six females (no. 2408-4, 5, 6, 8, 9, 11) from *Mallotus paniculatus* (Euphorbiaceae), 8.xi.2018, J. R. Liao (NTU); Xiulin Township, Hualien County (24°11.611' N 121°29.219' E, 767 m), one female (no. 2418-2) from *Trema orientalis* (Cannabaceae), 8.xi.2018, J. R. Liao (NTU).

Distribution. Africa: Burundi (Ueckermann *et al.* 2007), Madagascar Island (Blommers 1976). Asia: China (Hainan (Wu & Ou 2002a), Hong Kong (Swirski & Shechter 1961), Wuling Mountain Region (Wu & Lan 1992a)), India (Gupta 1986), Indonesia (Oomen 1982), Japan (Ehara 1967b), Philippines (Corpuz-Raros & Garcia 1994a), Singapore (Corpuz-Raros 1995b), Taiwan (Ho *et al.* 2003).

Remarks. Swirski & Shechter (1961) reported this species from Hong Kong. They reported this species has 3 teeth on fixed digit, 1 tooth on movable digit; the present study found 2 teeth on fixed digit, 1 tooth on movable digit. Besides, no significant difference was found. This species is characterized by the significantly longer seta *s*₄, besides, the relative length of macrosetae on leg IV is also important.

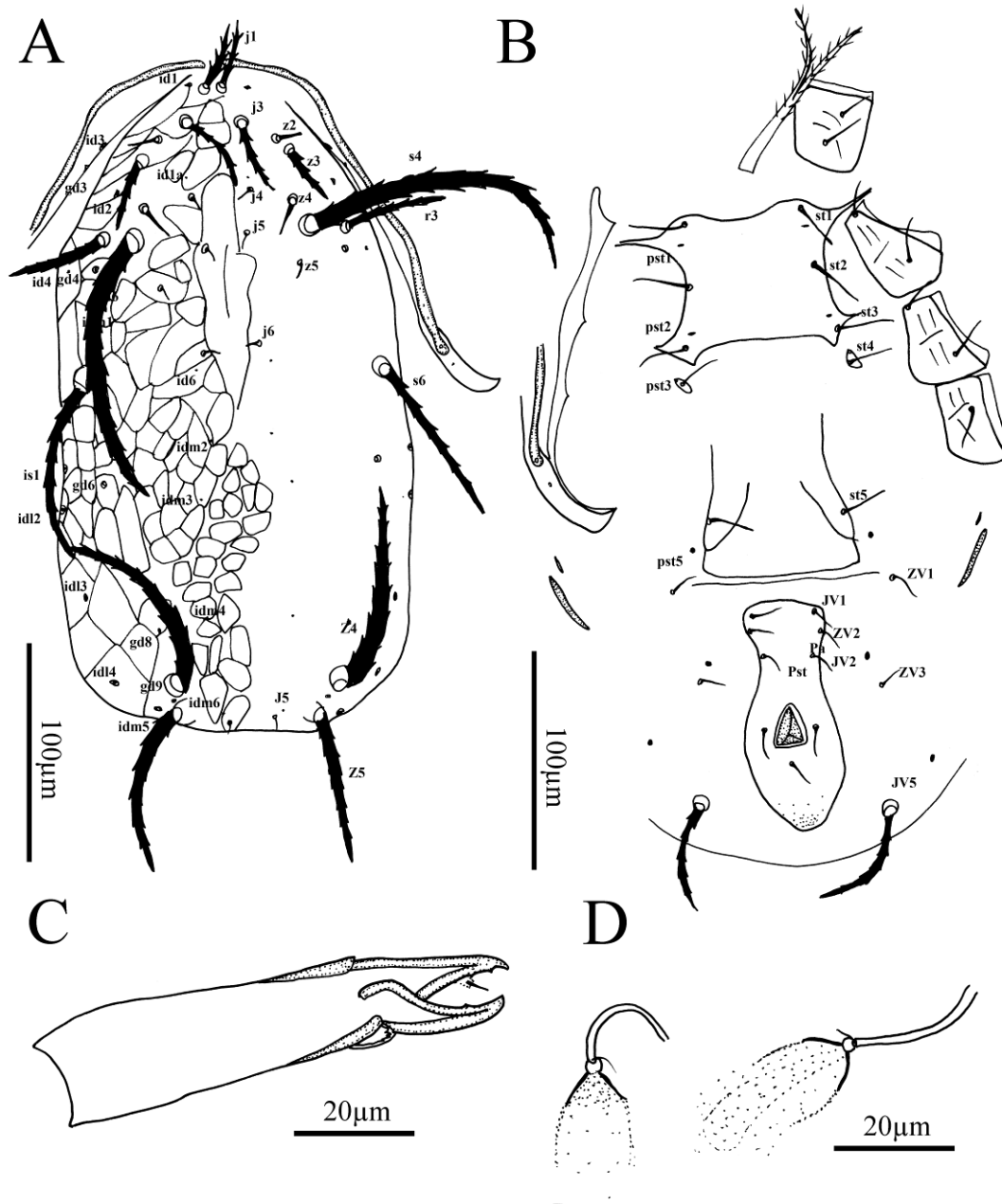


FIGURE 150. *Phytoseius crinitus* Swirski & Shechter, 1961, Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

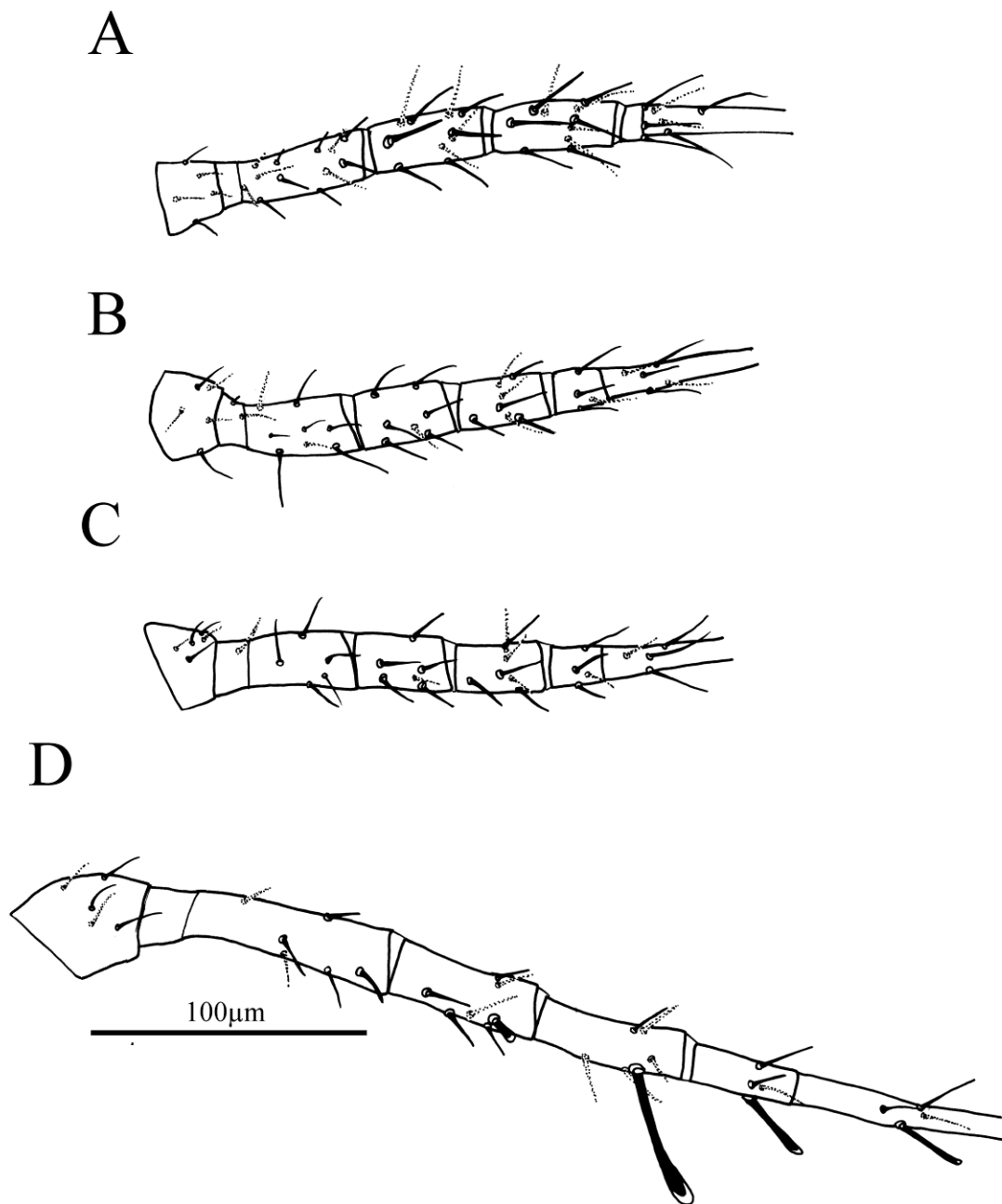


FIGURE 151. *Phytoseius crinitus* Swirski & Shechter, 1961, Female, legs A. leg I dorsal view, B. leg II anterodorsal view, C. leg III anterior view, D. leg IV anterior view.

Phytoseius hongkongensis Swirski & Shechter, 1961

香港植綏蟎



(Figures 152–155)

Phytoseius (*Phytoseius*) *hongkongensis* Swirski & Shechter, 1961: 99.

Phytoseius (*Pennaseius*) *hongkongensis*.—Ehara, 1966: 25.

Female (n=10)

A lightly sclerotized mite. Idiosomal setal pattern: 12A:5A/JV-3,4:ZV.

Dorsum. Dorsal shield anterolaterally reticulated, much longer than wide, 290 (266–302) long, 144 (112–155) wide at level of *s4*, 137 (93–175) wide at level of *S4*, with incision at seta *r3* level, seta *r3* inserted on dorsal shield; six pairs of solenostomes (*gd1*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), thirteen pairs of lyrifissures (*id1*, *id2*, *id4*, *id6*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*), solenostome *gd5* conspicuous; length of dorsal setae: *j1* 26 (19–36), *j3* 70 (60–79), *j4* 5 (4–7), *j5* 5 (3–8), *j6* 5 (4–8), *J2* 7 (5–8), *J5* 5 (4–6), *z2* 11 (6–16), *z3* 42 (39–47), *z4* 8 (6–10), *z5* 7 (3–9), *Z4* 71 (46–89), *Z5* 75 (59–83), *s4* 89 (74–99), *s6* 80 (69–89), *r3* 42 (35–47), *R1* 11 (8–15). Setae *j1*, *j3*, *z3*, *Z4*, *Z5*, *s4*, *s6*, *r3* longer and serrated, other short and smooth. Setae *r3* inserted on shield, *R1* inserted on lateral integument.

Peritreme. Peritreme extending to *j3* level, peritremal shield smooth, lightly sclerotized, with one pair of solenostome (*gd3*) and one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, much wider than long, posterior margin with median projection, 68 (54–77) long, 88 (80–96) wide at *st3* level, with three pairs of setae *st1* 30 (25–34), *st2* 27 (22–31), *st3* 25 (17–34) and two pairs of lyrifissures (*pst1*, *pst2*). Metasternal platelets tear-shaped, with a pair metasternal setae, *st4* 22 (18–28), and one pair of lyrifissures (*pst3*). Exopodal shield at coxae I–IV. Genital shield smooth, posteriorly truncate, *st5* 22 (16–26), 66 (61–73) wide. Distances between *st1*–*st1* 60

(46–69), *st2-st2* 69 (64–75), *st3-st3* 78 (70–86), *st1-st3* 65 (53–76), *st5-st5* 61 (55–66). Ventrianal shield smooth, much longer than wide, with waist, 10 (91–105) long, 54 (47–62) wide at level of *ZV2* and 48 (36–57) wide at level of anus; with three pairs of pre-anal setae, *JV1* 16 (11–20), *JV2* 16 (10–18), *ZV2* 17 (10–23), with a pair of minute, widely separated solenostome *gv3* near lateral margins posterior to setae *JV2*, *Pa* 13 (10–17), *Pst* 13 (10–17) on shield.. Setae *JV5* 51 (38–58), *ZV1* 16 (10–20), *ZV3* 11 (7–16) on interscutal membrane. All ventral setae smooth, except seta *JV5*. Two pairs of metapodal plates 26 (23–29) long, 3 (2–4) wide, 9 (5–11) long, 2 (2–3) wide.

Spermatheca. Calyx of spermatheca goblet-shaped, flaring distally, 17 (11–19) long, 14 (11–17) wide, and atrium enlarged, major duct broader.

Chelicera. Movable digit 26 (23–28) long, with two teeth; fixed digit 27 (23–29) long, anterior half with two teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): 2-3/2-2/1-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* IV (ad2) 26 (24–28), *Sti* IV (ad) 32 (27–34), *St* IV (d) 29 (24–33). Macrosetae apically shovel-shaped with expanded blade.

Male (n=5)

A lightly sclerotized mite. Idiosomal setal pattern: 12A:5A/JV-3,4:ZV-1,3.

Dorsum. Dorsal shield anterolaterally reticulated, much longer than wide, 217 (191–245) long, 133 (118–145) wide at level of *s4*, 112 (102–121) wide at level of *S4*; six pairs of solenostomes (*gd1*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), thirteen pairs of lyrifissures (*id1*, *id2*, *id4*, *id6*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 19 (15–21), *j3* 51 (47–54), *j4* 5 (4–6), *j5* 4 (4–6), *j6* 5 (4–6), *J2* 6 (5–7), *J5* 5 (4–6), *z2* 7 (5–10), *z3* 30 (23–37), *z4* 7 (7–8), *z5* 6 (5–7), *Z4* 37 (27–41), *Z5* 37 (29–44), *s4* 61

(57–65), *s6* 50 (43–55), *r3* 30 (26–34), *R1* 9 (7–11). Setae *j1*, *j3*, *z3*, *Z4*, *Z5*, *s4*, *s6*, *r3* longer and serrated, other short and smooth. Setae *r3* and *R1* inserted on dorsal shield.

Peritreme. Peritreme extending to *z4* level; peritremal shield lightly sclerotized.

Venter. Sternogenital shield smooth, posterior margin straight, much longer than wide, 118 (107–132) long, 76 (66–82) wide at level *st2*, with five pairs of setae *st1* 22 (15–27), *st2* 22 (15–29), *st3* 17 (15–18), *st4* 19 (16–20), *st5* 15 (11–20), three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Exopodal shield at coxae I–IV. Distance between *st1*–*st1* 48 (39–55), *st2*–*st2* 57 (53–67), *st3*–*st3* 61 (59–64), *st4*–*st4* 51 (47–55), *st5*–*st5* 41 (38–44), *st1*–*st5* 105 (97–116). Exopodal shield at coxae I–IV. Ventrianal shield subtriangular, reticulated, 89 (73–101) long, 131 (124–139) wide at level of anterior corner and 53 (42–64) wide at level of anus; with three pairs of pre-anal setae, *JV1* 11 (9–15), *JV2* 10 (7–12), *ZV2* 9 (7–11), *Pa* 9 (4–12), *Pst* 9 (6–12) on shield. *JV5* 20 (14–25) on interscutal membrane. All ventral setae smooth, except seta *JV5* serrate.

Chelicera. Movable digit 16 (14–18) long, with one tooth; fixed digit 16 (14–17), with two teeth on anterior half, with *pilus dentilis*. Spermatodactyl L-shaped, shaft 16 (14–17) long, heel rounded, foot 16 (14–17) long.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): 2-3/2-2/1-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* IV (ad2) 18 (15–20), *Sti* IV (ad) 22 (19–25), *St* IV (d) 21 (14–26). Macrosetae apically shovel-shaped with expanded blade.

Specimens examined. Qingfan Village, Juguang Township, Lienchiang County, seven females (TAL092N187, 88, 89, 90) from *Pueraria lobata* (Fabaceae), 17.ix.2003, C. C. Ho (TARL); Huiminongzhuang, Jinhu Township, Kinmen County, two females one male (TAL093C347, 48, 49) from *Lantana camara* (Verbenaceae), 27.vii.2004, C.

C. Ho (TARL).

Distribution. Africa: Benin (Ueckermann *et al.* 2007), Kenya (Moraes *et al.* 1989c), Madagascar Island (Blommers 1976), Malawi (Ueckermann *et al.* 2007). Asia: China (Guangdong (Chen *et al.* 1980), Hainan (Wu and Ou, 2002), Wuling mountain region (Wu and Lan, 1992), Hong Kong (Swirski & Shechter, 1961)), Indonesia (Ehara, 2002), Japan (Ehara, 1972), Malaysia (Ehara, 2002), South Korea (Ryu, 1997), Thailand (Ehara & Bhandhufalck, 1977), Taiwan (Tseng, 1976). Oceania: Australia (Schicha, 1984b), Papua New Guinea (McMurtry & Moraes, 1985).

Remarks. Swirski & Shechter (1961) described this species from *Urena lobata* leaf in Hong Kong. Denmark (1966) re-described this species based on paratype specimens. He mentioned that the differences between *P. minutus*; relative length between setae j_3 , z_3 , and with/without notch on seta r_3 level of dorsal shield. In the present study, all specimens have notch on dorsal shield; it should belong to *P. hongkongensis*. However, different setal length combinations are found in these specimens, therefore, it probably has more than one species in these specimens, and the species status need clarify in future.

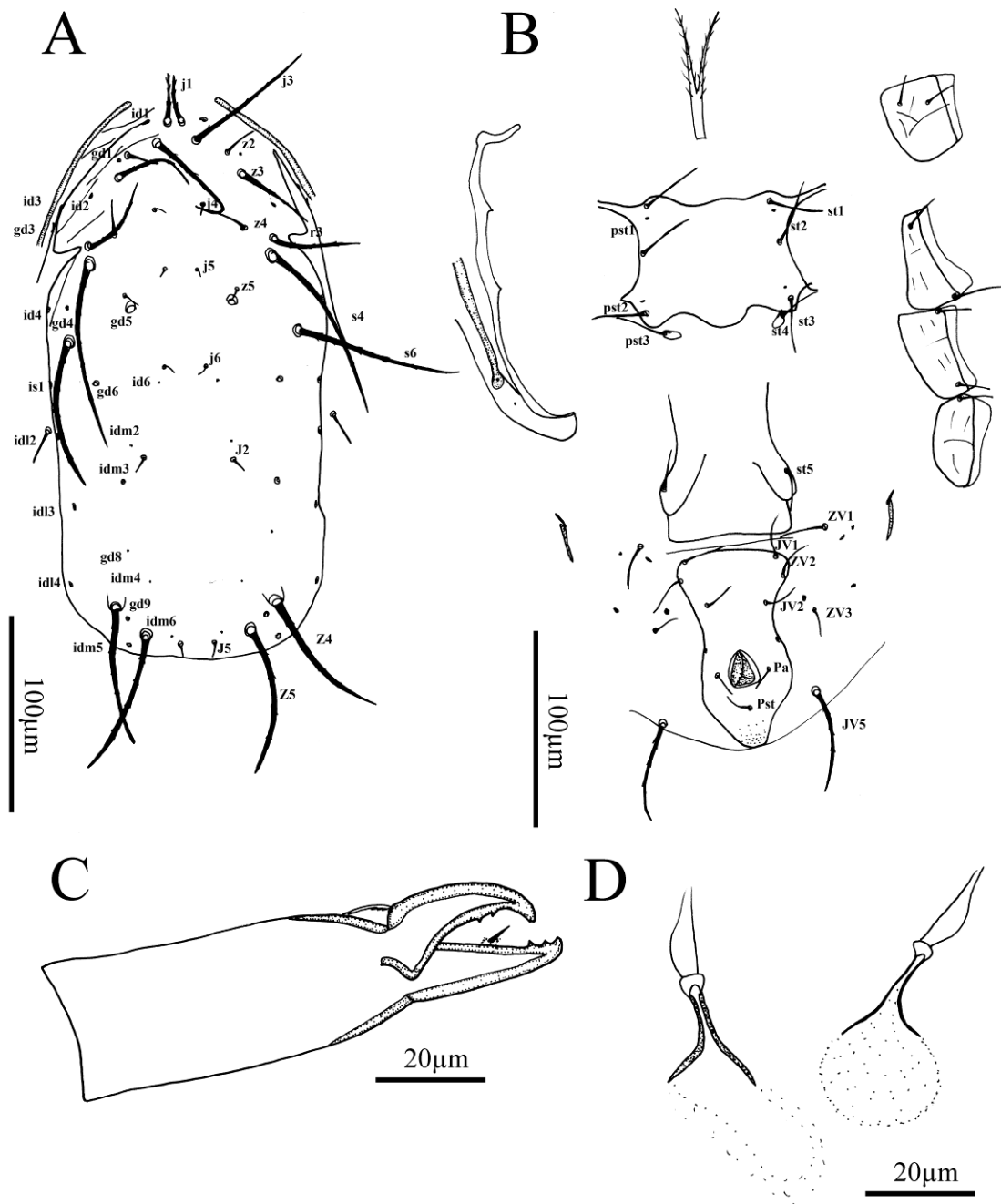


FIGURE 152. *Phytoseius hongkongensis* Swirski & Shechter, 1961, Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

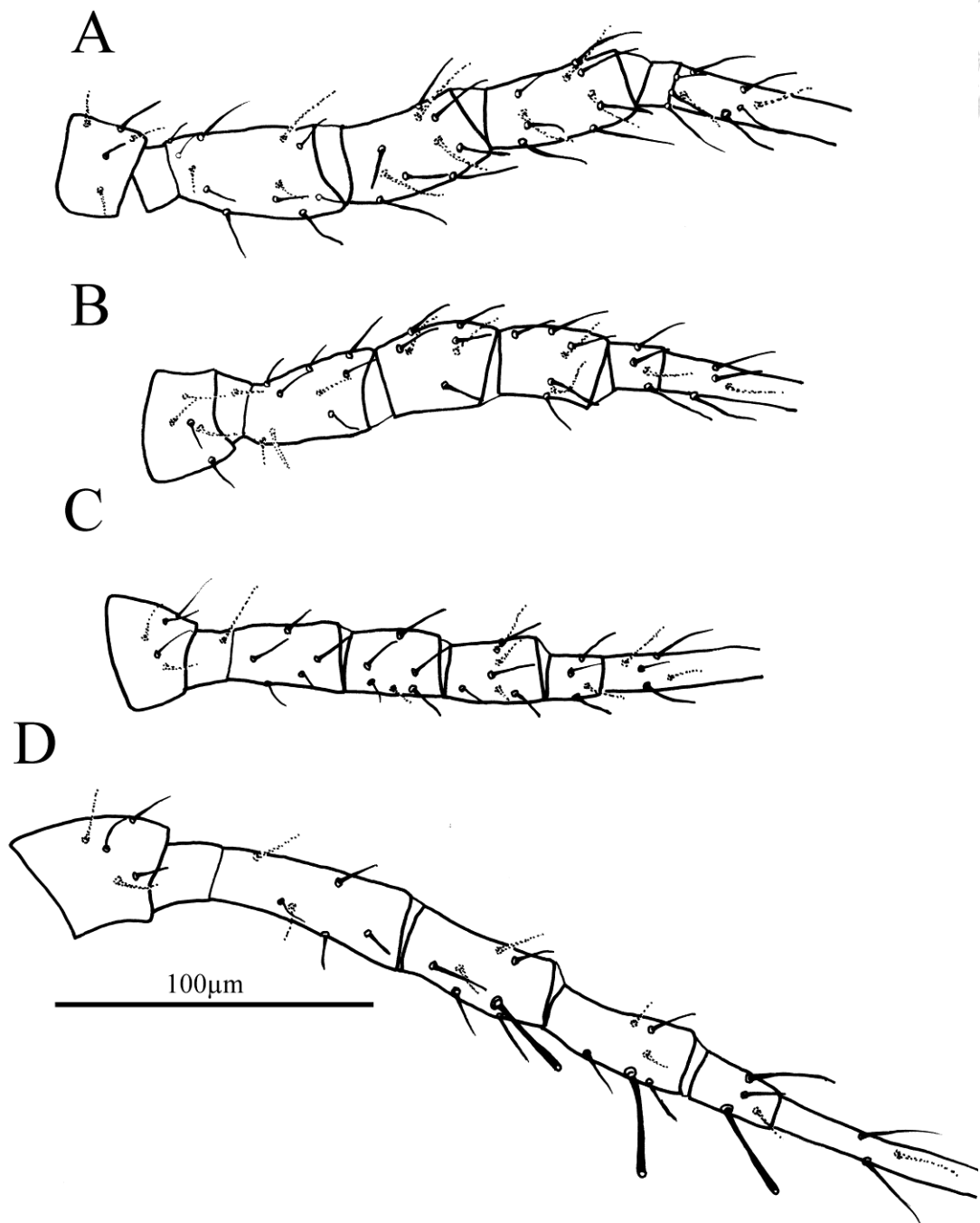


FIGURE 153. *Phytoseius hongkongensis* Swirski & Shechter, 1961, Female, legs A. leg I anterior view, B. leg II posterior view, C. leg III anterodorsal view, D. leg IV anterior view.

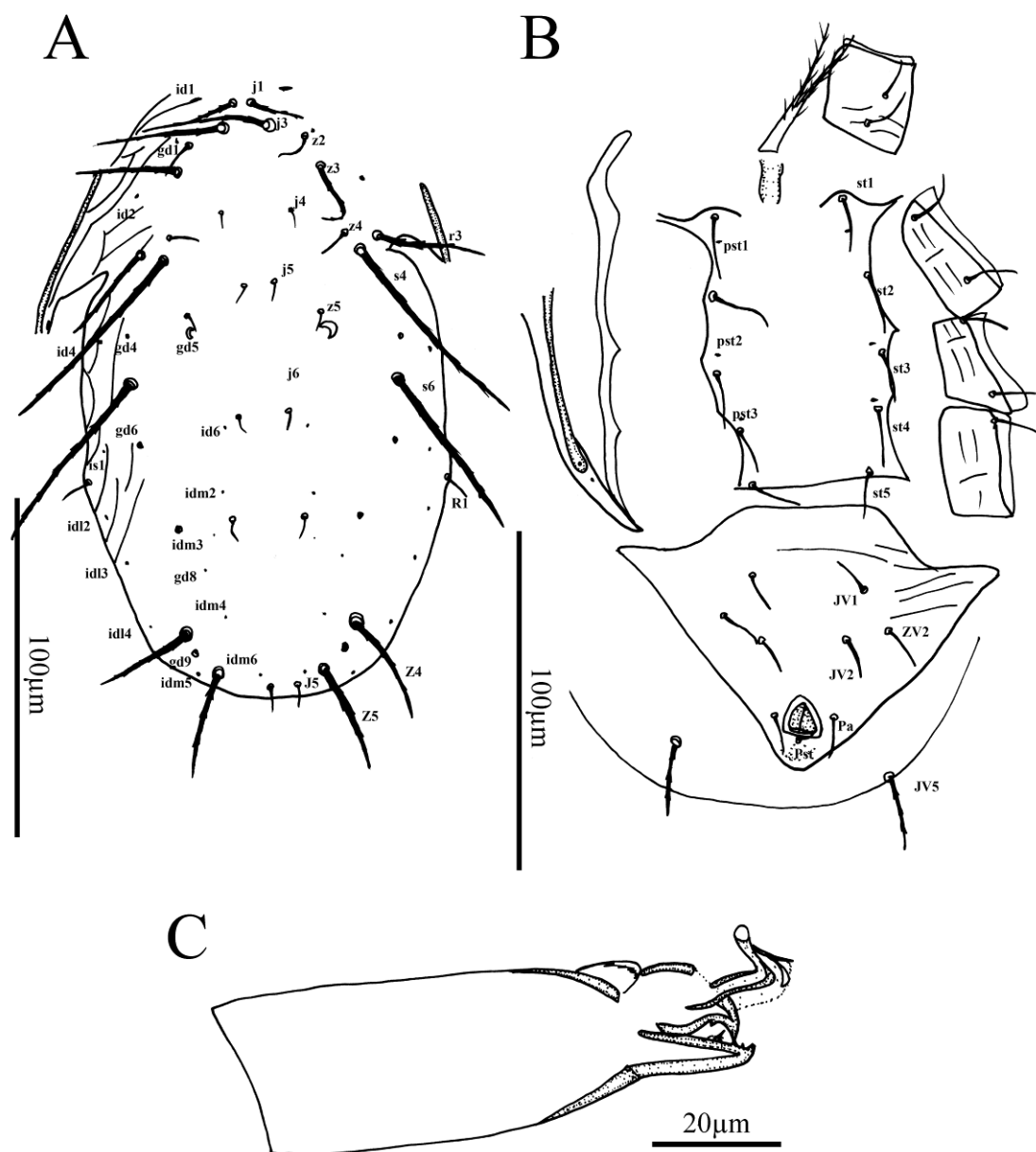


FIGURE 154. *Phytoseius hongkongensis* Swirski & Shechter, 1961, Male, A. dorsal shield; B. ventral idiosoma; C. chelicera and spermatodactyl.

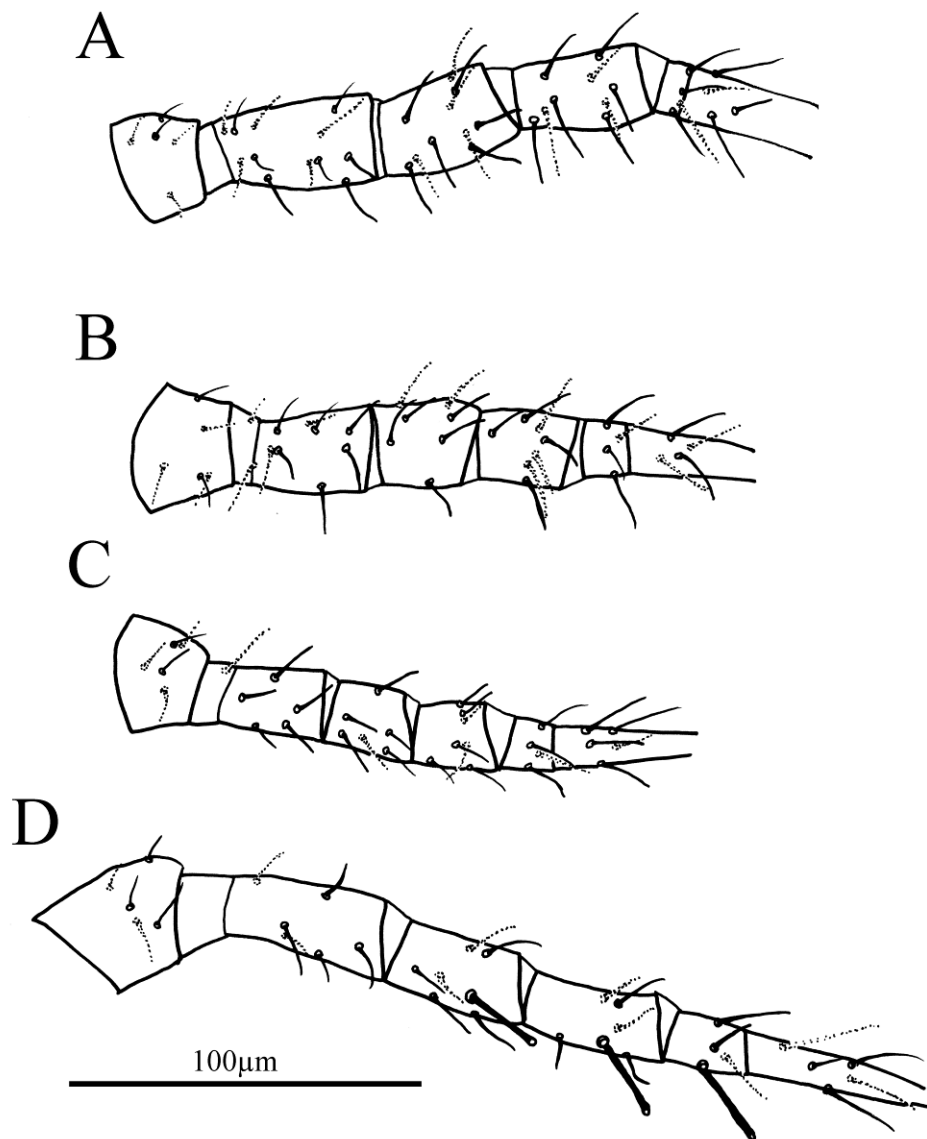


FIGURE 155. *Phytoseius hongkongensis* Swirski & Shechter, 1961, Male, legs A. leg I anterior view, B. leg II dorsal view, C. leg III anterodorsal view, D. leg IV anterior view.

***Phytoseius minutus* Narayanan, Kaur & Ghai, 1960**

微小植綫蟎



(Figures 156–157)

Phytoseius minutus Narayanan, Kaur & Ghai, 1960: 391.

Phytoseius (Phytoseius) minutus.—Denmark, 1966: 48.

Phytoseius (Pennaseius) minutus.—Ehara, 1966: 25.

Phytoseius wuxianensis Xin *et al.*, 1983: 45. (Synonymy according to Wu 1997)

Phytoseius yunanensis Lou *et al.*, 1992: 215. (Synonymy according to Wu *et al.* 2009)

Female

A lightly sclerotized mite. Idiosomal setal pattern: 12A:5A/JV-3,4:ZV.

Dorsum. Dorsal shield anteroreticulated, much longer than wide, 295 long, 157 wide; at least four pairs of solenostomes (*gd4*, *gd5*, *gd6*, *gd9*), solenostomes *gd5* conspicuous; length of dorsal setae: *j1* 30, *j3* 71, *j4* 4, *j5* 3, *j6* 5, *J2* 8, *J5* 5, *z2* 17, *z3* 52, *z4* 6, *z5* 3, *Z4* 83, *Z5* 79, *s4* 99, *r3* 49, *R1* 16. Setae *j1*, *j3*, *z3*, *Z4*, *Z5*, *s4*, *s6*, *r3* longer and serrated, other short and smooth. Setae *r3* inserted on dorsal shield, and *R1* inserted on lateral integument.

Peritreme. Peritreme extending to *j3* level, peritremal shield smooth, lightly sclerotized.

Venter. Sternal shield smooth, much wider than long, posterior margin unknown, with three pairs of setae *st1*, *st2*, *st3*. Metasternal platelets tear-shaped, with a pair metasternal setae, *st4*. Genital shield smooth, posteriorly truncate, *st5*. Ventrianal shield smooth, much longer than wide, with waist; with three pairs of pre-anal setae, *JV1*, *JV2*, *ZV2*. Setae *JV5*, *ZV1*, *ZV3* on interscutal membrane. All ventral setae smooth, except seta *JV5*. One metapodal plate.

Spermatheca. Calyx of spermatheca goblet-shaped, flaring distally, and atrium

enlarged, major duct wider.

Chelicera. Movable digit 30 29 (24–32) long, with two teeth; fixed digit 26 27. (24–28) long, anterior half with two teeth, with *pilus dentilis*.

Legs. Macrosetae: *Sge* IV (ad2) 30, *Sti* IV (ad) 28, *St* IV (d) 27.

Male

A lightly sclerotized mite. Idiosomal setal pattern: 12A:5A/JV-3,4:ZV-1,3.

Dorsum. Dorsal shield smooth, much longer than wide. Setae *j1*, *j3*, *z3*, *Z4*, *Z5*, *s4*, *s6*, *r3* longer and serrated, other short and smooth. Setae *r3* and *R1* inserted on dorsal shield.

Peritreme. Peritreme extending to seta *z4* level; peritremal shield lightly sclerotized.

Venter. Sternogenital shield smooth, posterior margin straight, much longer than wide, with five pairs of setae *st1*, *st2*, *st3*, *st4*, *st5*. Ventrianal shield subtriangular, reticulated, with three pairs of pre-anal setae, *JV1*, *JV2*, *ZV2*; *JV5* 58 on interscutal membrane. All ventral setae smooth, except seta *JV5* serrate.

Chelicera. Movable digit with one tooth; fixed digit, with three teeth, with *pilus dentilis*. Spermatodactyl L-shaped.

Legs. Macrosetae: *Sge* IV (ad2), *Sti* IV (ad), *St* IV (d).

Specimens examined. No specimens.

Distribution. Asia: China (Fujian (Wu *et al.* 2009), JiangSu (Xin *et al.* 1983), Yunnan (Lou *et al.* 1992)), India (Narayanan *et al.* 1960), Taiwan (Tseng 1976).

Remarks. Narayanan *et al.* (1960) reported this species from tetranychid infected leaves of *Hibiscus esculentus* in India. They provided detailed descriptions and illustrations on both sexes. Denmark (1966) provided description and illustration based on one specimen. Although the specimen is not labeled as type, but it seem same



collection data with type specimens (probably syntype). He reported the difference between *P. hongkongensis* and *P. minutus* is relative length of setae *j*3, *z*3, *P. minutus* have setae *j*3 slightly longer than *z*3. Besides, the other significant difference is with/without incision on seta *r*3 level. However, during the survey in Taiwan, all specimens have incision on dorsal shield but with different combinations of relative length of dorsal setae. The present study considers these two species are valid, but the existence of *P. minutus* in Taiwan should need further survey.

The present study provided the description which was modified from Narayanan *et al.* (1960), and the measurements were modified from Denmark (1966).

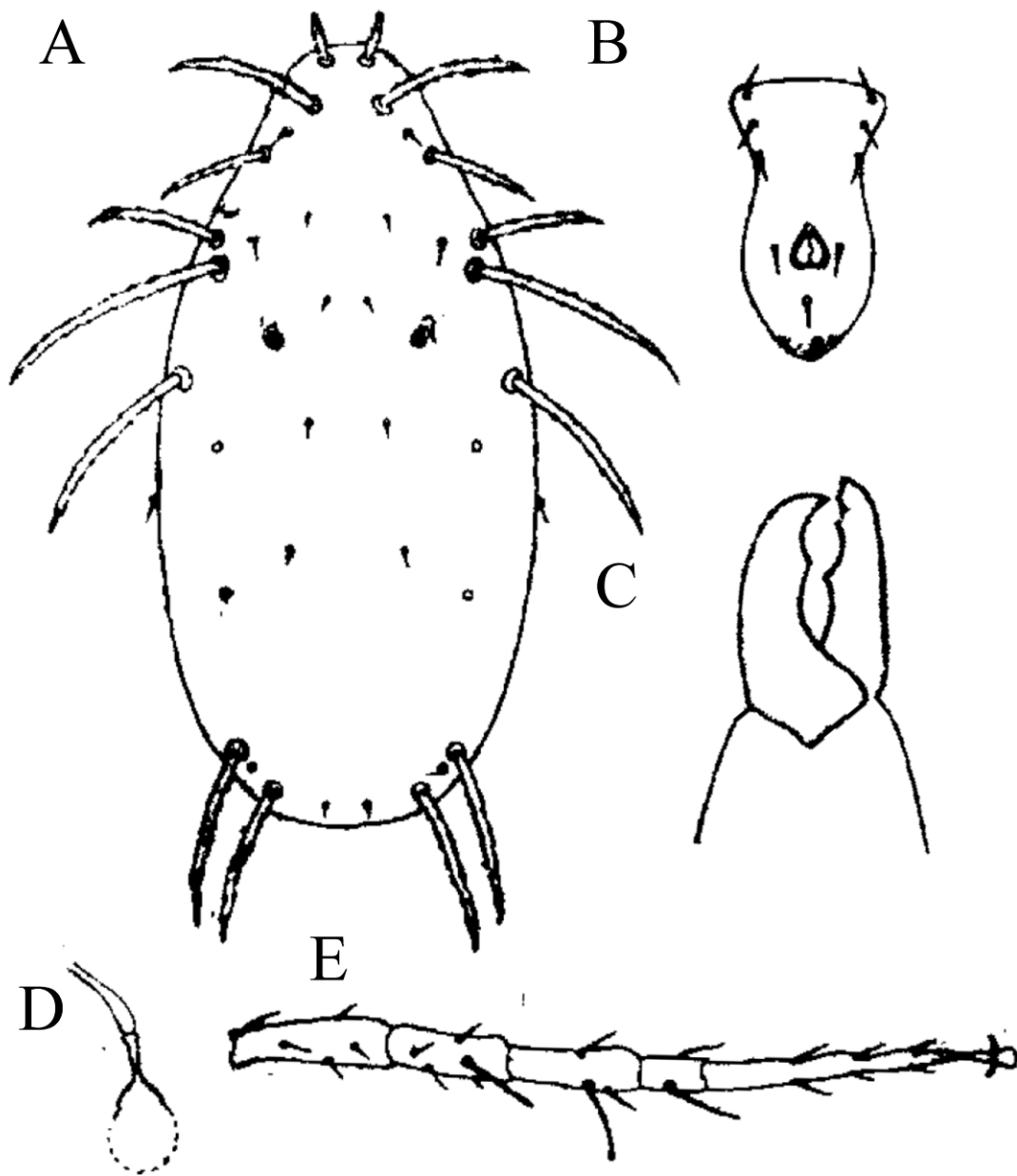


FIGURE 156. *Phytoseius minutus* Narayanan, Kaur & Ghai, 1960, (after Narayanan *et al.* 1960), Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca, E. leg IV.

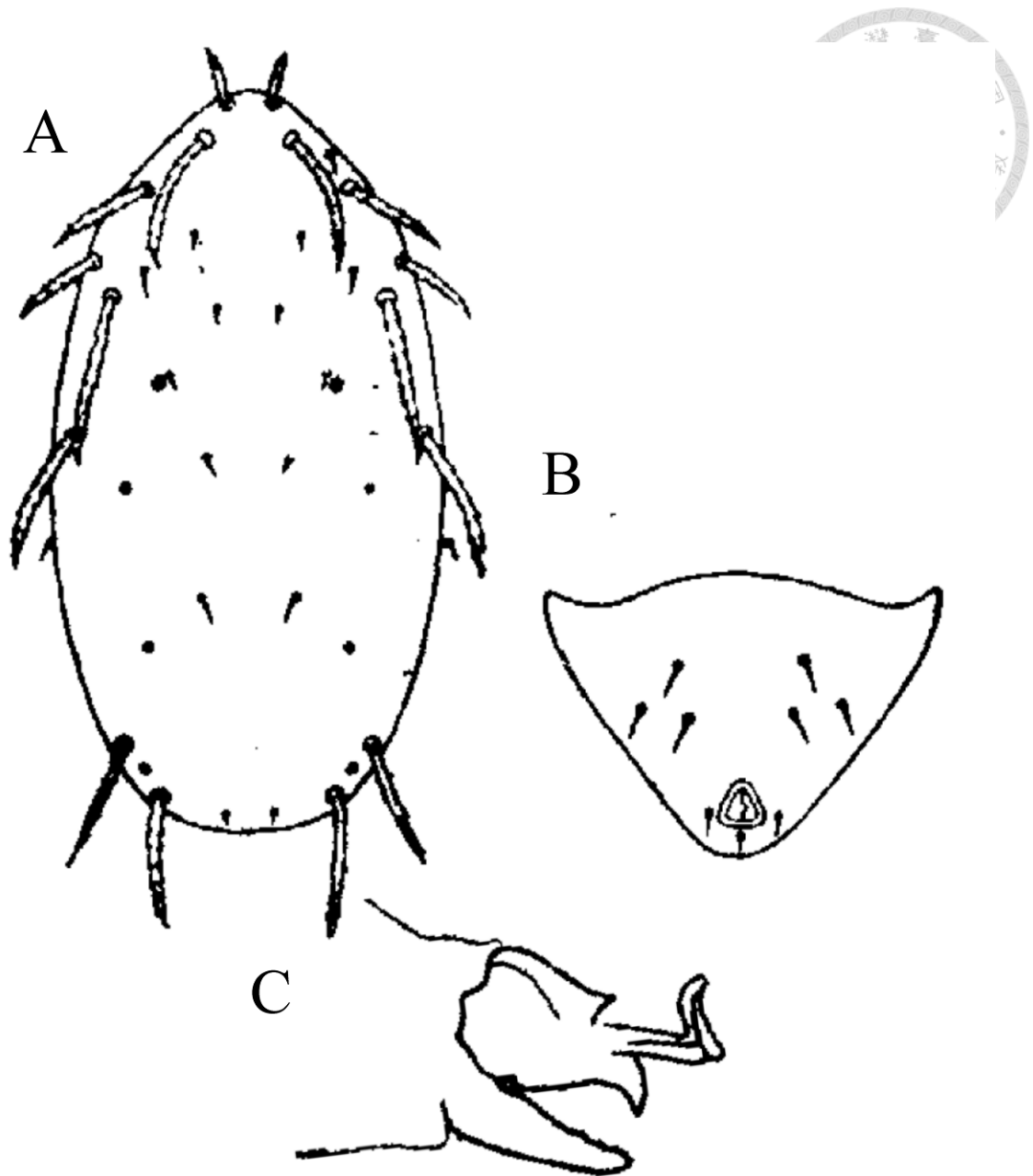


FIGURE 157. *Phytoseius minutus* Narayanan, Kaur & Ghai, 1960, (after Narayanan *et al.* 1960), Male, A. dorsal shield, B. ventral idiosoma, C. chelicera and spermatodactyl.

***Phytoseius rugatus* Tseng, 1976**

皺褶植綫蟎



(Figure 158)

Phytoseius (Dubininellus) rugatus Tseng, 1976: 94.

Female

A lightly sclerotized mite. Idiosomal setal pattern: 12A:3A/JV-3,4:ZV.

Dorsum. Dorsal shield distinctly reticulated throughout; rugose, much longer than wide, 303.6 long, 205.6 wide, seta *r3* inserted on dorsal shield; five pairs of solenostomes; length of dorsal setae: *j1* 32.5, *j3* 21, *j4* 7.5, *j5* 7.5, *j6* 11, *J5* ?, *z2* 10, *z3* 32.5, *z4* 12.5, *z5* 12.5, *Z4* 62.5, *Z5* 82.5, *s4* 91, *s6* 101, *r3* 45. Setae *j1*, *j3*, *z3*, *Z4*, *Z5*, *s4*, *s6*, *r3* longer and serrated, other short and smooth. Setae *r3* inserted on dorsal shield.

Peritreme. Peritreme extending to *j1* level, peritremal shield smooth, lightly sclerotized.

Venter. Sternal shield smooth, much wider than long, posterior margin unknown, with three pairs of setae *st1*, *st2*, *st3*. Metasternal platelets tear-shaped, with a pair metasternal setae, *st4*. Genital shield smooth, posteriorly truncate, *st5*. Ventrianal shield smooth, much longer than wide, with waist, 112.5 long, 62.5 wide; with three pairs of pre-anal setae, *JV1*, *JV2*, *ZV2*. Setae *JV5* 67.5, *ZV1* on interscutal membrane. All ventral setae smooth. One metapodal plates 30 long, 2.5 wide.

Spermatheca. Calyx of spermatheca cup-shaped, flaring distally, and atrium nodular, major ducts visible.

Chelicera. Movable digit with one tooth; fixed digit, anterior half with three teeth.

Legs. Macrosetae: *Sge* IV (ad2) 50, *Sti* IV (ad) 47.5, *Sbta* IV (d) 32.5. *Sdta* IV (d) 30.

Specimens examined. No specimens.

Distribution. Asia: Taiwan (Tseng, 1976)

Remarks. Tseng (1976) described this species based on two female specimens from *Acacia* sp. in Tainan City. Because of the specimens were lost (Liao *et al.* 2017b), survey the type locality is needed. However, the investigation did not find this species. The species is distinguished from *P. coheni* by relative length of setae *s*4, *s*6. However, no other difference was reported, this difference could be a slightly variation. The present study suspected this species as junior synonym of *P. coheni* based on original description. Besides, the illustration of present study is modified from Tseng (1976), but original article is lacked of one seta *z*4, and the present study added it.



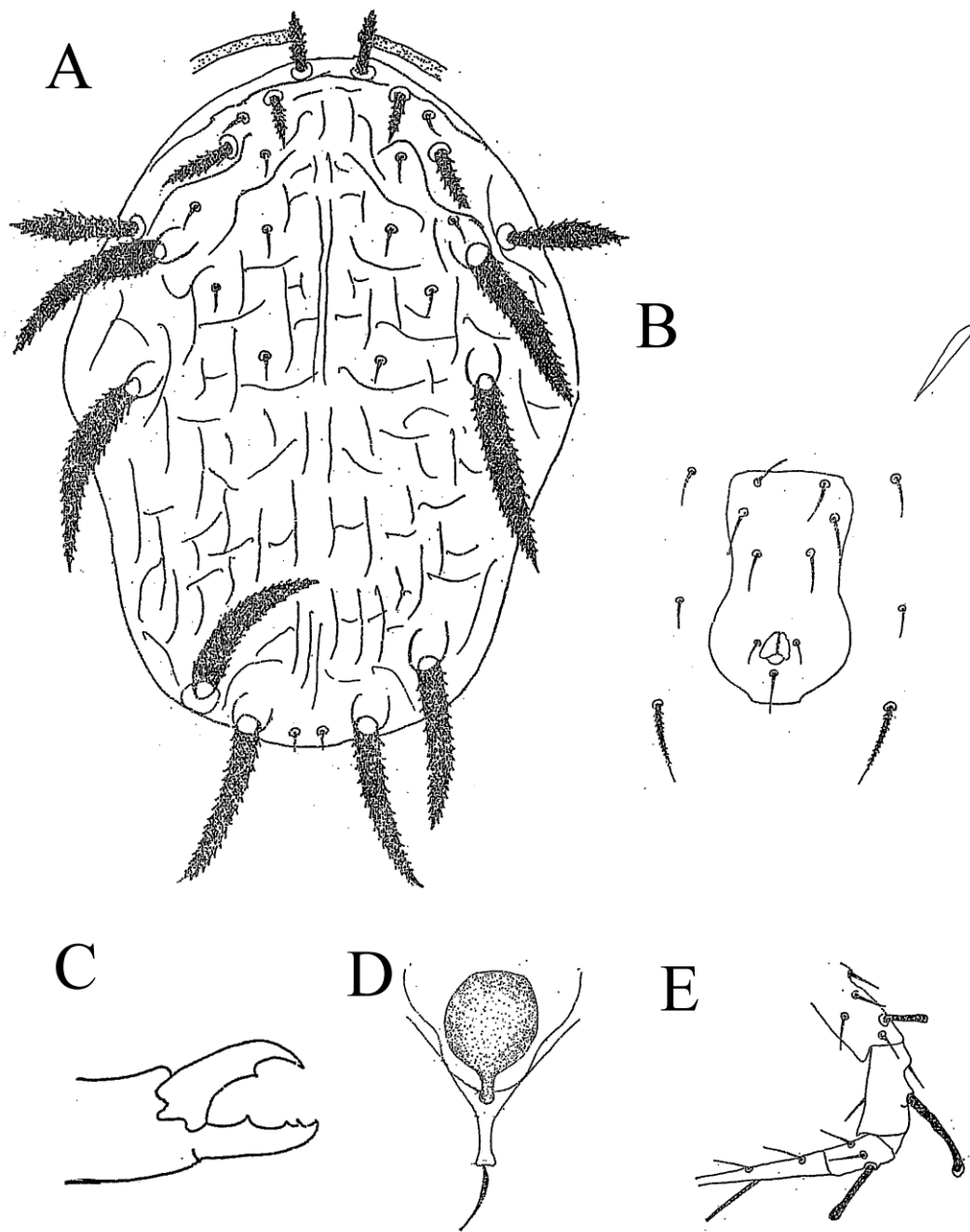


FIGURE 158. *Phytoseius rugatus* Tseng, 1976, (after Tseng 1976), Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca, E. leg IV.

***Phytoseius sonunensis* Ryu & Ehara, 1993**

松能植綏蟎



(Figures 159–162)

Phytoseius (Phytoseius) sonunensis Ryu & Ehara, 1993: 16.

Female (n=3)

A lightly sclerotized mite. Idiosomal setal pattern: 12A:3A/JV-3,4:ZV.

Dorsum. Dorsal shield distinctly reticulated throughout; rugose, much longer than wide, 306 (279–325) long, 159 (150–165) wide at level of *s*4, 162 (159–164) wide at level of *S*4, seta *r*3 inserted on dorsal shield; five pairs of solenostomes (*gd*4, *gd*5, *gd*6, *gd*8, *gd*9), fourteen pairs of lyrifissures (*id*1, *id*2, *id*4, *id*6, *idm*1, *idm*2, *idm*3, *idm*5, *idm*6, *idx*, *is*1, *idl*2, *idl*3, *idl*4); length of dorsal setae: *j*1 28 (27–30), *j*3 30 (27–34), *j*4 5 (4–6), *j*5 7 (5–9), *j*6 8 (7–8), *J*5 5 (5–6), *z*2 10 (9–11), *z*3 23 (21–25), *z*4 11 (9–15), *z*5 8 (6–10), *Z*4 66 (64–70), *Z*5 75 (74–77), *s*4 82 (78–86), *s*6 74 (70–80), *r*3 41 (35–47). Setae *j*1, *j*3, *z*3, *Z*4, *Z*5, *s*4, *s*6, *r*3 longer and serrated, other short and smooth. Setae *r*3 inserted on dorsal shield.

Peritreme. Peritreme extending beyond to *j*1 level, peritremal shield smooth, lightly sclerotized, with one pair of solenostome (*gd*3) and one pair of lyrifissures (*id*3).

Venter. Sternal shield smooth, wider than long, posterior margin straight, 66 (61–73) long, 86 (72–93) wide at *st*3 level, with three pairs of setae *st*1 24 (18–29), *st*2 24 (21–26), *st*3 21 (17–24) and two pairs of lyrifissures (*pst*1, *pst*2). Exopodal shield at coxae II–IV. Metasternal platelets tear-shaped, with a pair metasternal setae, *st*4 18 (16–23), and one pair of lyrifissures (*pst*3). Genital shield smooth, posteriorly truncate, *st*5 20 (19–21), 73 (71–75) wide. Distances between *st*1–*st*1 54 (52–57), *st*2–*st*2 61 (50–67), *st*3–*st*3 74 (62–87), *st*1–*st*3 62 (58–68), *st*5–*st*5 61 (54–66). Ventrianal shield smooth, much longer than wide, with waist, 102 (95–106) long, 44 (42–46) wide at

level of ZV2 and 57 (50–61) wide at level of anus; with three pairs of pre-anal setae, *JV1* 21 (12–27), *JV2* 13 (10–15), *ZV2* 12 (8–15), *Pa* 12 (10–14), *Pst* 12 (10–13) on shield. Setae *JV5* 48 (46–50), *ZV1* 17 (13–20), *ZV3* 12 (8–16) on interscutal membrane. All ventral setae smooth, except seta *JV5* thick and serrated. One pair of metapodal plates 32 (22–38) long, 4 (2–5) wide.

Spermatheca. Calyx of spermatheca disc-shaped, flaring distally, 2 (2–2) long, 7 (6–8) wide, atrium nodular, major and minor ducts visible.

Chelicera. Movable digit 24 (23–25) long, with one tooth; fixed digit 23 (22–24) long, anterior half with three teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sti* IV (ad) 65 (63–68), *St* IV (d) 18 (17–19). Macrosetae shovel-end with expanded blade.

Male (n=1)

A lightly sclerotized mite. Idiosomal setal pattern: 12A:3A/JV-3,4:ZV-1,3.

Dorsum. Dorsal shield distinctly reticulated throughout; rugose, much longer than wide, 258 long, 152 wide at level of *s4*, 118 wide at level of *S4*; five pairs of solenostomes (*gd4*, *gd5*, *gd6*, *gd8*, *gd9*), fourteen pairs of lyrifissures (*id1*, *id2*, *id4*, *id6*, *idm1*, *idm2*, *idm3*, *idm5*, *idm6*, *idx*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 18, *j3* 28, *j4* 4, *j5* 4, *j6* 4, *J5* 6, *z2* 10, *z3* 20, *z4* 12, *z5* 7, *Z4* 33, *Z5* 39, *s4* 52, *s6* 50, *r3* 31. Setae *j1*, *j3*, *z3*, *Z4*, *Z5*, *s4*, *s6*, *r3* longer and serrated, other short and smooth. Setae *r3* inserted on dorsal shield.

Peritreme. Peritreme extending to *j1* level; peritremal shield lightly sclerotized, with one pair of solenostomes (*gd3*).

Venter. Sternogenital shield smooth, posterior margin almost straight, much longer than wide, 115 long, 59 wide at level *st2*, with five pairs of setae *st1* 26, *st2* 21, *st3* 22, *st4* 20, *st5* 20, three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Exopodal shield at coxae II–IV. Distance between *st1-st1* 49, *st2-st2* 55, *st3-st3* 62, *st4-st4* 53, *st5-st5* 45, *st1-st5* 103. Exopodal shield at coxae II–IV. Ventrianal shield subtriangular, reticulated, 114 long, 141 wide at level of anterior corner and 68 wide at level of anus, not fused with peritremal shield; with three pairs of pre-anal setae, *JV1* 11, *JV2* 11, *ZV2* 10, solenostomes *gv3* rounded; *Pa* 10, *Pst* 8 on shield. Seta *JV5* 34 on interscutal membrane. All ventral setae smooth.

Chelicera. Movable digit 15 long, with one tooth; fixed digit 18, with two teeth on anterior half, one tooth on posterior half, with *pilus dentilis*. Spermatodactyl L-shaped, shaft 14 long, heel rounded, foot 8 long,.

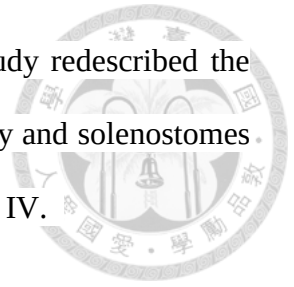
Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sti* IV (ad) 27, *St* IV (d) 15. Macrosetae shovel-end with expanded blade.

Specimens examined. Dongyin Township Office, Dongyin Township, Lienchiang County, one female (TAL091F144) from *Pueraria lobata* (Fabaceae), 4.vi.2002, C. C. Ho (TARL); Fuxing Village, Nangan Township, Lienchiang County, two females one male (TAL091F043, 45, 48) from soil, 5.vi.2002, C. C. Ho (TARL).

Distribution. South Korea (Ryu & Ehara 1993), Taiwan (Matsu Islands (Ho *et al.* 2003)).

Remarks. Ryu & Ehara (1993) reported this species from *Boehmeria spicata* in Korea. Ho *et al.* (2003) reported this species in Matsu Island. However, there are no

occurrences of this species in Taiwan main island. The present study redescribed the same materials of Ho *et al.* (2003), and also described leg chaetotaxy and solenostomes of dorsal shield. This species is characterized by no macroseta on Ge IV.



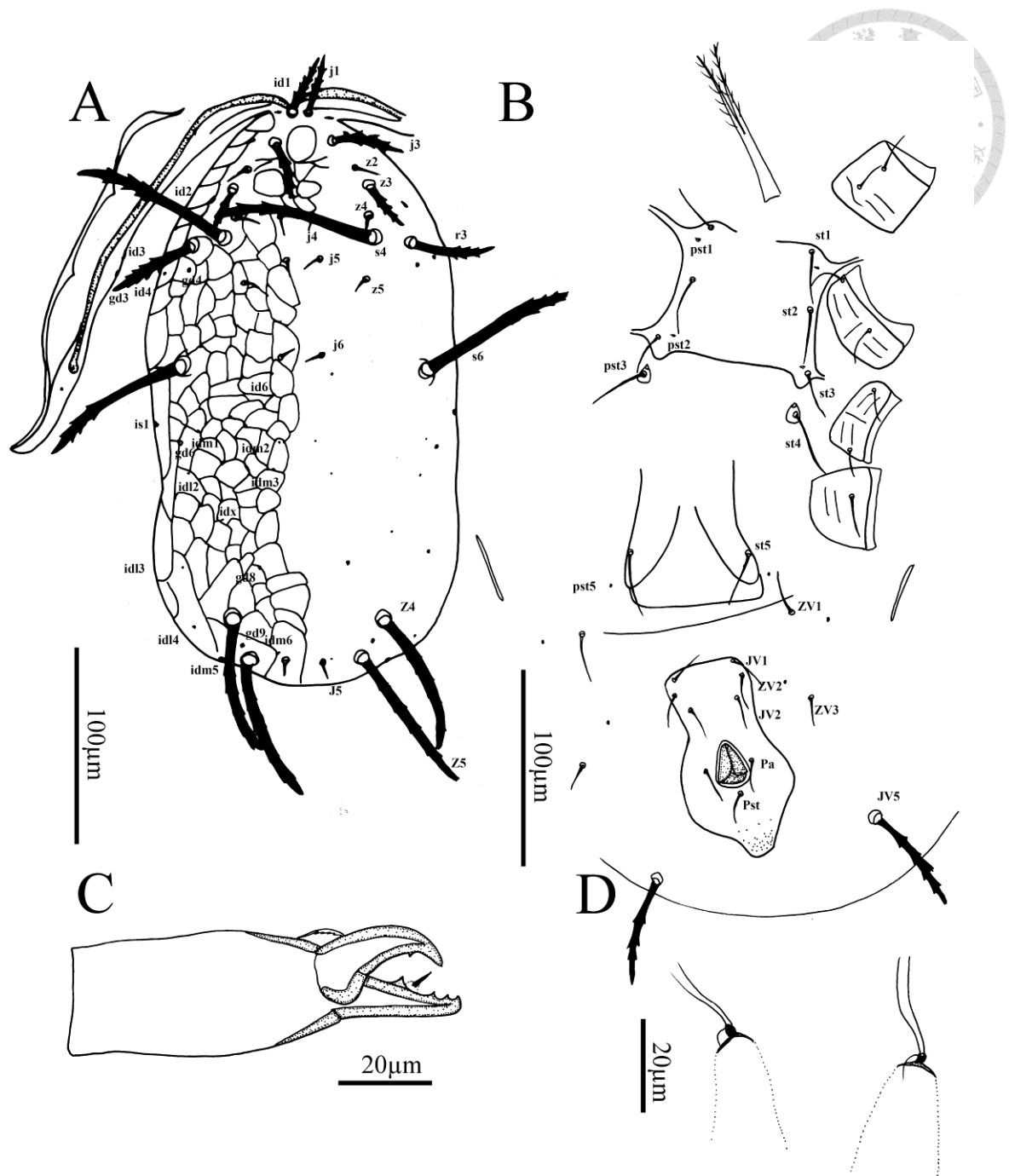


FIGURE 159. *Phytoseius sonunensis* Ryu & Ehara, 1993, Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

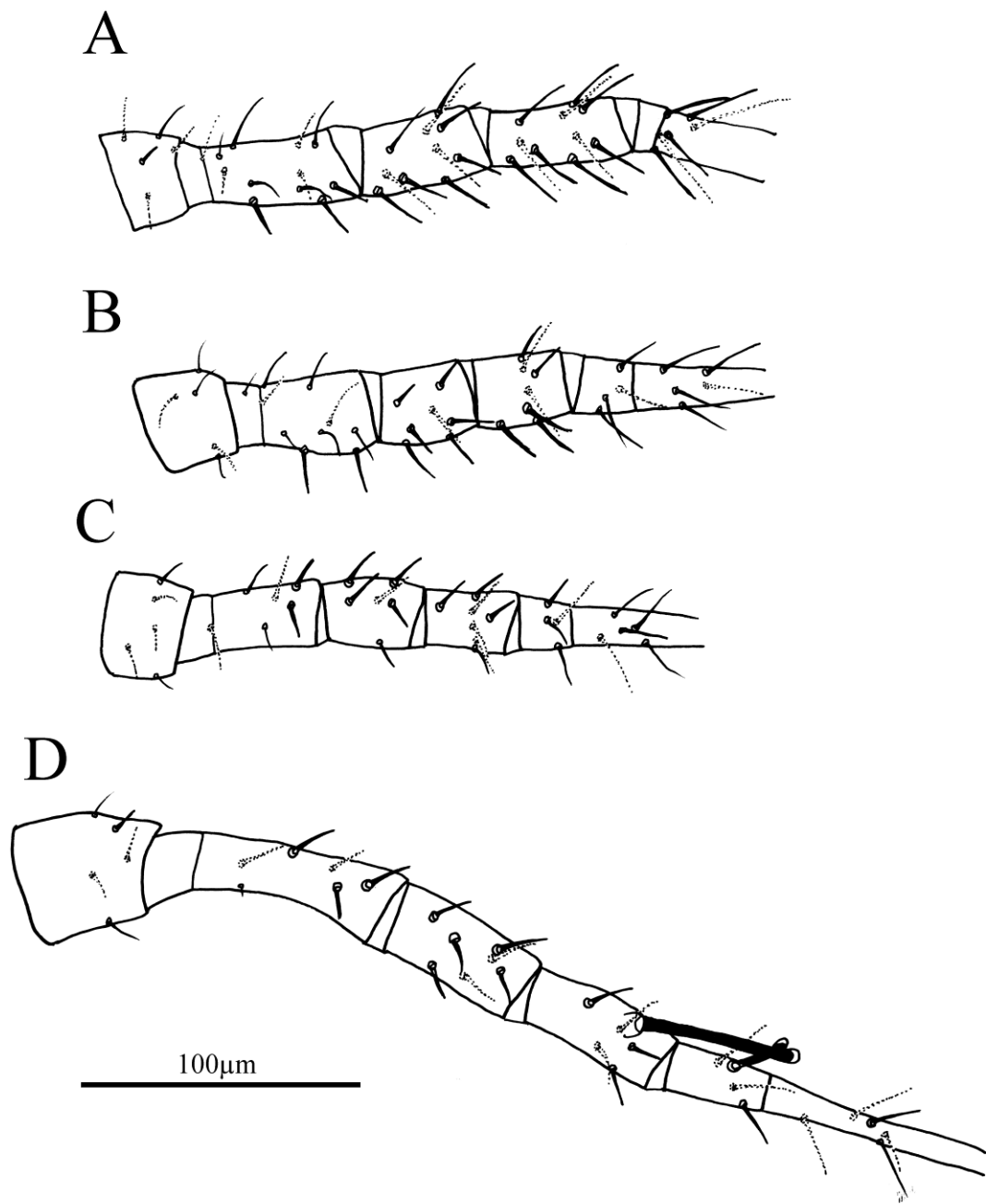


FIGURE 160. *Phytoseius sonunensis* Ryu & Ehara, 1993, Female, legs A. leg I anterior view, B. leg II anterior view, C. leg III posterior view, D. leg IV posterodorsal view.

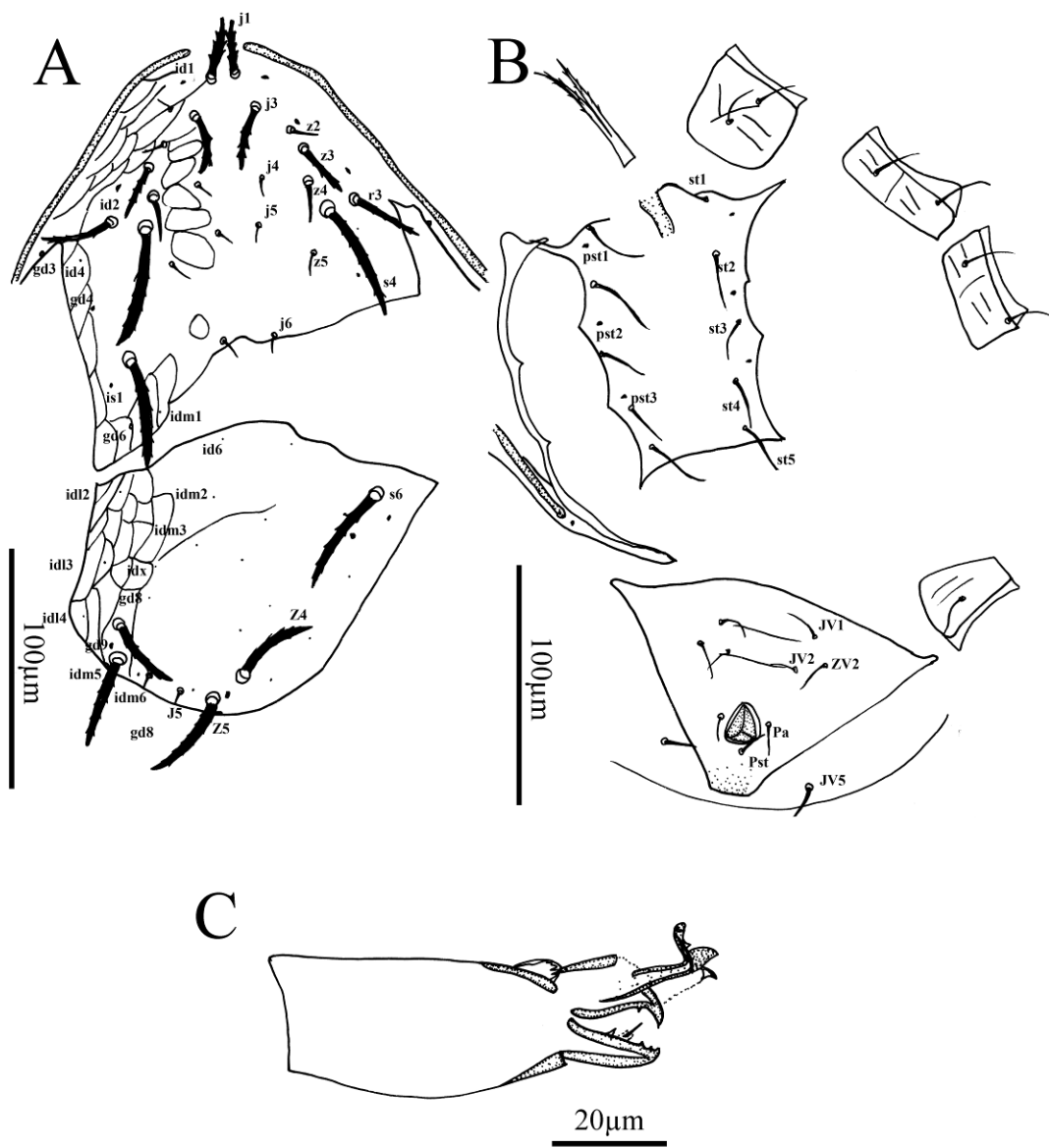


FIGURE 161. *Phytoseius sonunensis* Ryu & Ehara, 1993, Male, A. dorsal shield; B. ventral idiosoma; C. chelicera and spermatodactyl.

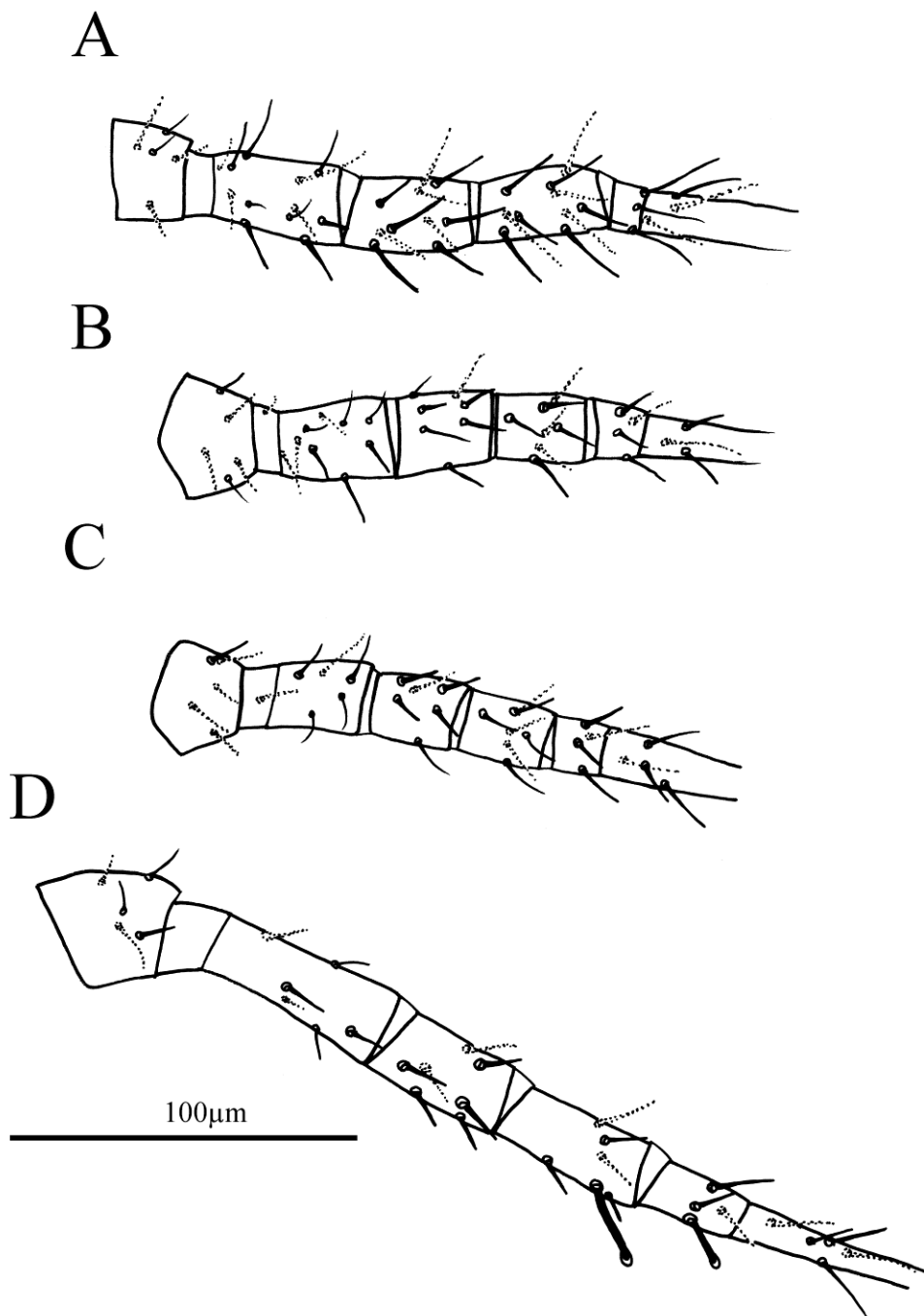


FIGURE 162. *Phytoseius sonunensis* Ryu & Ehara, 1993, Male, legs A. leg I anterior view, B. leg II dorsal view, C. leg III posterodorsal view, D. leg IV anterior view.

Subfamily TYPHLODROMINAE Wainstein, 1962

盲走蟎亞科



Typhlodromus.—Evans, 1958: 223.

Typhlodromus (*Typhlodromus*).—Chant, 1957b: 531.

Typhlodromini Wainstein, 1962: 26.

Gigagnathinae Wainstein, 1973: 276. Type genus - *Gigagnathus* Chant, 1965a.

Gigagnathini.—Karg, 1983: 299.

Cydnodromellinae Chant & Yoshida-Shaul, 1986b: 2812. Type genus - *Cydnodromella*
Muma, 1961.

Typhlodrominae.—Chant & McMurtry, 1994: 235.

Type genus - *Typhlodromus* Scheuten, 1857: 111.

Chant & McMurtry (1994) recognized the group at subfamily level, and also provided a completed review. The subfamily is characterized by either or both of setae *z3* and *s6* present on the podosoma and at least one of setae *Z1*, *S2*, *S4*, *S5* present on the opisthosoma. Five tribes are belonging to this subfamily, including Chanteiini Chant & McMurtry, Galendromimini Chant & McMurtry, Paraseiulini Wainstein, Typhlodromini Wainstein, Metaseiulini Chant & McMurtry.

Key to the genera in the subfamily Typhlodrominae from Taiwan

1. Seta *s6* absent
.....tribe Chanteiini Chant & McMurtry
.....genus *Chanteius* Wainstein

..... *contiguus* (Chant, 1959a)

— Seta *s6* present

..... tribe *Typhlodromini* Wainstein

..... 2

2. Seta *Z1* present genus *Neoseiulella* Muma

..... *compta* (Corpuz, 1966)

— Seta *Z1* absent genus *Typhlodromus* Scheuten

Tribe CHANTIINI Chant & McMurtry, 1994

錢綏蟎族

Chantiinae Chant & Yoshida-Shaul, 1986a: 2025.

Chantiini, Chant & McMurtry, 1994: 237.

Type genus - *Chanteius* (*Chanteius*) Wainstein, 1962b: 19.

The tribe is characterized by the absence of seta *s6* and the presences of seta *z3* and at least one pair of setae *Z1*, *S2*, *S4* and/or *S5*. Three genera are belonging to this tribe, including *Chanteius* Wainstein, *Cocoseius* Denmark & Andrews, *Papuaseius* Chant & McMurtry.

Genus *Chanteius* Wainstein, 1962

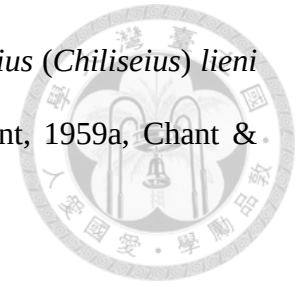
錢綏蟎屬

Typhlodromus (*Diadromus*) Athias-Henriot, 1960: 67. Preoccupied by *Diadromus*

Wesmael. Type species - *Typhlodromus* (*Typhlodromus*) *contiguus* Chant, 1959a.

Chanteius (*Chanteius*) Wainstein, 1962: 19.

Chiliseius (*Chiliseius*) [sic] Tseng, 1976: 97. Type species - *Chiliseius* (*Chiliseius*) *lieni* Tseng, 1976 (= *Typhlodromus* (*Typhlodromus*) *contiguus* Chant, 1959a, Chant & Yoshida-Shaul, 1986a).



Diadromus.—Chant & Yoshida-Shaul, 1986a: 2026.

Chanteius.—Chant & Yoshida-Shaul, 1987: 2574.

T. parasukatus group Schicha & Corpuz-Raros, 1992: 24.

T. apoensis group Schicha & Corpuz-Raros, 1992: 24.

Type species - *Typhlodromus* (*Typhlodromus*) *contiguus* Chant, 1959a: 2574.

There are 9 valid species belong to this genus (Demite *et al.* 2019). The genus is characterized by seta *z3* present, seta *s6* absent, setae *Z1*, *S5* present. Chant & McMurtry (1994) recognized two species group, *contiguus* Chant & McMurtry, *parasukatus* Schicha & Corpuz-Raros.

Diagnosis – Idiosomal pattern 11C:9B/JV:ZV, 11C:9B/JV-3:ZV, 11C:7C/JV:ZV. Dorsal shield lightly sclerotized, ovoid, with slightly waist. Dorsal setae setiform. Sternal shield posterior margin concave. Genital shield truncated posteriorly. Female ventrianal shield variable, pentagonal, sometimes divided to two shields, with 3 pair of preanal setae, *gv3* conspicuous. Peritreme usually extending to *j1* level. Spermatheca variable. Chelicera multidentate. Leg IV with 3 macrosetae. Ge II with 7 setae. Male ventrianal shield triangular, caudoventral pattern JV-4:ZV-1,3.

***Chanteius contiguus* (Chant, 1959a)**

鄰近錢綏蟎



(Figures 163–166)

Typhlodromus (*Typhlodromus*) *contiguus* Chant, 1959a: 29.

Typhlodromus (*Diadromus*) *contiguus*.—Athias-Henriot, 1960: 67.

Typhloseiopsis contiguus.—Muma, 1961: 294.

Typhlodromus (*Typhloseiopsis*) *contiguus*.—Pritchard & Baker, 1962: 222.

Typhlodromus contiguus.—Hirschmann, 1962: 17.

Chanteius (*Chanteius*) *contiguus*.—Wainstein, 1962: 19.

Typhlodromus contiguas [sic].—Chen *et al.*, 1980: 17.

Diadromus contiguus.—Chant & Yoshida-Shaul, 1986a: 2030.

Chanteius lienii (Tseng, 1976): 97. *Chiliseius* (*Chiliseius*) [sic] *lienii* on original description (Synonymy according to Chant & Yoshida-Shaul, 1986a)

Female (n=10)

A lightly sclerotized mite. Idiosomal setal pattern: 11C:7C/JV:ZV.

Dorsum. Dorsal shield smooth, ovoid, 331 (301–367) long, 209 (189–231) wide at level of *s4*, 220 (190–232) wide at level of *S4*, with slightly waist at level of seta *R1*; five pairs of solenostomes (*gd2*, *gd4*, *gd6*, *gd8*, *gd9*), thirteen pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *id6*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of dorsal setae: *j1* 19 (13–24), *j3* 44 (30–49), *j4* 6 (5–8), *j5* 6 (4–7), *j6* 7 (5–11), *J2* 6 (3–7), *J5* 6 (4–7), *z2* 6 (4–9), *z3* 63 (58–67), *z4* 7 (4–11), *z5* 5 (4–6), *Z1* 67 (57–76), *Z4* 75 (67–80), *Z5* 144 (121–163), *s4* 73 (63–85), *S5* 10 (8–11), *r3* 12 (11–16), *R1* 9 (7–11). All setae smooth, except setae *Z4*, *Z5* slightly serrated.

Peritreme. Peritreme extending to *j1* level, peritremal shield smooth, lightly sclerotized, with one pair of solenostome (*gd3*) and one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, much wider than long, posterior margin concave, 65 (58–79) long, 87 (79–101) wide at *st3* level, with three pairs of setae *st1* 19 (14–25), *st2* 17 (12–24), *st3* 15 (11–17) and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae II–IV. Metasternal platelets tear-shaped, with a pair metasternal setae, *st4* 15 (11–22), and one pair of lyrifissures (*pst3*). Genital shield smooth, posteriorly truncate, *st5* 14 (10–20), 69 (64–76) wide. Distances between *st1-st1* 54 (51–63), *st2-st2* 63 (58–70), *st3-st3* 68 (62–73), *st1-st3* 60 (53–70), *st5-st5* 59 (54–69). Ventrianal shield smooth, pentagonal, 69 (64–76) long, 115 (100–133) wide at level of ZV2 and 85 (77–91) wide at level of anus; with four pairs of pre-anal setae, *JV1* 12 (11–15), *JV2* 12 (10–14), *JV3* 10 (7–13), ZV2 11 (8–14), solenostome *gv3* crescentic, *Pa* 13 (10–16), *Pst* 15 (12–17) on shield. Setae *JV4* 9 (6–12), *JV5* 46 (42–51), *ZV1* 11 (9–13), *ZV3* 8 (6–12) on interscutal membrane. All ventral setae smooth. Two pairs of metapodal plates 20 (17–23) long, 6 (4–8) wide, 9 (6–12) long, 2 (1–3) wide.

Spermatheca. Calyx of spermatheca disc-shaped, 1 (1–2) long, 3 (2–5) wide, and atrium nodular, major duct wider, and minor duct visible.

Chelicera. Movable digit 26 (24–29) long, with two teeth; fixed digit 24 (21–26) long, anterior half with two teeth, posterior half with six teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): 2-3/2-2/2-1, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* III (ad2) 31 (28–36), *Sti* III (ad) 24 (21–28), *Sge* IV (ad2) 49 (42–56), *Sti* IV (ad) 46 (38–55), *St* IV (d) 51 (46–57).

Male (n=4)

A lightly sclerotized mite. Idiosomal setal pattern: 11C:7C/JV-4:ZV-1,3.

Dorsum. Dorsal shield smooth, ovoid, 239 (224–249) long, 171 (162–178) wide at

level of *s4*, 142 (134–154) wide at level of *S4*, with slightly waist at level of seta *R1*; five pairs of solenostomes (*gd2*, *gd4*, *gd6*, *gd8*, *gd9*), thirteen pairs of lyrifissures (*id1*, *id1a*, *id2*, *id4*, *id6*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 17 (14–20), *j3* 35 (30–39), *j4* 6 (5–7), *j5* 5 (3–6), *j6* 7 (5–9), *J2* 7 (6–8), *J5* 6 (5–7), *z2* 6 (5–9), *z3* 51 (49–52), *z4* 7 (7–8), *z5* 6 (5–6), *Z1* 52 (45–56), *Z4* 62 (56–68), *Z5* 91 (83–98), *s4* 58 (54–63), *S5* 10 (9–11), *r3* 12 (10–13), *R1* 10 (10–11). All setae smooth, except setae *Z4*, *Z5* slightly serrated. Setae *r3* and *R1* inserted on dorsal shield.

Peritreme. Peritreme extending to *j1* level; peritremal shield lightly sclerotized.

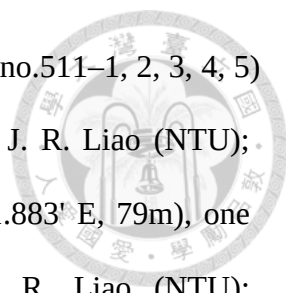
Venter. Sternogenital shield smooth with slightly reticulated, posterior margin almost straight, much longer than wide, 111 (105–119) long, 73 (67–81) wide at level *st2*, with five pairs of setae *st1* 15 (14–18), *st2* 12 (10–15), *st3* 12 (11–14), *st4* 11 (8–14), *st5* 11 (9–11), three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Distance between *st1-st1* 46 (43–49), *st2-st2* 51 (49–57), *st3-st3* 50 (38–58), *st4-st4* 41 (39–43), *st5-st5* 40 (35–48), *st1-st5* 99 (95–104). Exopodal shield at coxae II–IV. Ventrianal shield subtriangular, reticulated, 110 (104–117) long, 145 (142–147) wide at level of anterior corner and 53 (43–67) wide at level of anus, fused with peritremal shield cingulum; with four pairs of pre-anal setae, *JV1* 10 (8–11), *JV2* 10 (9–10), *JV3* 10 (8–12), *ZV2* 9 (8–11), solenostome *gv3* crescentic, *Pa* 11 (10–13), *Pst* 10 (10–11) on shield; *JV5* 26 (22–29) on interscutal membrane. All ventral setae smooth.

Chelicera. Movable digit 18 (14–20) long, with one tooth; fixed digit 16 (14–18), with two teeth on anterior half, six teeth on posterior half, with *pilus dentilis*. Spermatodactyl straight, shaft 16 (13–18) long, heel rounded, foot 11 (9–12) long.

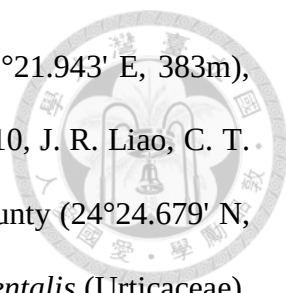
Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): 2-3/2-2/2-1, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1,

1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* III (ad2) 24 (23–25), *Sti* III (ad) 23 (21–24), *Sge* IV (ad2) 30 (28–32), *Sti* IV (ad) 30 (26–33), *St* IV (d) 40 (37–43).

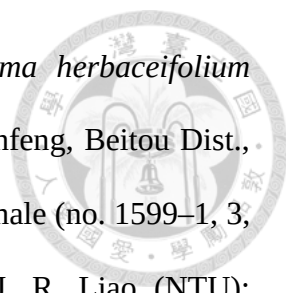
Specimens examined. Zhiben, Taitung City, Taitung County, one female (TAL077J009) from *Dodonaea viscosa* (Sapindaceae), 23.iii.1988, C. C. Ho (TARL); Zhiben, Taitung City, Taitung County, one female one male (88-0814, 15) from *Phymatosorus scolopendria* (Polypodiaceae), 24.iii.1988, C. C. Ho (TARL); Nanren Mountain, Manzhou Township, Pingtung County, one female one male (88-Ph-0004) from *Ilex pedunculosa* (Aquifoliaceae), 26.xi.1988, C. C. Ho (TARL); Malabang Mountain, Dahu Township, Miaoli County, one female (89-Am-1367) from *Citrus nobilis* (Rutaceae), 9.v.1989, C. C. Ho (TARL); Cikong waterfalls, Manzhou Township, Pingtung County, one female (TAL090H118) from *Piper kadsura* (Piperaceae), 7.vi.2001, C. C. Ho (TARL); Xuhai, Mudan Township, Pingtung County, one female (TAL090H181) from *Pueraria montana* var. *lobata* (Fabaceae), 7.vi.2001, C. C. Ho (TARL); Banju Branch, Taitung Distric Agricultural Research and Extension Station, Beinan Township, Taitung County (22°49.759' N, 121°04.634' E, 310m), two females one male (no.413–1, 2, 3) from *Dendrocnide* sp. (Urticaceae), 31.iii.2010, Y. T. Hsu & J. R. Liao (NTU); Banju Branch, Taitung Distric Agricultural Research and Extension Station, Beinan Township, Taitung County (22°49.759' N, 121°04.634' E, 310m), two females two males (no.413–3, 4, 5, 6) from *Machilus kusanoi* (Lauraceae), 31.iii.2010, Y. T. Hsu & J. R. Liao (NTU); Mt. Shitou, Xindian Dist., New Taipei City (24°57.466' N, 121°32.649' E, 208m), one male (no. 483–8) from *Ficus fistulosa* (Moraceae), 17.iv.2010, J. R. Liao (NTU); Nanchuang Township, Miaoli County (24°37.203' N, 121°00.552' E, 209m), one female (no. 504–1) from *Polygonum chinense* (Polygonaceae), 19.iv.2010, J. R. Liao, Y. H. Chiang & M. J. Cheng (NTU); Banju Branch, Taitung Distric Agricultural Research and Extension Station, Beinan Township,



Taitung County (22°49.759' N, 121°04.634' E, 310m), five females (no.511–1, 2, 3, 4, 5) from *Mangifera indica* (Anacardiaceae), 31.iii.2010, Y. T. Hsu & J. R. Liao (NTU); Guangxing, Xindian Dist., New Taipei City (24°55.528' N, 121°31.883' E, 79m), one male (no. 630–1) from *Morus* sp. (Moraceae), 25.vi.2010, J. R. Liao (NTU); Paomagudao, Jiaoxi Township, Yilan County (24°49.656' N, 121°45.928' E, 36m), three females (no. 684–3, 4, 6) from *Trema orientalis* (Cannabaceae), 16.vii.2010, M. C. Chiu & J. R. Liao (NTU); Paomagudao, Jiaoxi Township, Yilan County (24°49.656' N, 121°45.928' E, 36m), four females (no. 685–1, 2, 5, 7) from *Morus* sp. (Moraceae), 16.vii.2010, M. C. Chiu & J. R. Liao (NTU); Paomagudao, Jiaoxi Township, Yilan County (24°49.656' N, 121°45.928' E, 36m), four females (no. 692–1, 2, 3, 4) from *Boehmeria densiflora* (Urticaceae), 16.vii.2010, M. C. Chiu & J. R. Liao (NTU); Paomagudao, Jiaoxi Township, Yilan County (24°49.656' N, 121°45.928' E, 36m), one female one male (no. 701–2, 3) from fern, 16.vii.2010, M. C. Chiu & J. R. Liao (NTU); Taroko, Xiulin Township, Hualien County (24°09.296' N, 121°37.755' E, 65m), five females three males (no. 702–1, 2, 3, 4, 5, 6, 7, 8) from *Morus* sp. (Moraceae), 1.viii.2010, J. R. Liao & S. F. Lin (NTU); Taroko, Xiulin Township, Hualien County (24°09.296' N, 121°37.755' E, 65m), one female (no. 704–2) from *Boehmeria nivea* (Urticaceae), 1.viii.2010, J. R. Liao & S. F. Lin (NTU); Xiaowulai, Fuxing Dist., Taoyuan City (24°46.605' N, 121°21.943' E, 383m), one female two males (no. 814–3, 4, 5) from *Morus* sp. (Moraceae), 28.viii.2010, J. R. Liao, C. T. Chen & J. F. Hsieh (NTU); Xiaowulai, Fuxing Dist., Taoyuan City (24°46.605' N, 121°21.943' E, 383m), one female two males (no. 817–1) from *Rhododendron* sp. (Ericaceae), 28.viii.2010, J. R. Liao, C. T. Chen & J. F. Hsieh (NTU); Xiaowulai, Fuxing Dist., Taoyuan City (24°46.605' N, 121°21.943' E, 383m), one female one male (no. 819–1, 2) from *Phyllostachys makinoi* (Poaceae), 28.viii.2010, J. R. Liao, C. T. Chen & J. F. Hsieh



(NTU); Xiaowulai, Fuxing Dist., Taoyuan City (24°46.605' N, 121°21.943' E, 383m), one male (no. 820–2) from *Bambusa oldhamii* (Poaceae), 28.viii.2010, J. R. Liao, C. T. Chen & J. F. Hsieh (NTU); Simaxian, Tai'an Township, Miaoli County (24°24.679' N, 120°56.725' E, 852m), one males (no. 907–6) from *Debregeasia orientalis* (Urticaceae), 31.x.2010, W. C. Yang & J. R. Liao (NTU); Jinfeng Township, Taitung County (22°35.779' N, 120°57.244' E, 132m), one female one male (no. 1054–1, 5) from *Phyllostachys makinoi* (Poaceae), 23.i.2011, J. R. Liao & J. F. Hsieh (NTU); Tianlong Suspension Bridge, Haiduan Township, Taitung County (23°10.371' N, 121°02.527' E, 719m), two females (no. 1074–1, 2) from *Actinodaphne pedicellata* (Lauraceae), 21.i.2011, J. R. Liao & J. F. Hsieh (NTU); Shangde Village, Donghe Township, Taitung County (22°57.629' N, 121°14.138' E, 267m), two females (no. 1090–2) from *Mallotus paniculatus* (Euphorbiaceae), 21.i.2011, J. R. Liao & J. F. Hsieh (NTU); Paomagudao, Jiaoxi Township, Yilan County (24°50.276' N, 121°46.346' E, 147m), four females (no. 1116–5, 11, 12, 13, 14) from *Morus* sp. (Moraceae), 9.ii.2011, M. C. Chiu & J. R. Liao (NTU); Guangxing, Xindian Dist., New Taipei City (24°54.804' N, 121°32.747' E, 79m), one male (no. 1142–9) from *Morus* sp. (Moraceae), 27.ii.2011, J. R. Liao (NTU); Northern Cross Star, Fuxing Dist., Taoyuan City (24°46.133' N, 121°21.202' E, 478m), one female (no. 1542–1) from *Arenga tremula* (Arecaceae), 26.vi.2015, J. R. Liao (NTU); Paomagudao, Jiaoxi Township, Yilan County (24°49.656' N, 121°45.928' E, 36m), one female (no. 1546–2) from *Saurauia tristyla* (Actinidiaceae), 17.vii.2015, J. R. Liao (NTU); Paomagudao, Jiaoxi Township, Yilan County (24°49.656' N, 121°45.928' E, 36m), three females (no. 1549–1, 3, 4) from *Acacia confusa* (Fabaceae), 17.vii.2015, J. R. Liao (NTU); Paomagudao, Jiaoxi Township, Yilan County (24°49.656' N, 121°45.928' E, 36m), three females (no. 1550–1, 4, 6) from *Morus* sp. (Moraceae), 17.vii.2015, J. R. Liao (NTU); Wufengqi, Jiaoxi Township, Yilan County (24°49.900' N,



121°44.837' E, 108m), one female (no. 1559–1) from *Elatostema herbaceifolium* (Urticaceae), 17.vii.2010, M. C. Chiu & J. R. Liao (NTU); Mt. Danfeng, Beitou Dist., Taipei City (25°07.947' N, 121°30.687' E, 149m), five females one male (no. 1599–1, 3, 5, 6, 7, 9) from *Schefflera octophylla* (Araliaceae), 2.iii.2016, J. R. Liao (NTU); Wufengqi, Jiaoxi Township, Yilan County (24°49.827' N, 121°44.904' E, 83m), one female (no. 1794–7) from *Pueraria montana* (Fabaceae), 2.viii.2016, J. R. Liao (NTU); Wufengqi, Jiaoxi Township, Yilan County (24°49.827' N, 121°44.904' E, 83m), five females three males (no. 1798–1, 2, 3, 4, 5, 6, 7) from unknown plant, 2.viii.2016, J. R. Liao (NTU); Kinyang Village, Nan'ao Township, Yilan County (24°25.208' N, 121°44.200' E, 192m), one female (no. 1816–1) from *Phyllostachys makinoi* (Poaceae), 2.viii.2016, J. R. Liao (NTU); Guanziling, Baihe Dist., Tainan City (23°19.330' N, 120°28.993' E, 451m), one female (no. 1840–5) from *Phyllostachys makinoi* (Poaceae), 10.viii.2016, J. R. Liao (NTU).

Distribution. Africa: Madagascar Island (Bloomer 1976). Asia: China (Guangdong (Wu & Lan 1992), Hainan (Chen *et al.* 1980), Hong Kong (Chant, 1959a)), Japan (Ehara 1967), Philippines (Chant 1959b), Singapore (Corpuz-Raros 1995), Taiwan (Liao *et al.* 2013).

Remarks. Chant (1959a) described this species from *Citrus* sp. in Hong Kong. The original description and illustration provided detailed information for identification. He mentioned 8 teeth on fixed digit, and 2 or 3 teeth on movable digit; present study showed 8 teeth on fixed digit, and 2 teeth on movable digit.

During the survey, this species is a common species, distributed in whole Taiwan. Not only occur in agricultural area, but also in mountain area.

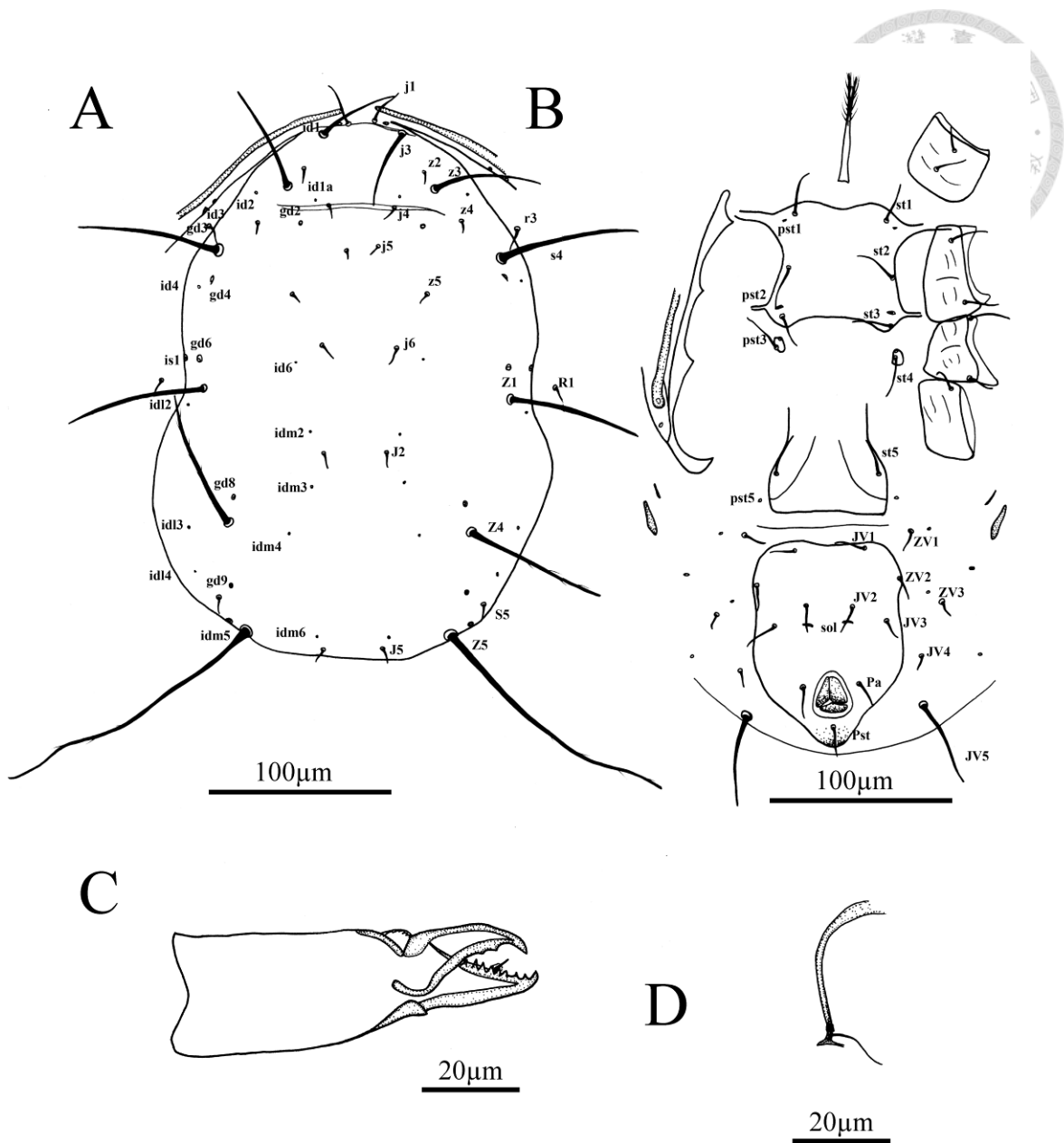


FIGURE 163. *Chanteius contiguus* (Chant, 1959a), Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

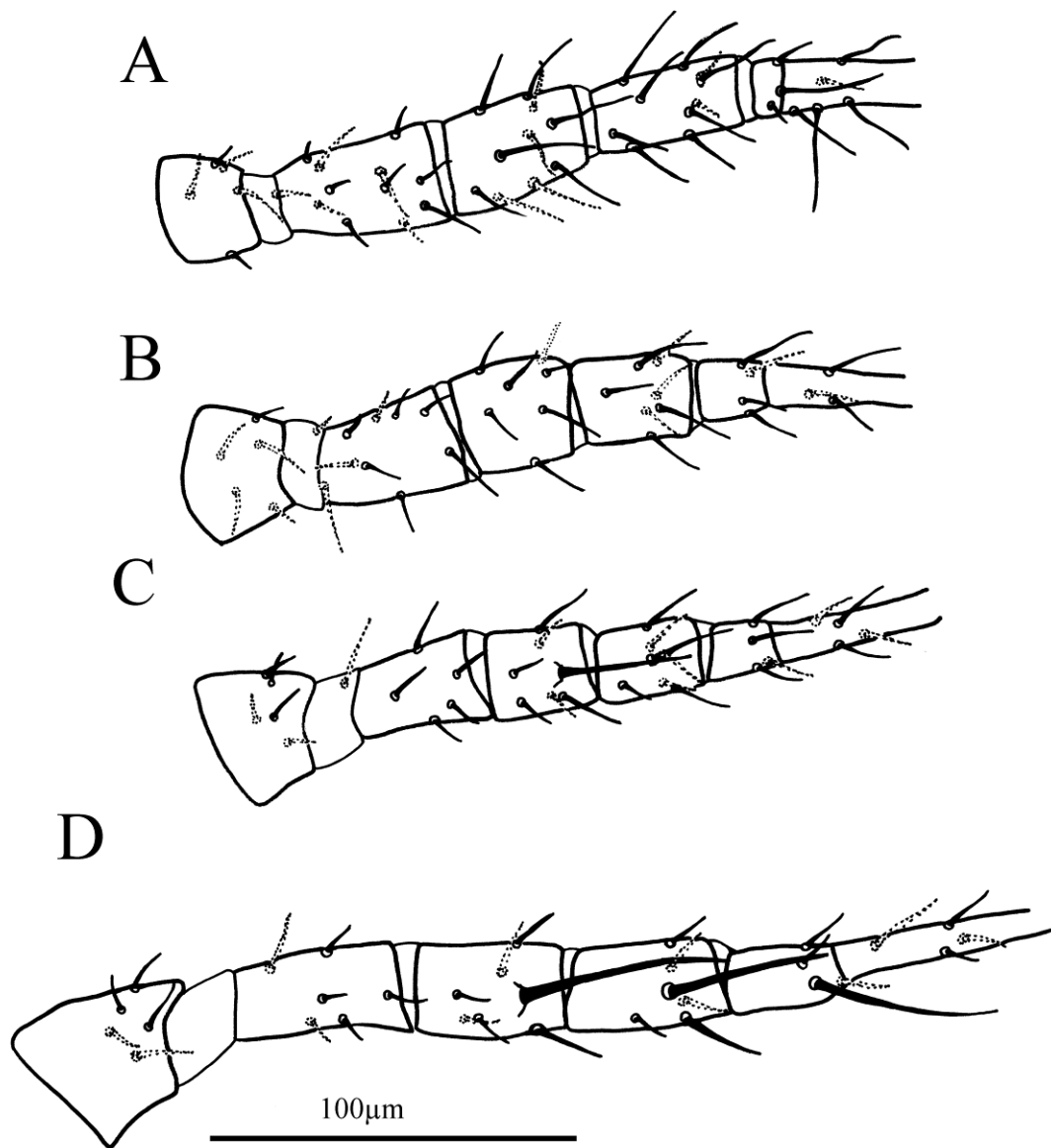


FIGURE 164. *Chanteius contiguus* (Chant, 1959a), Female, legs A. leg I dorsal view, B. leg II posterodorsal view, C. leg III anterodorsal view, D. leg IV anterodorsal view.

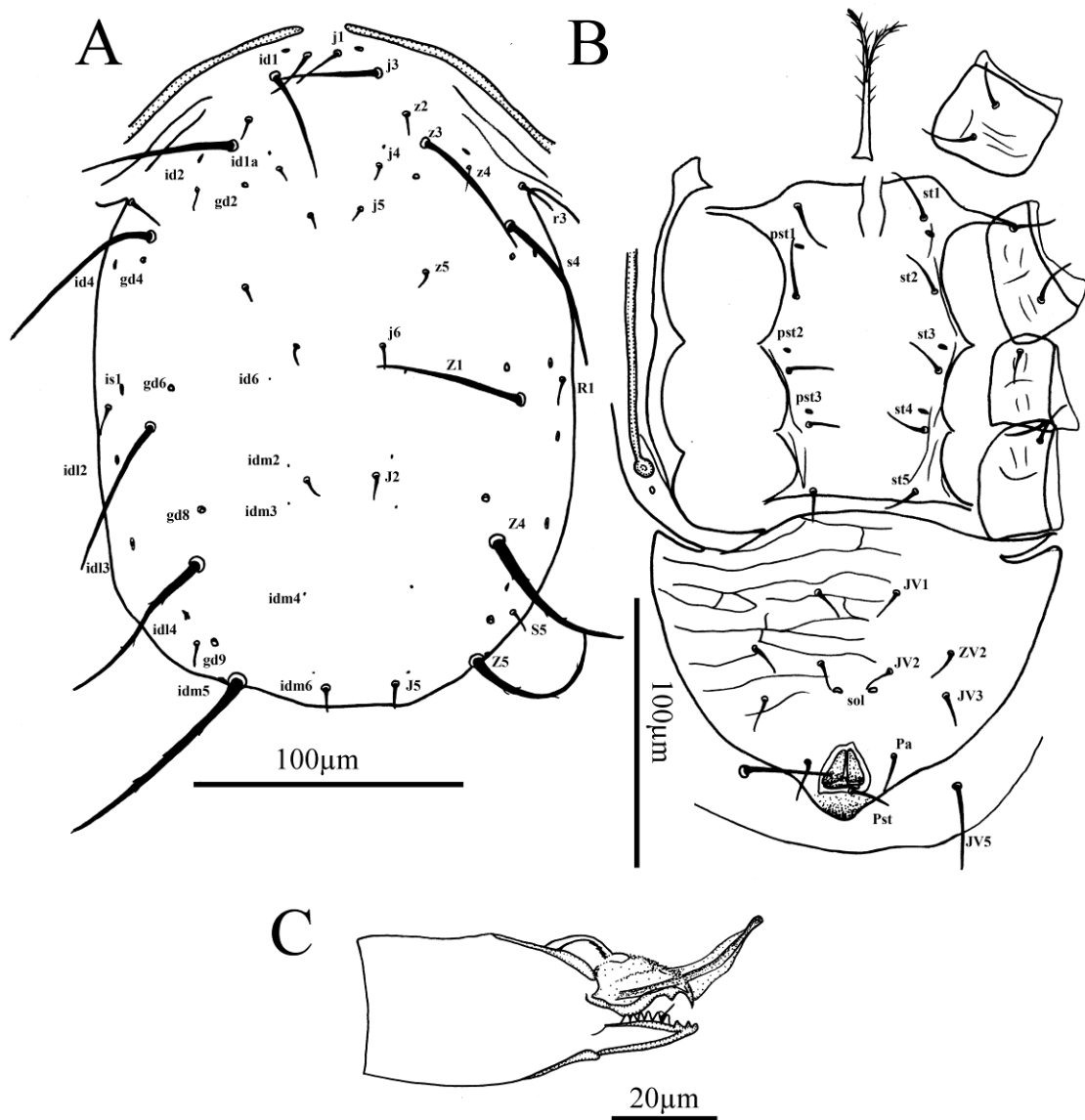


FIGURE 165. *Chanteius contiguus* (Chant, 1959a), Male, A. dorsal shield; B. ventral idiosoma; C. chelicera and spermatodactyl.

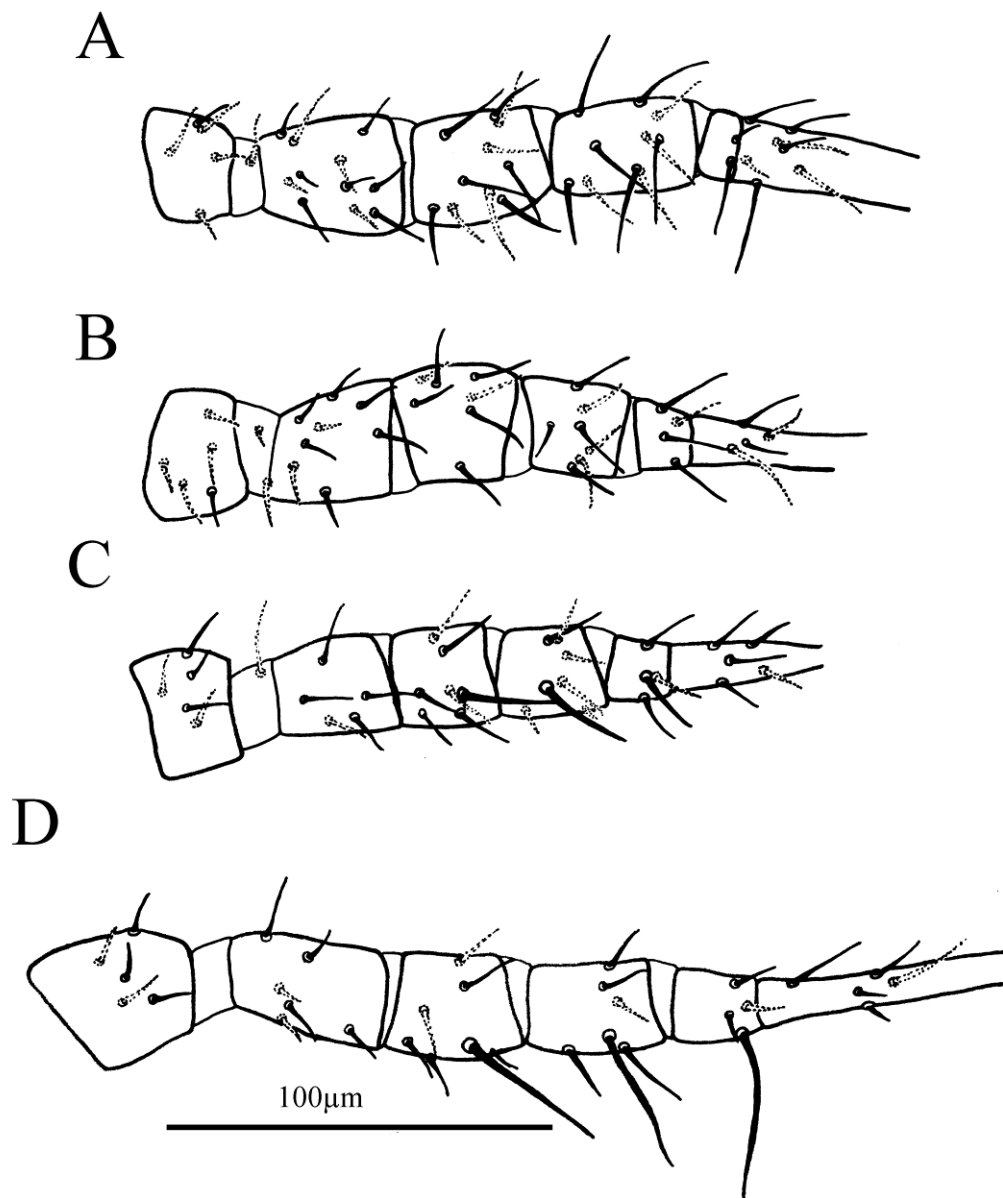


FIGURE 166. *Chanteius contiguus* (Chant, 1959a), Male, legs A. leg I anterior view, B. leg II posterior view, C. leg III anterior view, D. leg IV anterior view.

Tribe TYPHLODROMINI Wainstein, 1962

盲走蟎族



Typhlodromus Scheuten.—Evans, 1953: 449.

Typhlodromus (*Typhlodromus*).—Chant, 1957c: 528.

Typhlodromini Wainstein, 1962: 26.

Type genus - *Typhlodromus* Scheuten, 1857:111.

The tribe is characterized by setae *z3*, *s6*, *J2*, *S2*, *R1*, *JV2*, *ZV3* present, seta *z6* absent. Three genera are belonging to this tribe, *Neoseiulella* Muma, *Typhlodromus* Scheuten, *Typhloseiulus* Chant & McMurtry.

Genus *Neoseiulella* Muma, 1961

微新綏蟎屬

Neoseiulella Muma, 1961: 295.

Typhloctonus Muma, 1961: 299. Type species - *Typhlodromus tiliarum* Oudemans, 1930: 51.

Typhlodromus (*Nesbittius*) section *Nesbittius* Wainstein, 1962: 23. Type species - *Typhlodromus nesbitti* Womersley, 1954: 179.

Typhlodromus (*Nesbittius*) section *Kallistoseius* Wainstein, 1962: 23. Type species - *Typhlodromus tiliarum* Oudemans, 1930: 51.

Shiehia Tseng, 1975: 48. Type species - *Shiehia multispinosa* Tseng, 1975: 48. (= *Typhlodromus comptus* Corpuz-Raros, 1966: 729).

Typhloctonus (*Typhlocionus*).—Wainstein, 1977: 1416.

Typhloctonus (*Neoseiulella*).—Wainstein, 1977: 1416.

Typhloctonus (Tasmanidromus) Wainstein, 1977: 1416. Type species - *Typhlodromus cottieri* Collyer, 1964b: 640.

Seiulus (Typhloctonus).—Begljarov, 1981: 19.

Pegodromus Athias-Henriot & Fauvel, 1981: 71. Type species - *Pegodromus crassipilis* Athias-Henriot & Fauvel, 1981: 73.

Heteroseiulus Lehman, 1982: 236. Type species - *Heteroseiulus aceris* Lehman, 1982: 236.

T. tiliarum group.—Chant, 1959b: 64.

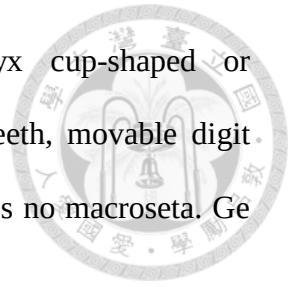
tiliarum species group.—Chant & Yoshida-Shaul, 1989a: 1008.

Type species - *Typhlodromus nesbitti* Womersley, 1954: 179.

There are 40 valid species in the genus (Demite *et al.* 2019). The genus is characterized by seta *z6* absent, seta *z3*, *s6*, *Z1*, *S5* present (Kanouh *et al.* 2012). Two species groups are recognized in this genus, including *tiliarum* Chant, *cottieri* Chant & McMurtry, which is identified by seta *JV3* present/absent. Seta *J1* is present on three species (*N. aceris*, *N. montforti*, *N. myopori*) but only present one seta; Chant & Yoshida-Shaul (1989a) called this circumstance as “aberration”.

Diagnosis – Idiosomal pattern 12A:9B/JV:ZV, or 12A:9B/JV-4:ZV. Dorsal shield lightly sclerotized to heavily sclerotized. Dorsal setae are usually smooth and *Z4*, *Z5* slightly serrated, but sometimes, all dorsal and sub-lateral setae are serrated. Sternal shield posterior margin concave, with 2 or 3 setae. Genital shield truncated posteriorly. Female ventrianal shield longer than wide, with 3 or 4 pair of preanal setae, *gv3* conspicuous. Peritreme usually extending to *j1* level, but sometimes between *z2-j3* level,

sometimes $z4$ level. Spermatheca with atrium nodular, calyx cup-shaped or goblet-shaped, never elongated. Chelicera fixed digit with 1-13 teeth, movable digit with 0-4 teeth. Leg IV usually at least one macroseta, but sometimes no macroseta. Genitalia II with 7 setae. Male ventrianal shield triangular.



Neoseiulella compta (Corpuz, 1966)

瓣髮微新綏蟎



(Figures 167–170)

Typhlodromus comptus Corpuz, 1966: 729.

Neoseiulella multispinosa Tseng, 1975: 48. (Synonymy according to Chant & Yoshida-Shaul 1989b)

Neoseiulella compta.—Moraes *et al.*, 2004: 292.

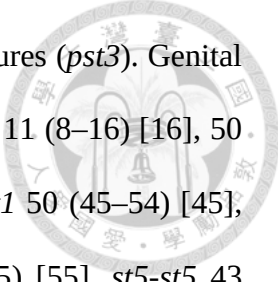
Female (n=3)

A heavily sclerotized mite. Idiosomal setal pattern: 12A:9B/JV:ZV.

Dorsum. Dorsal shield nearly oval, strongly reticulated, rugose, 294 (274–307) [307] long (*j1*–*J5* level) and 164 (149–174) [168] wide at level of *j6*, 161 (147–171) [171] wide at level of *S4*; seven pairs of solenostomes on dorsal shield, (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), twelve pairs of lyrifissures, (*id1*, *id2*, *id4*, *id6*, *idm2*, *idm3*, *idm4*, *idm5*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 12 (10–13) [13], *j3* 11 (9–14) [14], *j4* 10 (9–10) [10], *j5* 10 (7–12) [12], *j6* 10 (9–10) [10], *J2* 11 (9–13) [13], *J5* 7 (7–8) [8], *z2* 8 (7–11) [11], *z3* 9 (8–11) [11], *z4* 11 (9–13) [13], *z5* 8 (7–9) [9], *Z1* 13 (9–17) [17], *Z4* 17 (16–20) [20], *Z5* 16 (15–18) [15], *s4* 10 (9–12) [10], *s6* 11 (11–11) [?], *S2* 13 (11–17) [17], *S4* 14 (13–17) [17], *S5* 17 (15–18) [18], *r3* 9 (7–11) [1], *R1* 10 (9–11) [11]. Setae *r3*, *R1* on shield, all setae short, thick, serrated.

Peritreme. Peritreme extending to *j1* level; peritremal shield slightly reticulated, with one pair of solenostomes (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, posterior margin concave, wider than long, 46 (44–48) [44] long, 60 (58–63) [63] wide, with two pairs of setae *st1* 13 (12–15) [15], *st2* 13 (11–14) [14], *st3* 15 (10–20) [20], and two pairs of lyrifissures (*pst1*, *pst2*), *st3* on membrane. Exopodal shield at coxae II–IV. Metasternal platelets tear-shaped, with one



pair of metasternal setae, *st4* 10 (9–10) [10], with one pair of lyrifissures (*pst3*). Genital shield smooth, truncate posteriorly, with one pair of genital setae *st5* 11 (8–16) [16], 50 (44–54) [51] wide at level of genital setae. Distances between *st1-st1* 50 (45–54) [45], *st2-st2* 53 (48–58) [58], *st3-st3* 60 (57–63) [63], *st1-st3* 49 (42–55) [55], *st5-st5* 43 (39–46) [46]. Ventrianal shield triangular, reticulated, 95 (88–98) [98] long, 91 (83–99) [83] wide at level of ZV2, 67 (62–71) [71] wide at level of anus; with four pairs of pre-anal setae, *JV1* 7 (7–8) [7], *JV2* 7 (5–8) [8], *JV3* 7 (6–7) [7], *ZV2* 7 (7–8) [7], solenostomes *gv3* crescentic; *Pa* 8 (7–9) [9], *Pst* 7 (7–7) [7] on shield. Setae *JV4* 8 (5–11) [7], *JV5* 12 (11–14) [13], *ZV1* 9 (8–10) [8], *ZV3* 7 (5–9) [8] on interscutal membrane. All setae smooth, sharp pointed, *JV5* thickened, serrated. Two pairs of metapodal plates 30 (28–32) [28] long, 3 (3–4) [3] wide, 7 (5–8) [8] long, 2 (2–3) [3] wide.

Spermatheca. Calyx cup-shaped, 5 (5–5) [5] long, 6 (6–6) [6] wide, atrium nodular, minor and major ducts visible.

Chelicera. Movable digit 18 (15–20) [20] long, with one tooth; fixed digit 17 (14–19) [19] long, anterior half with two teeth, posterior half with one tooth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/2-1, 2-2/1-1/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. No marosetae on legs.

Male (n=1)

A heavily sclerotized mite. Idiosomal setal pattern: 12A:9B/JV-4:ZV-3.

Dorsum. Dorsal shield nearly oval, constricted at level of seta *R1*, strongly reticulated, rugose, 241 long (*j1–J5* level) and 140 wide at level of *j6*, 131 wide at level

of S4; seven pairs of solenostomes on dorsal shield, (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), twelve pairs of lyrifissures, (*id1*, *id2*, *id4*, *id6*, *idm2*, *idm3*, *idm4*, *idm5*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 10, *j3* 10, *j4* 7, *j5* 7, *j6* 8, *J2* 9, *J5* 6, *z2* 7, *z3* 8, *z4* 9, *z5* 6, *Z1* 9, *Z4* 12, *Z5* 15, *s4* 9, *s6* 10, *S2* 9, *S4* 10, *S5* 12, *r3* 9, *R1* 7. Setae *r3*, *R1* on shield, all setae short, thick, serrated.

Peritreme. Peritreme extending to *j1* level; peritremal shield slightly reticulated, with one pair of solenostomes (*gd3*).

Venter. Sternogenital shield smooth, posterior margin straight, much longer than wide, 104 long, 45 wide at level *st2*, with five pairs of setae *st1* 11, *st2* 10, *st3* 12, *st4* 12, *st5* 12, three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Distance between *st1-st1* 47, *st2-st2* 46, *st3-st3* 43, *st4-st4* 38, *st5-st5* 43, *st1-st5* 88. Exopodal shield at coxae II–IV. Ventrianal shield subtriangular, reticulated, 91 long, 120 wide at level of anterior corner and 56 wide at level of anus, without fused with peritremal shield; with five pairs of pre-anal setae, *JV1* 7, *JV2* 4, *JV3* 6, *ZV1* 11, *ZV2* 9; *JV5* 9 on interscutal membrane. All ventral setae smooth, except seta *JV5* serrated.

Chelicera. Movable digit 17 long, with one tooth; fixed digit 15 long, anterior half with two teeth, posterior half with one tooth, with *pilus dentilis*. Spermatodactyl straight, shaft 16 long, heel reduced, foot 47 long.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/2-1, 2-2/1-1/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. No marosetae on legs.

Specimens examined. PHILIPPINES: College Campus, Los Banos, Laguna, one paratype female (Aca 023) from *Casuarina equisetifolia* (Casuarinaceae), 1.xi.1962, L. A. Corpuz (UPLB-MNH); Visca Campus, Baybay City, Leyte, one male (LCR 3078,

Aca 4202) from *Casuarina equisetifolia* (Casuarinaceae), 23.ix.1988, L. A. Corpuz-Raros (UPLB-MNH); Visca Campus, Baybay City, Leyte, one female (LCR 3078, Aca 4202) from *Casuarina equisetifolia* (Casuarinaceae), 23.ix.1988, L. A. Corpuz-Raros (UPLB-MNH).

TAIWAN: Longmen Port, Lanyu Twonship, Taitung County (22°00.239' N 121°35.040' E, 14 m), one female from *Premna serratifolia* (Verbenaceae), 5.iv.2010, J. R. Liao & C. C. Ho (NTU); Ludao Township, Taitung County, one male (TAL078C006) from *Astragalus sinicus* (Fabaceae), 3.vi.1989, C. C. Ho (TARL).

Distribution. Asia: Philippines (Corpuz 1966), Taiwan (Tseng 1975)

Remarks. Corpuz (1966) described this species from *Casuarina equisetifolia* in Philippines. Tseng (1975) described a new species *Shiehia multispinosa* from *Acacia confusa* in Lanyu Island. Chant & Yoshida-Shaul (1989a) reported *Shiehia multispinosa* as a junior synonym of this species although they did not able to borrow the type material. The only difference is seta *ZV1* is on ventrianal shield in the illustration of *S. multispinosa*, but on integument of this species.

Corpuz (1966; 1992) reported three macrosetae on leg IV, however, the present study agreed the Tseng (1975) reported *Shiehia multisponisa* without macrosetae on legs; all setae seem strong but no noticeable setae. Besides, Corpuz (1966) reported that fixed digit with four teeth, without *pilus dentilis*, movable digit with a tooth. Schicha & Corpuz-Raros (1992) reported that fixed digit with 5 teeth, with *pilus dentilis*, movable digit with 2 teeth. The present study reported three teeth on fixed digit with *pilus dentilis*, one tooth on movable digit based on all specimens including paratype specimen. This study is the first time to report the spermatheca shape

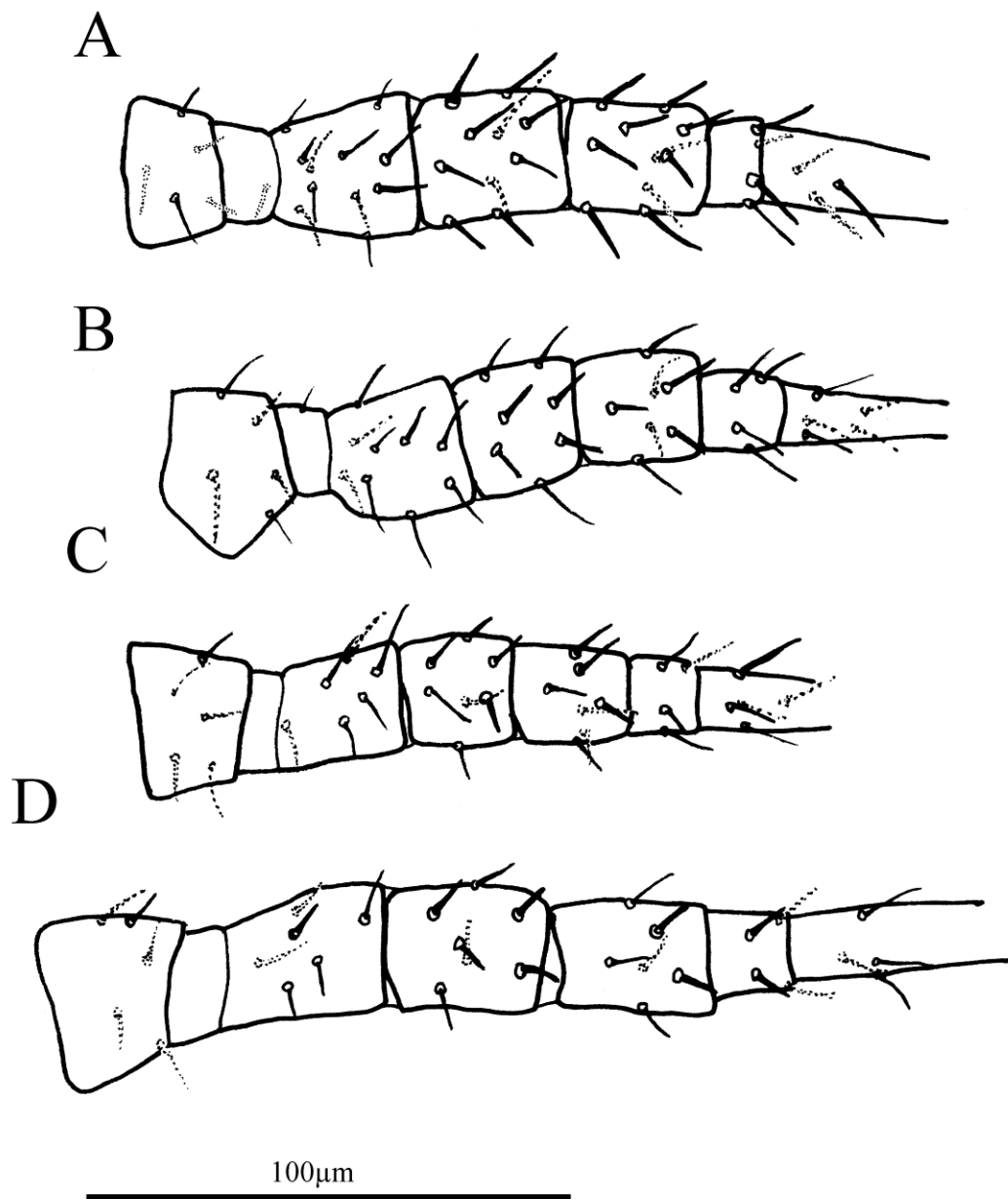


FIGURE 168. *Neoseiulella compta* (Corpuz, 1966), Female, legs A. leg I dorsal view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV dorsal view.

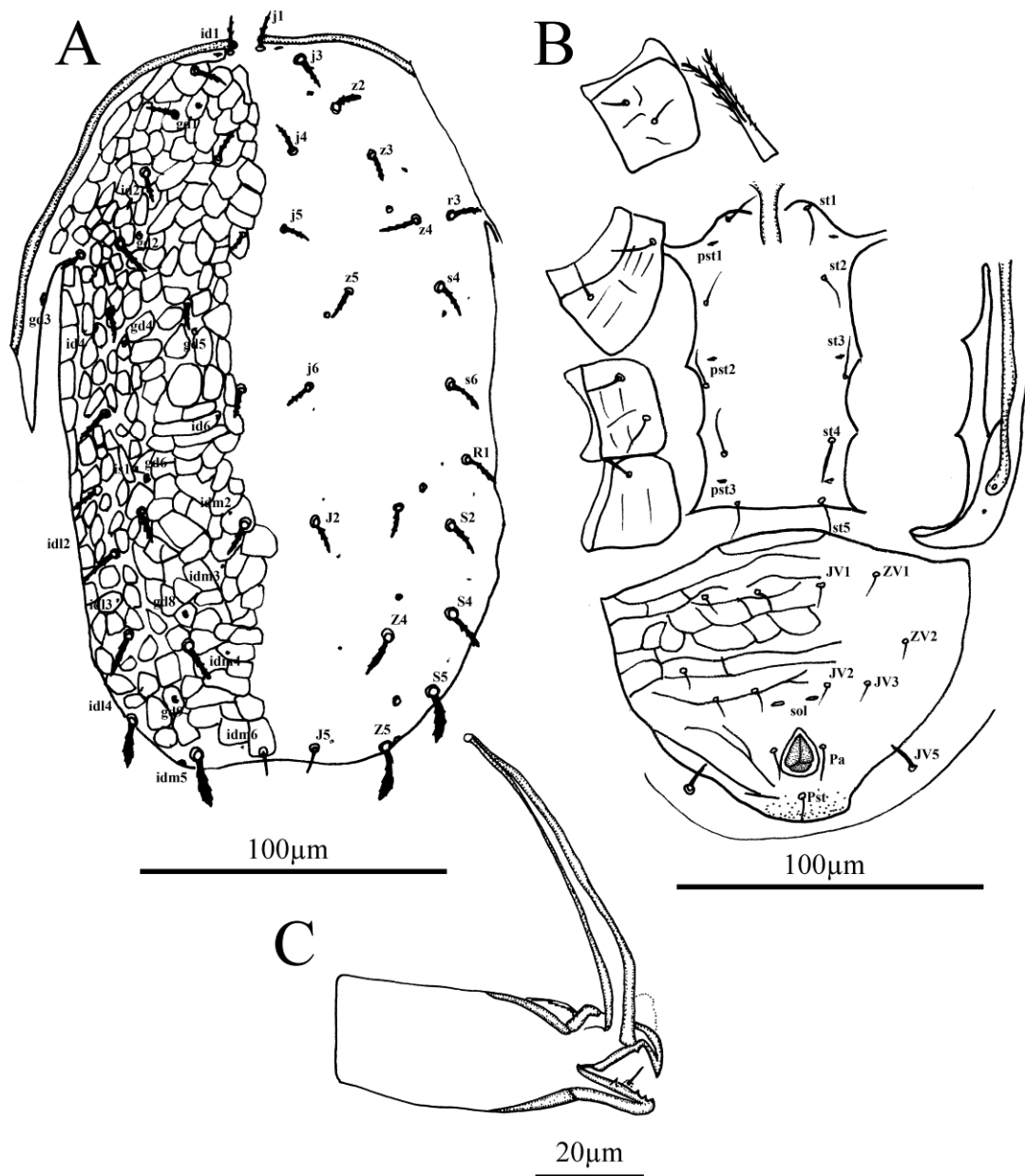


FIGURE 169. *Neoseiulella compta* (Corpuz, 1966), Male, A. dorsal shield; B. ventral idiosoma; C. chelicera and spermatodactyl.

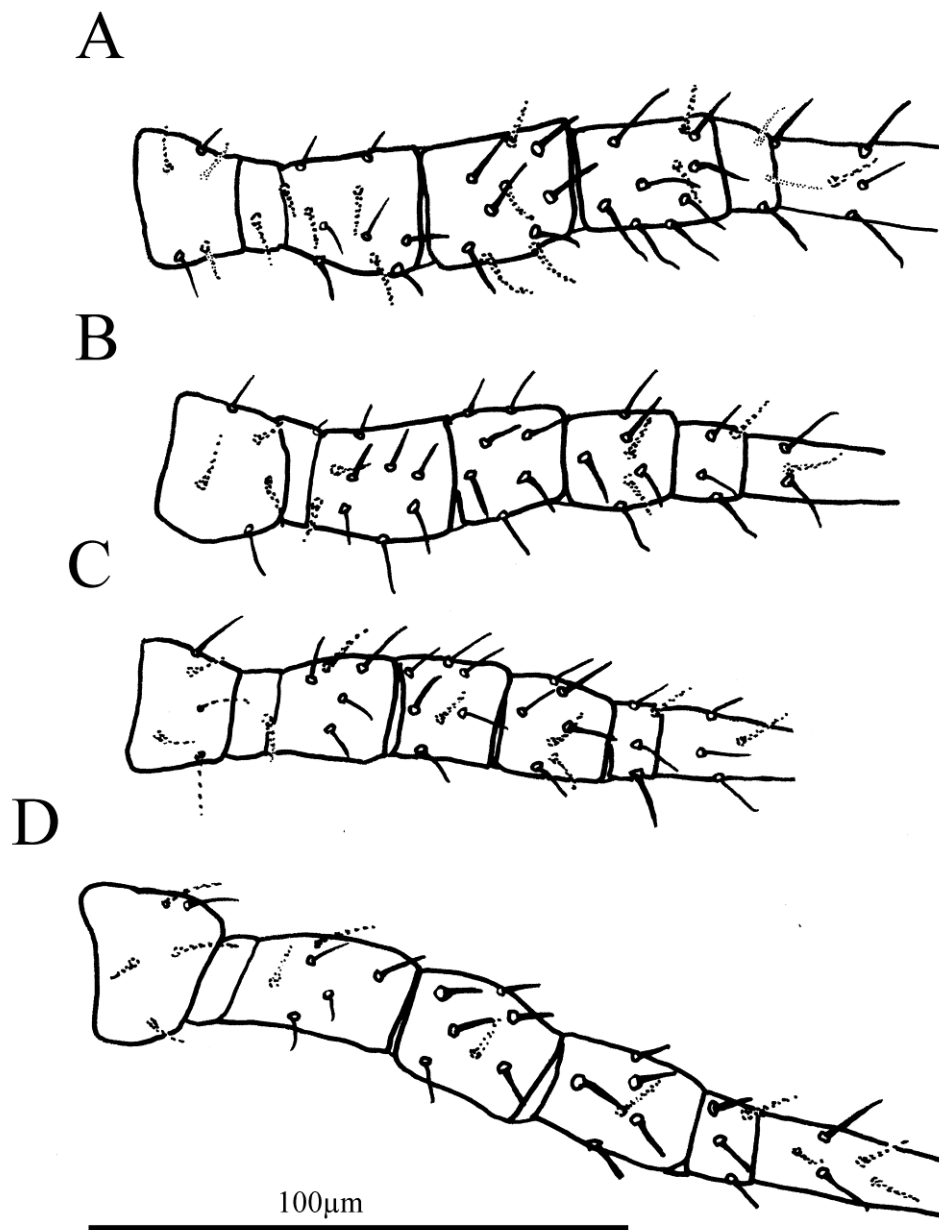


FIGURE 170. *Neoseiulella compta* (Corpuz, 1966), Male, legs A. leg I anterior view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV dorsal view.

Genus *Typhlodromus* Scheuten, 1857

盲走蟎屬



Typhlodromus Scheuten, 1857: 111.

Typhlodromus (*Typhlodromus*).—Chant, 1957b: 528.

Anthoseius De Leon, 1959c: 258. Type species - *Anthoseius hebetis* De Leon, 1959c: 258.

Amblydromella Muma, 1961: 294. Type species - *Typhlodromus* (*Typhlodromus*) *fleschneri* Chant, 1960: 60.

Clavidromus Muina, 1961: 296. Type species - *Kampimodromus transvaalensis* Nesbitt, 1951: 55.

Typhlodromella Muma, 1961: 299. Type species - *Seiulus rhenanus* Oudemans, 1905: 78.

Chanteius (*Colchodromus*) Wainstein, 1962: 19. Type species - *Typhlodromus rarus* Wainstein, 1961 : 157.

Typhlodromus (*Neoseiulus*).—Wainstein, 1962: 21.

Mumaseius De Leon, 1965c: 23. Type species - *Typhlodromus* (*Typhlodromus*) *singularis* Chant, 1957c: 289.

Orientiseius Muma & Denmark, 1968: 238. Type species - *Typhlodromus* (*Typhlodromus*) *rickeri* Chant, 1960a: 62.

Typhlodromus (*Anthoseius*).—van der Merwe, 1968: 20.

Indodromus Ghai & Menon, 1969: 348. Type species - *Indodromus meerutensis* Ghai & Menon, 1969: 348.

Wainsteinius Arutunjan, 1969: 180. Type species - *Typhlodromus leptodactylus* Wainstein, 1961: 153.

Anthoseius (*Anthoseius*) Wainstein, 1972: 1477.

Anthoseius (*Amblydromellus*).—Wainstein, 1972: 1477.

Anthoseius (*Indodromus*).—Wainstein, 1972: 1478.

Anthoseius (*Aphanoseius*) Wainstein, 1972: 1478. Type species - *Anthoseius* (*Aphanoseius*) *verrucosus* Wainstein, 1972: 1480.

Berethria Tuttle & Muma, 1973: 35. Type species - *Berethria arizonica* Tuttle & Muma, 1973: 36.

Vittoseius Kolodochka, 1988: 42. Type species - *Vittoseius povtari* Kolodochka, 1988: 42.

Typhlodromus (*Trionus*) Denmark, 1992b: 32. Type species - *Typhlodromus magdalenae* Pritchard & Baker, 1962: 218.

Typhlodromus (*Oudemanus*) Denmark, 1992a: 34. Type species - *Typhlodromus longipalpus* Swirski & Ragusa, 1976: 115.

Anthoseius (*Litoseius*) Kolodochka, 1992: 22. Type species - *Anthoseius* (*Litoseius*) *spectatus* Kolodochka, 1992: 22.

T. rhenanus group.—Chant, 1959b: 62.

T. barkeri group.—Chant, 1959b: 60.

Type species - *Typhlodromus pyri* Scheuten, 1857: 111.

There are 431 valid species in the genus (Demite *et al.* 2019). The genus is characterized by seta *Z1* absent. Chant & McMurtry (1994) recognized two subgenera in this genus, including *Anthoseius* De Leon, *Typhlodromus* Scheuten, which is identified by seta *S5* present/absent.



Subgenus *Anthoseius* De Leon, 1959b

花綏蟎亞屬



Anthoseius De Leon, 1959b: 258.

Amblydromella Muma, 1961: 294. Type species - *Typhlodromus fleschneri* Chant, 1960: 60.

Clavidromus Muma, 1961: 296. Type species - *Kampimodromus transvaalensis* Nesbitt, 1951: 55.

Typhlodromella Muma, 1961: 299. Type species - *Seiulus rhenanus* Oudemans, 1905: 78.

Chanteius (*Colchodromus*) Wainstein, 1962: 19. Type species - *Typhlodromus rarus* Wainstein, 1961: 157.

Mumaseius De Leon, 1965c: 23. Type species - *Typhlodromus singularis* Chant, 1957a: 289.

Orientiseius Muma & Denmark, 1968: 238. Type species - *Typhlodromus* (*Typhlodromus*) *rickeri* Chant, 1960a: 62.

Typhlodromus (*Anthoseius*).—van der Merwe, 1968: 20.

Indodromus Ghai & Menon, 1969: 348. Type species - *Indodromus meerutensis* Ghai & Menon, 1969: 348.

Anthoseius (*Anthoseius*).—Wainstein, 1972: 1477.

Anthoseius (*Amblydromellus*).—Wainstein, 1972: 1477.

Anthoseius (*Aphanoseius*) Wainstein, 1972: 1478. Type species - *Anthoseius* (*Aphanoseius*) *verrucosus* Wainstein, 1972: 1480.

Berethria Tuttle & Muma, 1973: 35. Type species - *Berethria arizonica* Tuttle & Muma, 1973: 35.

Vittoseius Kolodochka, 1988: 42. Type species - *Vittoseius povtari* Kolodochka, 1988:

42.

Anthoseius (Litoseius) Kolodochka, 1992: 22. Type species - *Anthoseius (Litoseius)*.

spectatus Kolodochka, 1992: 22.

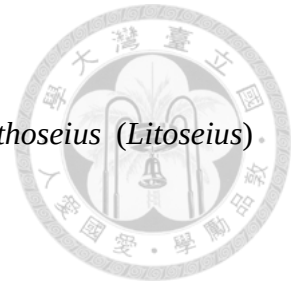
T. rhenanus group.—Chant, 1959b: 62.

T. barkeri group.—Chant, 1959b: 60.

Type species - *Anthoseius hebetis* De Leon, 1959b:258.

This subgenus is characterized by seta S5 present. Chant & McMurtry (1994) recognized 9 species group in the subgenus *Anthoseius*, including *arizonicus* (Tuttle & Muma), *bergi* Chant & McMurtry, *daresalaami* Chant & McMurtry, *egypticus* Chant & McMurtry, *religiosus* Chant & McMurtry, *rhenanus* Chant, *rickeri* (Chant), *singularis* (Chant), *transvaalensis* Schicha & Corpuz-Raros, which is identified by setae S4, JV3, JV4 present/absent, shapes of dorsal setae, relative lengths of dorsal setae, shape of ventrianal shield, insertions of setae *r3* and *R1*.

Diagnosis – Idiosomal pattern 12A:8A, 12A:7B, caudoventral pattern JV:ZV, JV-3:ZV, JV-4:ZV. Dorsal shield lightly sclerotized to heavily sclerotized, smooth to reticulated. Dorsal setae are usually smooth and Z4, Z5 slightly serrated, but sometimes, all dorsal and sub-lateral setae are serrated. Sternal shield posterior margin straight, or concave, *st3* on membrane, or shield. Genital shield truncated posteriorly. Female ventrianal shield variable, from long and narrow, to subquadrate, with 3 or 4 pair of preanal setae, *gv3* conspicuous. Peritreme usually extending to *j1* level. Spermatheca variable, sometimes calyx with membrane wall and thick wall areas. Chelicera usually few teeth. Leg IV usually at least one macroseta, or 3 macrosetae. Ge II with 7 setae. Male



ventrianal shield triangular.



Key to the species of subgenus *Typhlodromus* (*Anthoseius*) from Taiwan (except *eleglidus* due to inadequate description)

1. Ventrianal shield with three pairs of preanal setae *transvaalensis* (Nesbiit, 1951)
 - Ventrianal shield with four pairs of preanal setae..... 2
2. Preanal pores absent 3
 - Preanal pores present..... 4
3. Sternal shield with two pairs of setae..... *neocrassus* Tseng, 1983
 - Sternal shield with three pairs of setae..... *changi* Tseng, 1975
4. Ventrianal shield with small rounded preanal pores *ryukyuensis* Ehara, 1967
 - Ventrianal shield with crescentic preanal pores..... 5
5. Sternal shield with two pairs of setae..... *obesus* Tseng, 1983
 - Sternal shield with three pairs of setae..... 6
6. Movable digit of chelicera with one tooth 7
 - Movable digit of chelicera with more than one tooth 8
7. Fixed digit of chelicera with one tooth..... *lanyuensis* Tseng, 1975
 - Fixed digit of chelicera with four teeth *gracilentus* Tseng, 1975
8. Fixed digit of chelicera with seven teeth..... *serrulatus* Ehaara, 1972
 - Fixed digit of chelicera with about 3-4 teeth..... 9
9. Both dorsal setae Z4 and Z5 shovel-shaped end with expanded blade
 - *crossostephium* Liao & Ho, 2017c
 - Only dorsal setae Z4 shovel-shaped end *tridentiger* Tseng, 1975

***Typhlodromus (Anthoseius) changi* Tseng, 1975**

張氏盲走蟎



(Figures 171–172)

Typhlodromus (Typhlodromus) changi Tseng, 1975: 57.

Amblydromella changi.—Moraes *et al.*, 1986: 159.

Amblydromella (Amblydromella) changi.—Denmark & Welbourn, 2002: 307.

Typhlodromus (Anthoseius) changi.—Chant & McMurtry, 2007: 152.

Female (n=6)

A lightly sclerotized mite. Idiosomal setal pattern: 12A:8A/JV:ZV.

Dorsum. Dorsal shield nearly oval, constricted at level of *R1*, well sclerotized, strongly reticulated, 357 (344–366) long (*j1*–*J5* level) and 179 (171–230) wide at 89 level of *j6*, 187 (183–193) wide at level of *S4*; six pairs of solenostomes on dorsal shield, (*gd1*, *gd2*, *gd4*, *gd6*, *gd8*, *gd9*), fourteen pairs of lyrifissures, (*id1*, *id1a*, *id2*, *id4*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *idx*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 15 (11–20), *j3* 13 (12–15), *j4* 9 (6–12), *j5* 10 (9–12), *j6* 12 (11–14), *J2* 14 (12–17), *J5* 8 (7–10), *z2* 13 (11–15), *z3* 11 (9–14), *z4* 13 (12–14), *z5* 10 (9–12), *Z4* 17 (10–21), *Z5* 57 (53–61), *s4* 15 (14–16), *s6* 17 (15–20), *S2* 20 (16–22), *S4* 25 (21–30), *S5* 21 (18–29), *r3* 13 (10–15), *R1* 14 (12–15). All setae smooth, except seta *Z5* serrated, shovel-shaped with expanded blade.

Peritreme. Peritreme extending to *j1* level, with one pair of solenostomes (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, posterior margin irregular, wider than long, 77 (71–84) long, 81 (73–87) wide, with three pairs of setae *st1* 20 (15–24), *st2* 20 (15–24), *st3* 16 (14–19), and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae I–IV. Metasternal platelets tear-shaped, with one pair of metasternal setae, *st4* 14 (10–19),

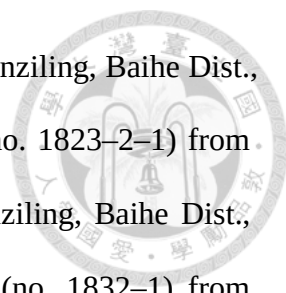
with one pair of lyrifissures (*pst3*). Genital shield smooth, posteriorly truncate, with one pair of genital setae *st5* 15 (12–21), 67 (60–75) wide at level of genital setae. Distances between *st1-st1* 52 (42–65), *st2-st2* 57 (50–68), *st3-st3* 65 (62–71), *st1-st3* 70 (67–74), *st5-st5* 57 (54–62). Ventrianal shield pentagonal, lateral margin slightly concave, 127 (122–134) long, 99 (88–95) wide at level of ZV2, 79 (74–87) wide at level of anus; with four pairs of pre-anal setae, *JV1* 10 (7–11), *JV2* 8 (6–11), *JV3* 11 (9–15), *ZV2* 12 (8–14), solenostomes *gv3* small, rounded; *Pa* 12 (8–16), *Pst* 12 (9–16) on shield. Setae *JV4* 14 (12–17), *JV5* 47 (41–51), *ZV1* 11 (10–12), *ZV3* 11 (8–12) on interscutal membrane. All setae smooth, sharp pointed, except seta *JV5* shovel end. Two pairs of metapodal plates 20 (19–23) long, 7 (6–9) wide, 9 (7–11) long, 3 (2–4) wide.

Spermatheca. Calyx cup-shaped, 12 (8–14) long, 7 (6–8) wide, with distal half thick, other membrane, atrium nodular, connected to the calyx without neck, minor and major ducts visible.

Chelicera. Movable digit 31 (27–38) long, with three teeth; fixed digit 28 (26–32) long, with eight teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/2-1, 2-2/1-1/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* III (ad2) 14 (12–16), *Sge* IV (ad2) 21 (18–23), *Sti* IV (ad) 18 (15–21), *St* IV (d) 45 (42–49). Macrosetae shovel-shaped with expanded blade.

Specimens examined. Shouka, Mudan Township, Pingtung County (22°14.577'N, 120°50.650' E, 555m), one female (no. 617–1) from *Bambusa oldhamii* (Poaceae), 14.vi.2010, J. R. Liao, Y. H. Chiang & A. K. Dubey (NTU); Simaxian, Tai'an Township, Miaoli County (24°23.753'N, 120°55.520' E, 513m), one female (no. 1660–3)



from *Arundo formosana* (Poaceae), 2.v.2016, J. R. Liao (NTU); Guanziling, Baihe Dist., Tainan County (23°20.035'N, 120°28.930' E, 320m), one female (no. 1823–2–1) from *Bambusa olhamii* (Poaceae), 10.viii.2016, J. R. Liao (NTU); Guanziling, Baihe Dist., Tainan County (23°20.035'N, 120°28.930' E, 320m), one female (no. 1832–1) from *Phyllostachys makinoi* (Poaceae), 10.viii.2016, J. R. Liao (NTU); Guanziling, Baihe Dist., Tainan County (23°19.330'N, 120°28.993' E, 456m), one female (no. 1840–1) from *Phyllostachys makinoi* (Poaceae), 10.viii.2016, J. R. Liao (NTU).

Distribution. Asia: Taiwan (Tseng 1975).

Remarks. Tseng (1975) described this species based on single female from *Areca catechu* (Arecaceae) in Neipu, Chiayi (now Neipu, Zhuqi Township, Chiayi County). He did not reported reticulated level of dorsal shield in the original description. The reticulation on dorsal shield is a common character among *Typhlodromus* (*Anthoseius*) species (Papadoulis *et al.* 2009; Döker *et al.* 2017). In addition, according to original description, there are five teeth on fixed digit. However, the present study found eight teeth on fixed digit, three teeth on movable digit.

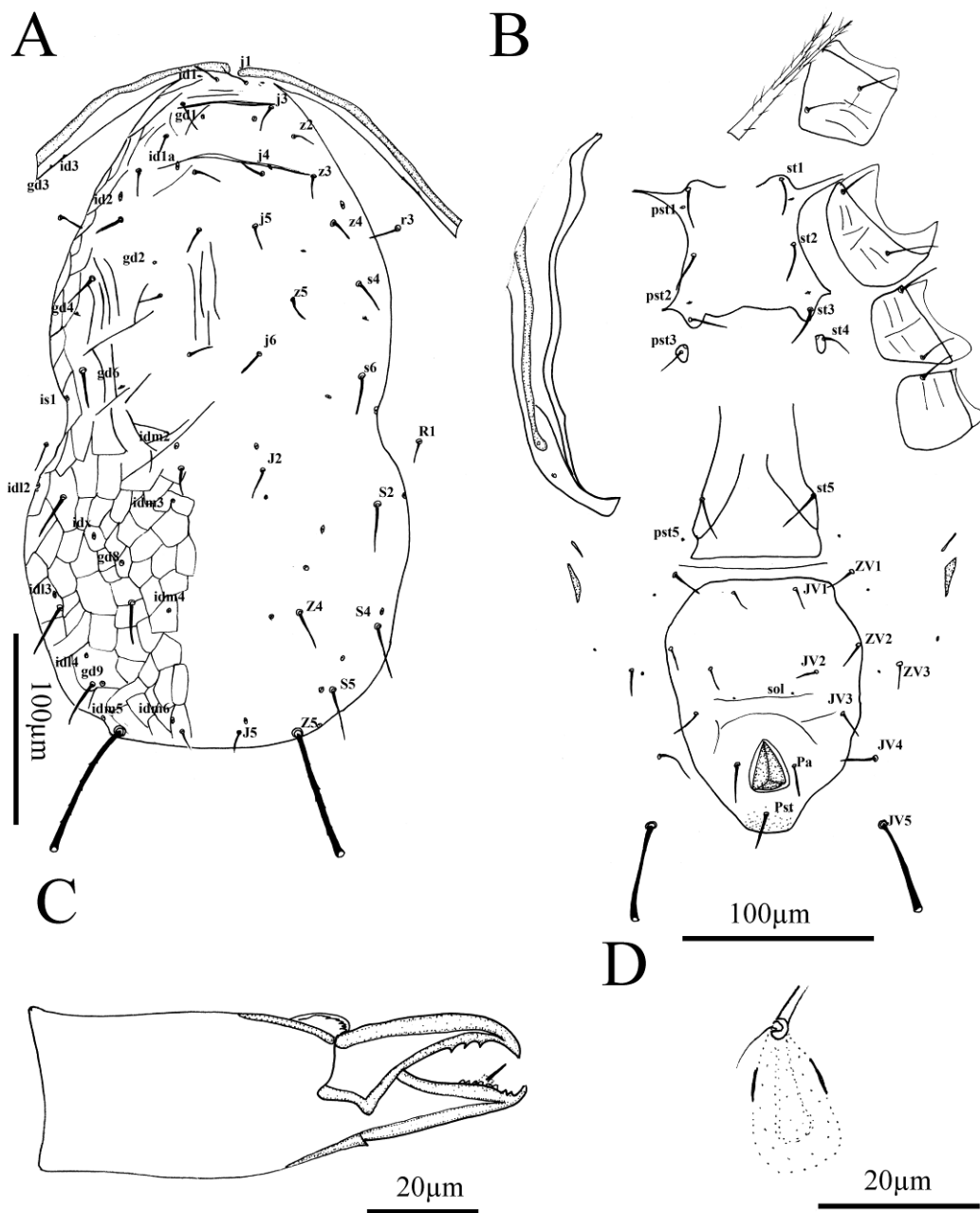


FIGURE 171. *Typhlodromus (Anthoseius) changi* Tseng, 1975, Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

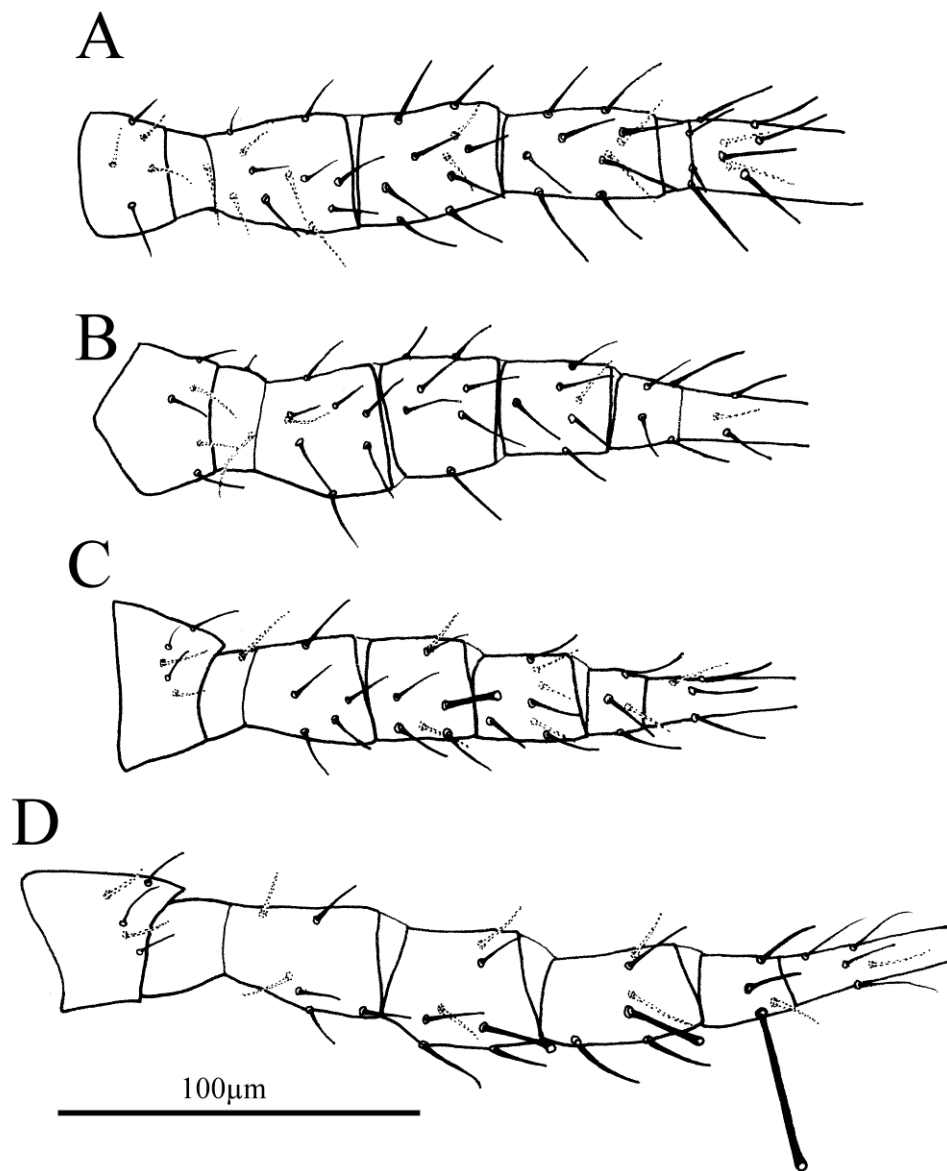


FIGURE 172. *Typhlodromus (Anthoseius) changi* Tseng, 1975, Female, legs A. leg I anterior view, B. leg II anterior view, C. leg III posterior view, D. leg IV posterodorsal view.

Typhlodromus (Anthoseius) crossostephium Liao & Ho, 2017c

薪艾盲走蟎



(Figures 173–176)

Typhlodromus (Anthoseius) crossostephium Liao & Ho, in Liao *et al.*, 2017c: 1640.

Female (n=10)

A lightly sclerotized mite. Idiosomal setal pattern: 12A:8A/JV:ZV.

Dorsum. Dorsal shield nearly oval, constricted at level of *R1*, with laterally reticulated; **317** 319 (308–328) long (*j1*–*J5* level) and **187** 193 (187–206) wide at level of *j6*, **183** 190 (180–199) wide at level of *S4*; five pairs of solenostomes on dorsal shield, (*gd2*, *gd4*, *gd6*, *gd8*, *gd9*), fifteen pairs of lyrifissures, (*id1*, *id1a*, *id2*, *id4*, *id6*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *idx*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* **20** 21 (19–23), *j3* **22** 22 (19–24), *j4* **14** 14 (11–18), *j5* **13** 14 (12–16), *j6* **17** 17 (16–19), *J2* **24** 23 (21–27), *J5* **9** 8 (6–11), *z2* **16** 14 (13–16), *z3* **17** 19 (16–21), *z4* **21** 21 (17–23), *z5* **15** 16 (13–20), *Z4* **32** 31 (26–37), *Z5* **44** 45 (41–51), *s4* **21** 21 (19–24), *s6* **24** 25 (22–29), *S2* **23** 27 (23–31), *S4* **19** 23 (19–31), *S5* **16** 14 (9–18), *r3* **15** 16 (14–19), *R1* **13** 13 (11–15). All setae smooth, shovel-shaped apically except for *Z4* and *Z5* which are distinct shovel-shaped apically with expanded blade.

Peritreme. Peritreme extending to *j1* level; peritremal shield lightly sclerotized, with one pair of solenostomes (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, posterior margin irregular, much wider than long, **52** 55 (46–63) long, **79** 84 (75–89) wide, with three pairs of setae *st1* **25** 25 (22–29), *st2* **21** 20 (19–21), *st3* **25** 20 (15–25), and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae II–IV. Metasternal platelets tear-shaped, with one pair of metasternal setae, *st4* **17** 19 (15–22), with one pair of lyrifissures (*pst3*). Genital shield smooth, with one pair of genital setae *st5* **23** 17 (12–23), **69** 70 (65–75) wide at level of genital setae.

Distances between *st1-st1* **46** 46 (43–49), *st2-st2* **57** 60 (56–64), *st3-st3* **67** 69 (66–72), *st1-st3* **62** 62 (59–64), *st5-st5* **62** 619 (59–67). Ventrianal shield pentagonal, smooth, **99** 103 (98–109) long, **85** 90 (84–95) wide at level of ZV2, **66** 67 (63–71) wide at level of anus; with four pairs of pre-anal setae, *JV1* **15** 13 (11–16), *JV2* **14** 12 (8–16), *JV3* **10** 13 (10–15), *ZV2* **16** 14 (9–17), solenostomes *gv3* crescentic; *Pa* **10** 10 (8–14), *Pst* **9** 10 (8–12) on shield. Setae *JV4* **11** 11 (9–13), *JV5* **30** 31 (26–37), *ZV1* **17** 16 (13–19), *ZV3* **8** 9 (6–12) on interscutal membrane. All setae smooth, sharp pointed, *JV5* shovel-shaped. Two pairs of metapodal plates **20** 21 (18–27) long, **3** 4 (3–5) wide, **10** 8 (5–12) long, **2** 2 (1–2) wide.

Spermatheca. Calyx bell-shaped, **17** 16 (14–19) long, **7** 8 (7–10) wide, atrium connected to the calyx with a neck, minor and major ducts visible.

Chelicera. Movable digit **25** 26 (25–28) long, with three teeth; fixed digit **26** 25 (23–26) long, anterior half with three teeth, posterior half with one tooth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* III (ad2) **14** 14 (14–16), *Sti* III (ad) **11** 11 (10–13), *St* III (ad) **9** 9 (7–10), *Sge* IV (ad2) **22** 22 (21–23), *Sti* IV (ad) **13** 13 (12–15), *St* IV (d) **24** 25 (22–27). Macrosetae apically shovel-shaped with expanded blade.

Male (n=10)

A lightly sclerotized mite. Idiosomal setal pattern: 12A:8A/JV-4:ZV-1,3.

Dorsum. Dorsal shield nearly oval, constricted at level of *R1*, with laterally reticulated; 252 (240–270) long (*j1-J5* level) and 168 (160–178) wide at level of *j6*, 135 (131–140) wide at level of *S4*, five pairs of solenostomes on dorsal shield, (*gd2*, *gd4*,

gd6, gd8, gd9), fifteen pairs of lyrifissures, (*id1, id1a, id2, id4, id6, idm2, idm3, idm4, idm5, idm6, idx, is1, idl2, idl3, idl4*); length of setae: *j1* 14 (10–19), *j3* 18 (16–20), *j4* 13 (11–16), *j5* 12 (11–14), *j6* 14 (11–16), *J2* 18 (16–21), *J5* 8 (6–10), *z2* 12 (10–13), *z3* 15 (13–17), *z4* 16 (14–18), *z5* 13 (11–16), *Z4* 24 (22–26), *Z5* 31 (29–34), *s4* 17 (15–21), *s6* 20 (18–23), *S2* 21 (20–22), *S4* 18 (16–19), *S5* 13 (11–15), *r3* 13 (11–16), *R1* 10 (9–12). All setae smooth, shovel-shaped apically except for *Z5* which are distinct shovel-shaped apically with expanded blade. Setae *r3* and *R1* inserted on dorsal shield.

Peritreme. Peritreme extending to *j1* level; peritremal shield lightly sclerotized, with one pair of solenostomes (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternogenital shield smooth, lateral slightly reticulated, posterior margin with slightly medium projection, longer than wide, 110 (105–123) long, 65 (60–73) wide at level of *st5*, with five pairs of setae, *st1* 16 (13–18), *st2* 11 (7–15), *st3* 14 (9–18), *st4* 13 (9–16), *st5* 12 (10–15), three pairs of lyrifissures (*pst1, pst2, pst3*). Distances between *st1-st1* 38 (36–42), *st2-st2* 54 (50–57), *st3-st3* 56 (53–61), *st4-st4* 42 (39–46), *st5-st5* 37 (34–42), *st1-st5* 110 (106–118). Exopodal shield at coxae II–IV. Ventrianal shield subtriangular, with striation, 97 (93–101) long, 136 (129–144) wide at anterior corner, 60 (52–97) at level of anus, fused with peritremal shield cingulum; with four pairs of pre-anal setae, *JV1* 12 (9–14), *JV2* 11 (10–12), *JV3* 10 (7–12), *ZV2* 11 (9–13), solenostomes *gv3* crescentic; *Pa* 8 (7–12), *Pst* 9 (7–12) on shield. Setae *JV5* 16 (13–18) on interscutal membrane. All setae smooth, sharp pointed, *JV5* shovel-shaped.

Chelicera. Movable digit 18 (16–21) long, with one tooth; fixed digit 20 (18–21) long, anterior half with two teeth, with *pilus dentilis*. Spermatodactyl L-shaped, shaft 18 (18–18) long, heel rounded, foot 11 (9–13) long, with expanded toe and lateral thorn-like projection.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2,

2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* III (ad2) 9 (7–12), *Sti* III (ad) 8 (7–10), *St* III (ad) 7 (7–8), *Sge* IV (ad2) 14 (13–16), *Sti* IV (ad) 9 (7–12), *St* IV (d) 19 (16–21). Macrosetae apically shovel-shaped.

Specimens examined. Lanyu Island, Elephant trunk rock (22°01.077' N, 121°35.990' E, 24 m), one holotype female (no. 1901–3) from *Crossostephium chinense* (Asteraceae), 23.ix.2016, H. Y. Lin (NTU); Lanyu Island, Elephant trunk rock (22°01.077' N, 121°35.990' E, 24 m), six paratype females (no. 467–1, 2, 3, 4, 5, 8) from *Crossostephium chinense* (Asteraceae), 5.iv.2010, J. R. Liao & C. C. Ho (NMNS); Lanyu Island, Elephant trunk rock (22°01.077' N, 121°35.990' E, 24 m), 65 females 12 males paratypes (HAL099B481, 483, 484, 486, 488, 489, 490, 491, 492, 493, 495, 497, 498, 501, 502, 503, 505, 506, 507, 508, 509, 511, 512, 513, 514, 515, 516, 517, 519, 520, 522, 523, 524, 525, 526, 527, 528, 530, 531, 533, 534, 535, 536, 537, 539, 540, 541, 543, 544, 546, 547, 548, 549, 551, 553, 554, 555, 556, 557, 558, 559, 560, 561, 563, 565, 569, 571, 573, 574, 575, 577, 578, 579, 581) from *Crossostephium chinense* (Asteraceae), 5.iv.2010, C. C. Ho (5 females in NTU, 4 females 4 males in NSNM, remaining in TARL); Lanyu Island, Elephant trunk rock (22°01.077' N, 121°35.990' E, 24 m), one female (no. 1647–2) from *Crossostephium chinense* (Asteraceae), 4.ix.2016, H. Y. Lin (NPUST); Lanyu Island, Five holes cave (22°4.914' N 121°30.664' E, 4 m), two females (no. 1895–1, 2) from *Crossostephium chinense* (Asteraceae), 4.ix.2016, H. Y. Lin (TARI); Lanyu Island, Lovers cave (22°3.693' N, 121°34.427' E, 12 m), one female (no. 1896–1) from *Crossostephium chinense* (Asteraceae), 4.ix.2016, H. Y. Lin (ESALQ-USP); three females and eight males (no. 1901–2, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14) data as holotype (NTU); Lanyu Island, Red head rock (22°01.077' N, 121°35.990' E,

24 m), one female one male (no. 2064–1, 2) from *Crossostephium chinense* (Asteraceae), 4.ix.2016, C. F. Hsu (NCHU).

Remarks. Liao *et al.* (2017c) reported this species from *Crossostephium chinense* in Lanyu Island. This species resemble to *T. (A.) acaciae*, *T. (A.) betulae*, *T. (A.) brisbanensis*, *T. (A.) bullatus*, *T. (A.) gressitti*, *T. (A.) gutierrezi*, *T. (A.) kimbasi*, *T. (A.) philippinensis*, *T. (A.) tridentiger* by having four pairs of pre-anal setae, pre-anal pores present and peritreme extend to setae *j1*, setae *R1* off dorsal shield, 3 teeth on movable digit, *st3* on sternal shield, seta *Z5* with shovel-shaped end, leg IV with 3 macrosetae. This species is characterized by setae *Z4*, *Z5* with shovel-shaped end. Besides, *T. (A.) philippinensis* and *T. (A.) tridentiger* which seems most close to the new species. The new species differs from *T. (A.) philippinensis* in the shovel-shaped end of seta *Z4* with expanded blade (*Z4* shovel-shaped without expanded blade in *philippinensis*), *Z5* smooth (barbed in *philippinensis*), seta *S5* thicker and longer 16 14 (9–18) (8 in *philippinensis*), relative length of macrosetae *St IV* > *Sge IV* > *Sti IV* (*Sge IV* > *St IV* > *Sti IV* in *philippinensis*), *JV5* with shovel-shaped (*JV5* normal in *philippinensis*), fixed digit with 4 teeth (3 teeth in *philippinensis*). These characters are persistent in the two paratypes and four voucher specimens of *T. philippinensis* we loaned from UPLB-MNH.

Tseng (1975) described *T. (A.) tridentiger* from Lanyu Island not detailed enough for the subgenus *Anthoseius*, and all specimens were lost (Liao *et al.* 2017b). It is impossible to compare this species to type specimens of *T. (A.) tridentiger*. However, this species is similar to *T. (A.) tridentiger* based on original description of Tseng (1975). The species differs from *T. (A.) tridentiger* in seta *Z4* with expanded shovel-shaped end (sharp end in *tridentiger*), fixed digit with 4 teeth (3 teeth in *tridentiger*), and leg IV without additional macrosetae (with additional macrosetae on

Sge IV, *Sti* IV in *tridentiger*). Seta *Z4* shape and additional macrosetae present/absent on leg IV could confirm they are separated species. In addition, this species and *T. (A.) tridentiger* were both occurred in Lanyu Island, the present study considered this species only distributed in coastal region (e.g. Elephant trunk rock, Five holes cave), but *T. (A.) tridentiger* in other places except coastal region.

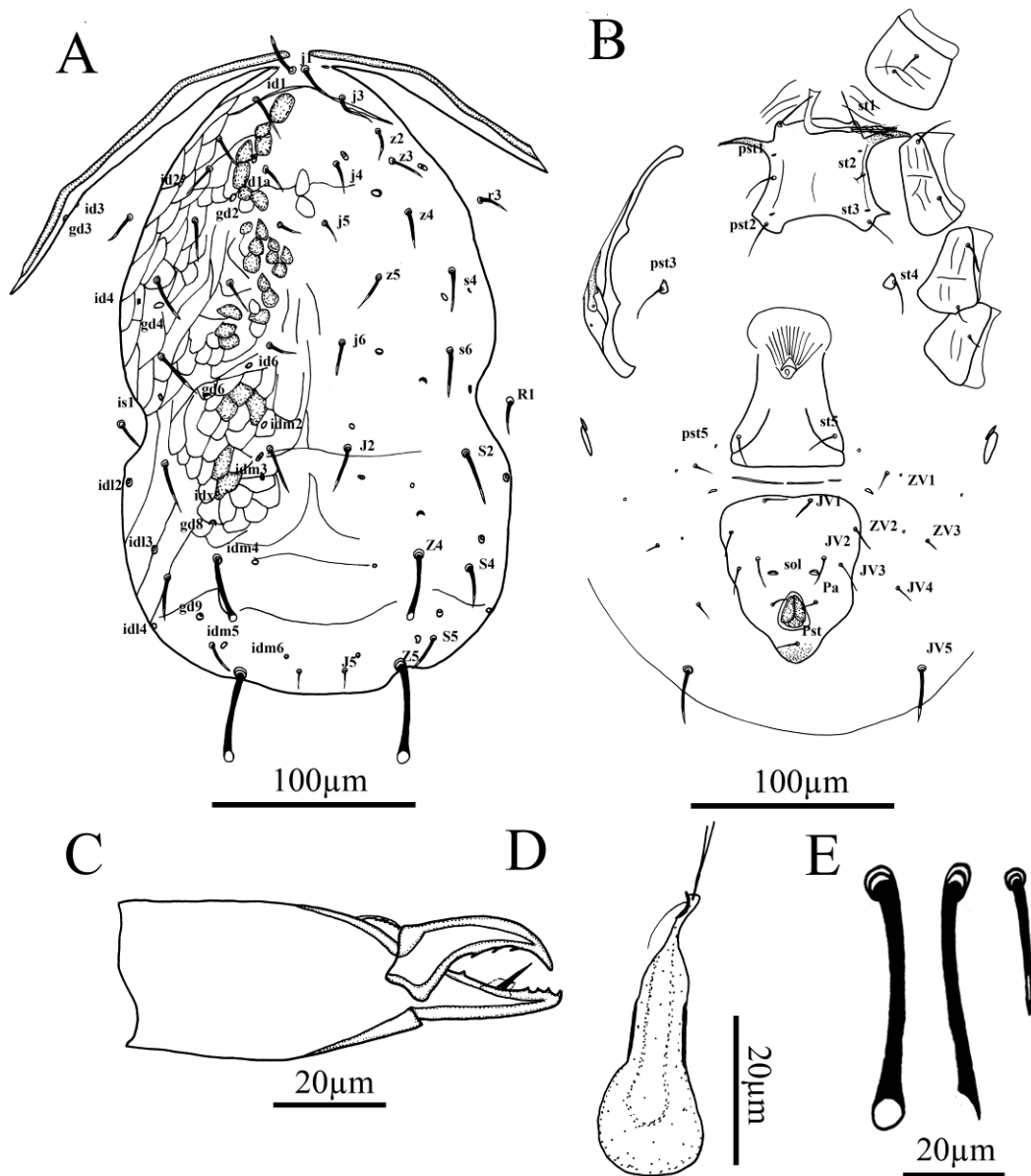


FIGURE 173. *Typhlodromus (Anthoseius) crossostephium* Liao & Ho, 2017c, Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

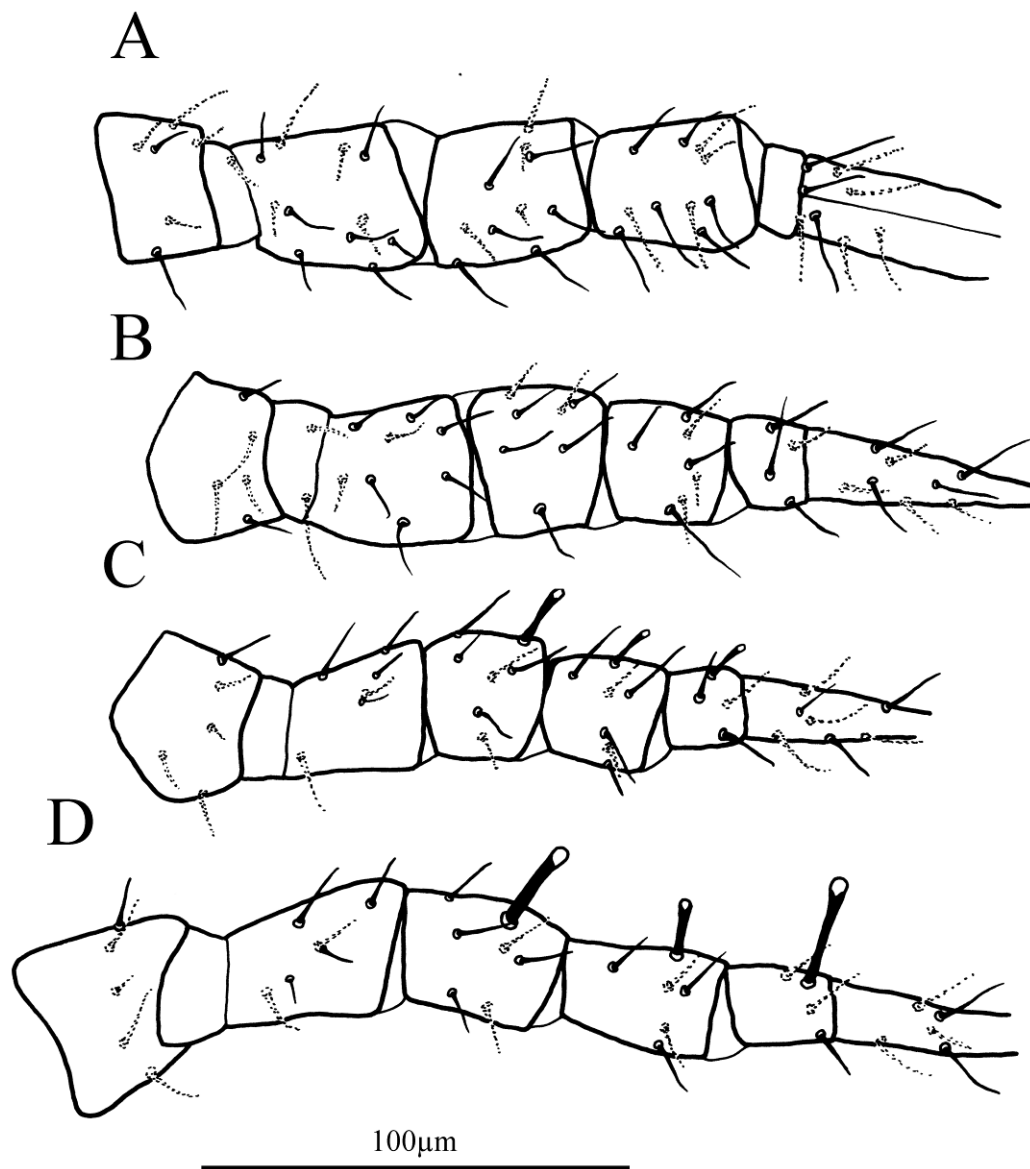


FIGURE 174. *Typhlodromus (Anthoseius) crossostephium* Liao & Ho, 2017c, Female, legs A. leg I anterior view, B. leg II posterodorsal view, C. leg III posterior view, D. leg IV posterior view.

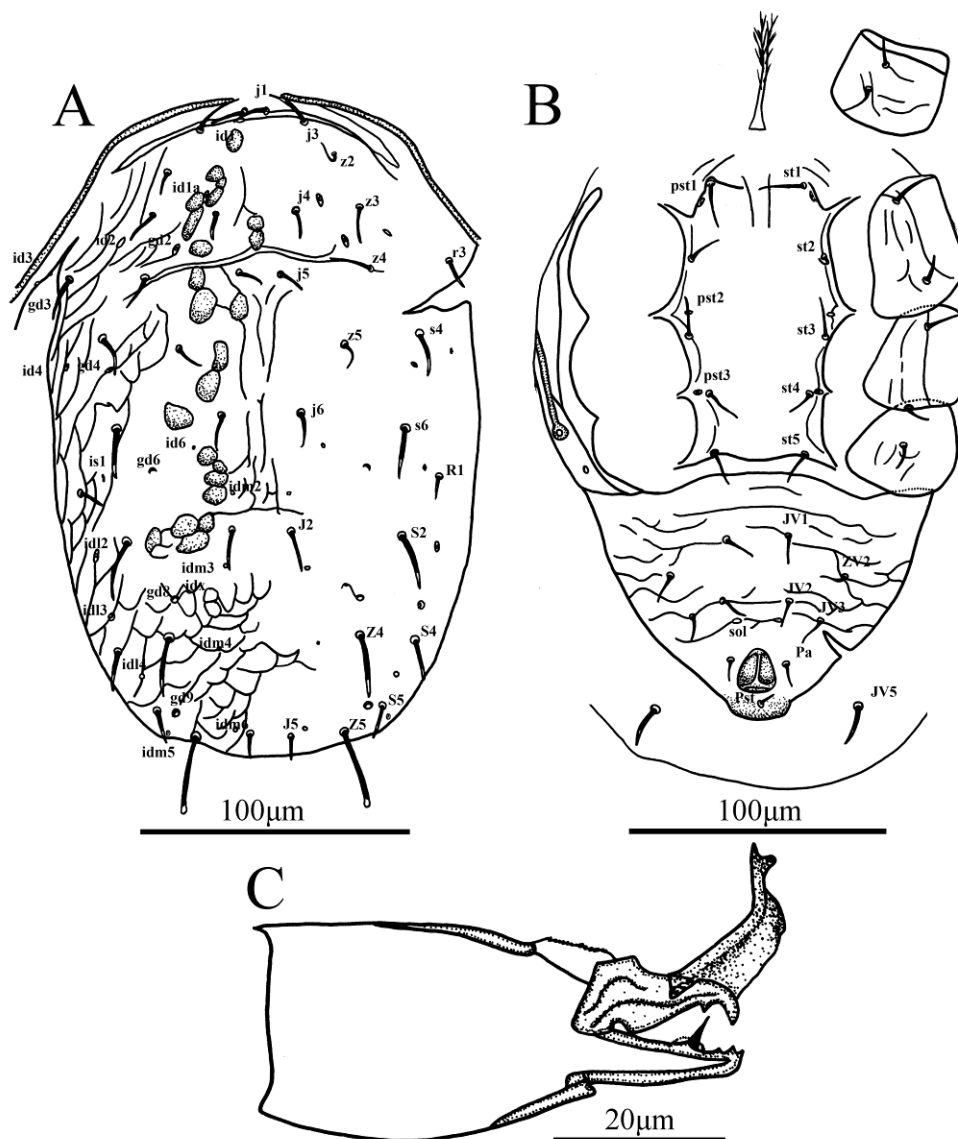


FIGURE 175. *Typhlodromus* (*Anthoseius*) *crossostephium* Liao & Ho, 2017c, Male, A. dorsal shield; B. ventral idiosoma; C. chelicera and spermatodactyl.

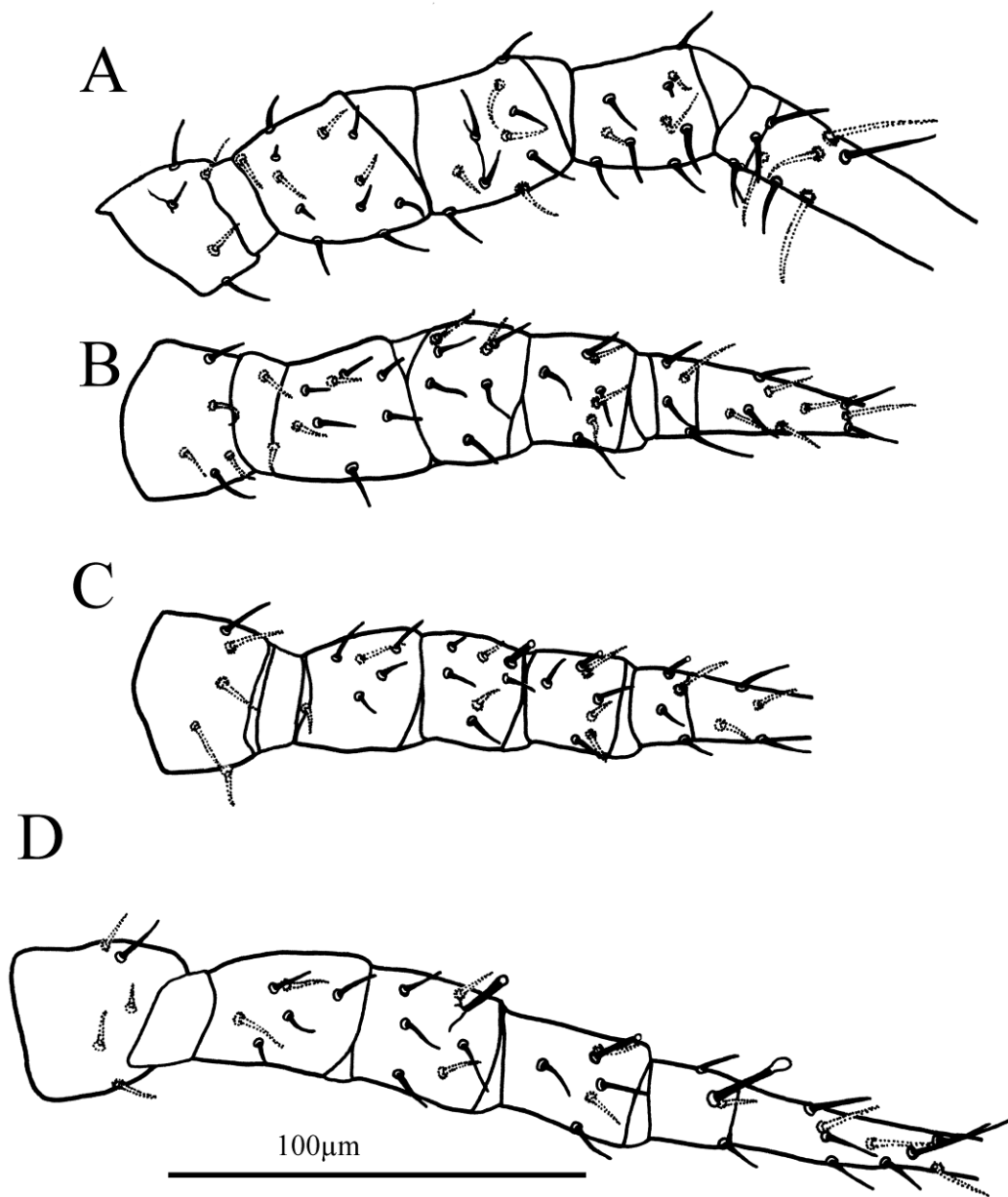


FIGURE 176. *Typhlodromus (Anthoseius) crossostephium* Liao & Ho, 2017c, Male, legs A. leg I anterior view, B. leg II dorsal view, C. leg III posterodorsal view, D. leg IV posterodorsal view.

***Typhlodromus (Anthoseius) eleglidus* Tseng, 1983**

長形微新綏蟎



(Figures 177)

Typhlodromus (Typhlodromus) eleglidus Tseng, 1983: 64.

Typhlodromus eleglidus.—Wu *et al.*, 1991: 82.

Neoseiulella eleglidus.—Moraes *et al.*, 2004: 293.

Typhlodromus (Anthoseius) eleglidus.—Kanouh *et al.*, 2012: 266.

Female

A lightly sclerotized mite. Idiosomal setal pattern: 12A:8A/JV:ZV.

Dorsum. Dorsal shield nearly oval, constricted at level of *R1*, well sclerotized, strongly reticulated, 274 long and 158 wide; length of setae: *j1* 19, *j3* 17, *j4* 11, *j5* 11, *j6* 14, *J2* 17, *J5* 5, *z2* 10, *z3* 12, *z4* 16, *z5* 13, *Z4* 27, *Z5* 38, *s4* 19, *s6* 19, *S2* 17, *S4* 16, *S5* 5, *r3* 10, *R1* 5. All setae smooth, except *Z5* serrated, shovel-shaped apically with expanded blade

Peritreme. Peritreme extending to *j1* level.

Venter. Sternal shield smooth, posterior margin irregular, as long as wide, three pairs of setae *st1*, *st2*, *st3*, and two pairs of lyrifissures (*pst1*, *pst2*). Metasternal platelets broader, with one pair of metasternal setae, *st4*. Genital shield wide as ventrianal shield, with one pair of genital setae *st5*. Ventrianal shield longer than wide, lateral margin slightly concave; with four pairs of pre-anal setae, *JV1*, *JV2*, *JV3*, *ZV2*, solenostomes *gv3* crescentic; *Pa*, *Pst* on shield. Setae *JV4*, *JV5*, *ZV1*, *ZV3* on interscutal membrane. All setae smooth, sharp pointed, *JV5* thick, knobbed. One pairs of metapodal plates 17 long, 3 wide.

Spermatheca. Calyx cup-shaped.

Chelicera. Unknown.

Legs. Macrosetae: *Sge* IV22, *Sti* IV 12, *St* IV 22. Macrosetae apically shovel-shaped.

Specimens examined. No specimens.

Distribution. Asia: Taiwan (Tseng 1983).

Remarks. Tseng (1983) reported this species based on single holotype female from *Litchi chinensis* in Paintienyen, Chiayi (now Bantianyan, Fanlu Township, Chiayi County). However, the original descriptions were too simple for identification, therefore, it is impossible to identify after all specimens lost (Liao *et al.* 2017b). Moraes *et al.* (2004a) considered this species was belonged to genus *Neoseiulella*, and Kanouh *et al.* (2012) considered this species was not include in genus *Neoseiulella* but in genus *Typhlodromus*, subgenus *Anthoseius*, due to setal pattern is 12A:8B (12A:9B in *Neoseiulella*).



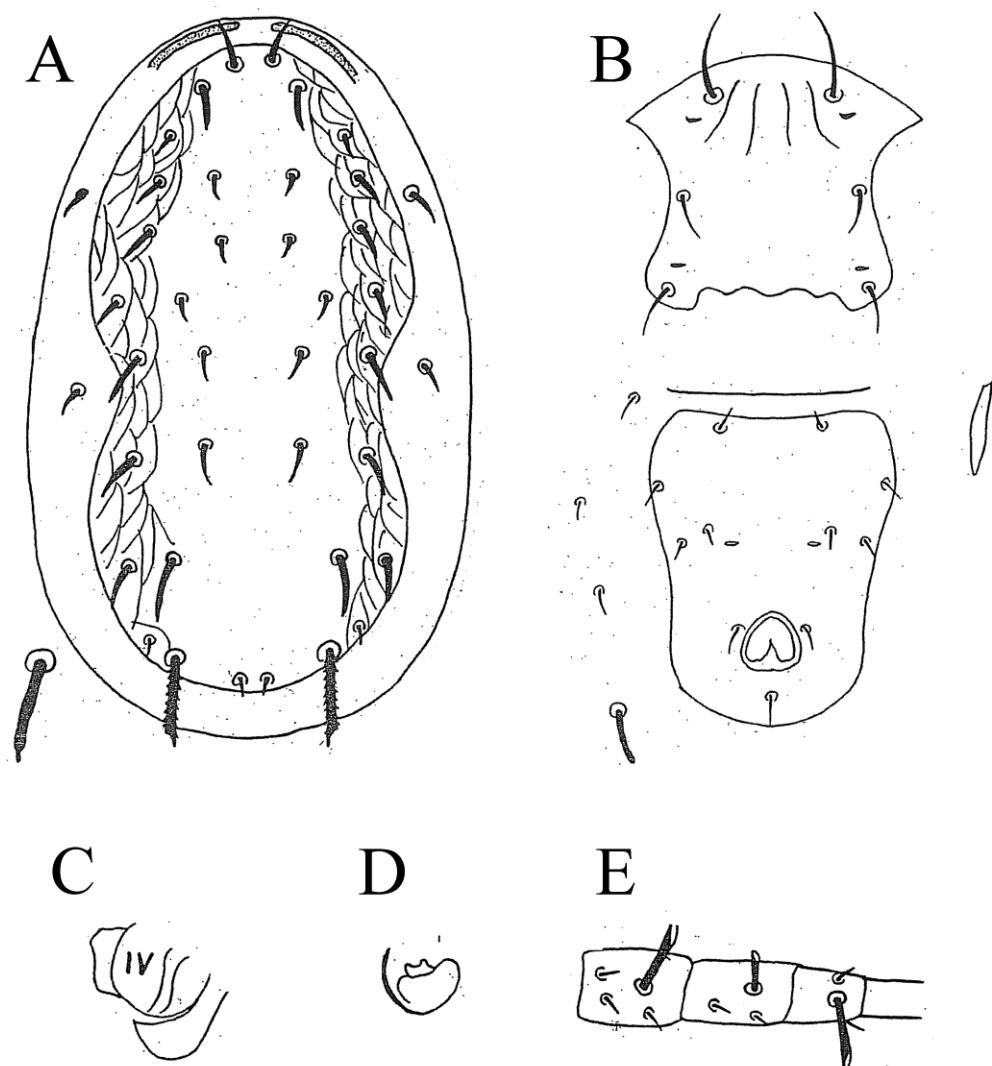


FIGURE 177. *Typhlodromus (Anthoseius) eleglidus* Tseng, 1983, Female, A. dorsal shield, B. ventral idiosoma, C. coxa IV, D. spermatheca, E. leg IV.

***Typhlodromus (Anthoseius) gracilentus* Tseng, 1975**

細小盲走蟎



(Figures 178–179)

Typhlodromus (Typhlodromus) gracilentus Tseng, 1975: 61.

Amblydromella gracilenta.—Moraes *et al.*, 1986: 162.

Amblydromella (Amblydromella) gracilenta.—Denmark & Welbourn, 2002: 307.

Typhlodromus (Anthoseius) gracilentus.—Chant & McMurtry, 2007: 152.

Female (n=2)

A lightly sclerotized mite. Idiosomal setal pattern: 12A:8A/JV:ZV.

Dorsum. Dorsal shield nearly oval, constricted at level of *R1*, well sclerotized, strongly reticulated, 314 (309–318) long (*j1*–*J5* level) and 188 (180–195) wide at level of *j6*, 180 (167–194) wide at level of *S4*; five pairs of solenostomes on dorsal shield, (*gd2*, *gd4*, *gd6*, *gd8*, *gd9*), twelve pairs of lyrifissures, (*id1*, *id2*, *id4*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 12 (11–13), *j3* 16 (15–17), *j4* 11 (10–12), *j5* 12 (11–14), *j6* 13 (11–14), *J2* 17 (14–20), *J5* 5 (5–6), *z2* 14 (12–17), *z3* 14 (10–17), *z4* 13 (12–14), *z5* 12 (11–13), *Z4* 23 (22–24), *Z5* 46 (43–50), *s4* 13 (11–15), *s6* 18 (15–22), *S2* 18 (14–22), *S4* 20 (18–23), *S5* 17 (17–17), *r3* 14 (14–15), *R1* 14 (12–15). All setae smooth, except seta *Z5* serrated, shovel-shaped with expanded blade.

Peritreme. Peritreme extending beyond *j1* level and curved downward, with one pair of solenostomes (*gd3*), one pair of lyrifissures (*id3*)

Venter. Sternal shield smooth, posterior margin irregular, much wider than long, 59 (55–62) long, 78 (77–80) wide, with three pairs of setae *st1* 17 (15–18), *st2* 13 (13–13), *st3* 15 (12–18), and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae II–IV. Metasternal platelets tear-shaped, with one pair of metasternal setae, *st4* 13 (10–15). Genital shield smooth, much narrower than ventrianal shield, with one pair of genital

setae *st5* 11 (10–13), 61 (59–63) wide at level of genital setae. Distances between *st1-st1* 49 (48–50), *st2-st2* 57 (55–58), *st3-st3* 64 (61–68), *st1-st3* 56 (54–58), *st5-st5* 60 (60–60). Ventrianal shield pentagonal, 97 (94–99) long, 93 (91–96) wide at level of ZV2, 79 (79–79) wide at level of anus; with four pairs of pre-anal setae, *JV1* 12 (11–13), *JV2* 8 (8–8), *JV3* 8 (7–8), *ZV2* 8 (6–10), solenostomes *gv3* rounded; *Pa* 8 (8–8), *Pst* 9 (8–10) on shield. Setae *JV4* 12 (9–15), *JV5* 32 (29–35), *ZV1* 8 (8–9), *ZV3* 7 (7–7) on interscutal membrane. All setae smooth, sharp pointed, *JV5* thick, shovel-shaped with expanded blade. Two pairs of metapodal plates 15 (12–17) long, 5 (4–6) wide, 8 (6–9) long, 2 (2–3) wide.

Spermatheca. Calyx cup-shaped, 10 (10–10) long, 9 (8–10) wide, with apical half thick, other membrane, atrium nodular, connected to the calyx without neck, minor and major ducts visible.

Chelicera. Movable digit 23 (22–25) long, with three teeth; fixed digit 22 (21–23) long, with four teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/2-1, 2-2/1-1/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae, *Sge* IV (ad2) 10 (10–10), *Sti* IV (ad) 11 (11–11), *St* IV (d) 23 (22–24). Macrosetae shovel-shaped with expanded blade.

Specimens examined. Mt. Nanren, Manzhou Township, Pingtung County, one female (88-Ty-0007) from *Lasianthus wallichii* (Rubiaceae), 26.xi.1988, C. C. Ho (TARL); Huisun Timberland, Ren'ai Township, Nantou County, one female (HAL102B140) from bamboo (Poaceae), 26.x.2013, C. C. Ho (TARL).

Distribution. Asia: Taiwan (Tseng 1983).

Remarks. Tseng (1975) described this species from *Grevillea robusta* in Yuch

Shih Chieh, Kaohsiung (now Yueshijie, Tianliao Dist., Kaohsiung City). The type locality is a unique geographic area called “badlands”, which is filled with a desolate, barren beauty. The present study did not collect materials in the place due to conservation law.

The species is characterized by the wider and pentagonal ventrianal shield, and relative length of leg IV macrosetae: $St\ IV > Sti\ IV > Sge\ IV$. Tseng (1975) described this species dorsal shield rugose, but did not draw in the illustration. The present study found this species is strongly reticulated, but not rugose on dorsal shield. In addition, according to original description, there are one tooth on movable digit and four teeth on fixed digit. Our examination revealed that there are three teeth on movable digit and four teeth on fixed digit.

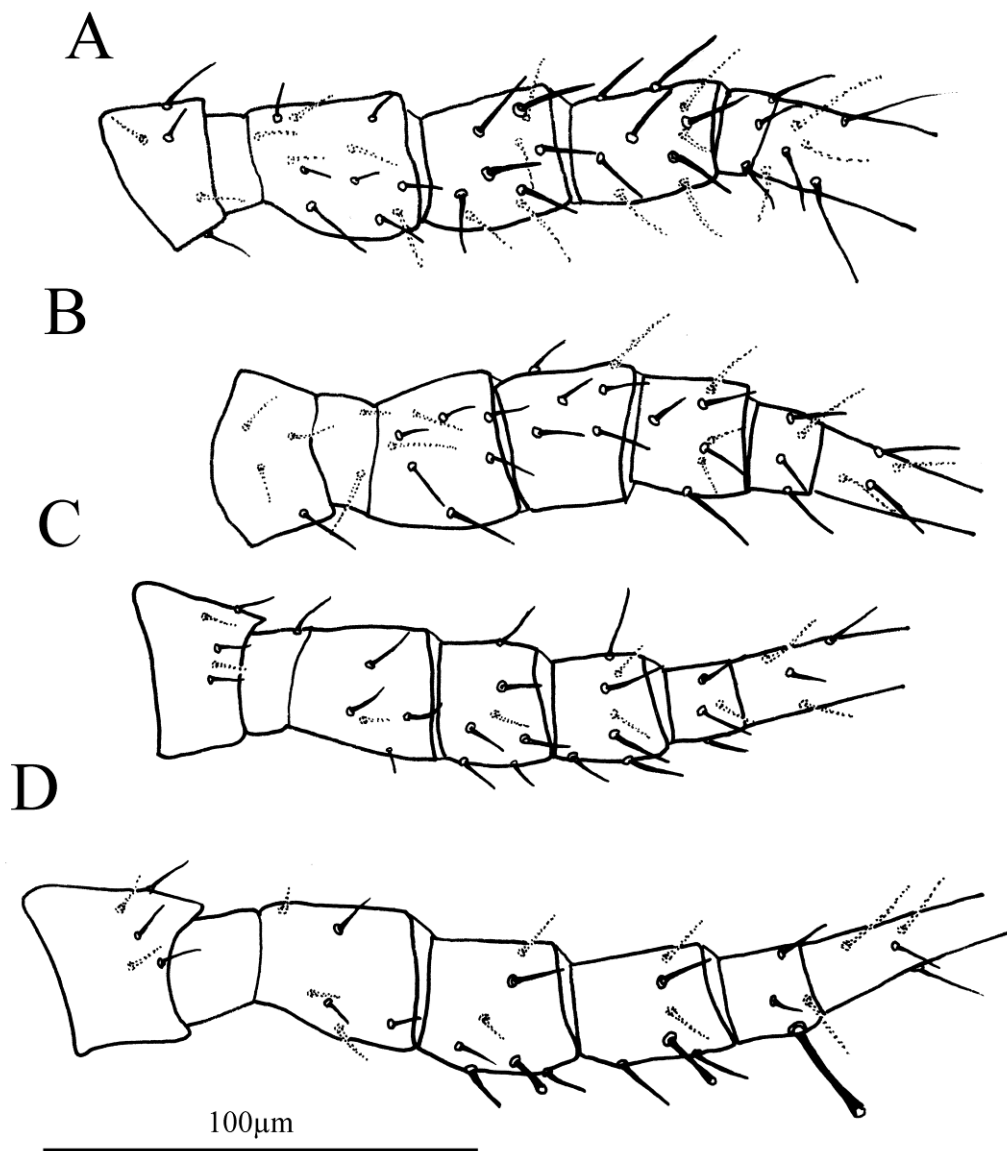


FIGURE 179. *Typhlodromus (Anthoseius) gracilentus* Tseng, 1975, Female, legs A. leg I anterior view, B. leg II dorsal view, C. leg III anterior view, D. leg IV anterior view.

***Typhlodromus (Anthoseius) lanyuensis* Tseng, 1975**

蘭嶼盲走蟎



(Figures 180–181)

Typhlodromus (Typhlodromus) lanyuensis Tseng, 1975: 54.

Amblydromella lanyuensis.—Moraes *et al.*, 1986: 166.

Amblydromella (Amblydromella) lanyuensis.—Denmark & Welbourn, 2002: 307.

Typhlodromus (Anthoseius) lanyuensis.—Chant & McMurtry, 2007: 155.

Female (n=4)

A lightly sclerotized mite. Idiosomal setal pattern: 12A:8A/JV:ZV.

Dorsum. Dorsal shield nearly oval, constricted at level of *R1*, laterally reticulated; 326 (313–345) long (*j1*–*J5* level) and 213 (202–230) wide at level of *j6*, 211 (200–218) wide at level of *S4*; five pairs of solenostomes on dorsal shield, (*gd2*, *gd4*, *gd6*, *gd8*, *gd9*), thirteen pairs of lyrifissures, (*id1*, *id2*, *id4*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *idx*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 21 (19–23), *j3* 29 (27–32), *j4* 9 (8–9), *j5* 8 (7–10), *j6* 11 (10–12), *J2* 12 (11–13), *J5* 5 (5–6), *z2* 6 (6–8), *z3* 22 (20–24), *z4* 11 (9–14), *z5* 8 (7–10), *Z4* 36 (31–41), *Z5* 64 (62–67), *s4* 27 (26–29), *s6* 33 (31–36), *S2* 31 (28–34), *S4* 21 (19–24), *S5* 8 (6–11), *r3* 13 (10–15), *R1* 9 (7–11). All setae smooth, sharp end, except for *Z5* slightly serrated.

Peritreme. Peritreme extending to *j1* level; peritremal shield lightly sclerotized, with one pair of solenostomes (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, posterior margin concave, much wider than long, 64 (61–65) long, 79 (78–81) wide, with three pairs of setae *st1* 15 (12–19), *st2* 14 (13–15), *st3* 15 (14–15), and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae I–IV. Metasternal platelets tear-shaped, with one pair of metasternal setae, *st4* 11 (9–13), with one pair of lyrifissures (*pst3*). Genital shield smooth, truncate posteriorly, with one pair

of genital setae *st5* 14 (13–16), 67 (64–69) wide at level of genital setae. Distances between *st1-st1* 50 (47–52), *st2-st2* 62 (61–64), *st3-st3* 65 (63–67), *st1-st3* 61 (58–64), *st5-st5* 59 (58–61). Ventrianal shield pentagonal with waist at *JV2* level, smooth, 94 (89–97) long, 76 (73–78) wide at level of *ZV2*, 73 (71–74) wide at level of anus; with four pairs of pre-anal setae, *JV1* 9 (6–10), *JV2* 8 (8–10), *JV3* 8 (7–9), *ZV2* 8 (7–10), solenostomes *gv3* crescentic; *Pa* 10 (8–11), *Pst* 11 (9–13) on shield. Setae *JV4* 7 (7–8), *JV5* 39 (38–41), *ZV1* 8 (7–9), *ZV3* 8 (7–10) on interscutal membrane. All setae smooth, sharp pointed. Two pairs of metapodal plates 18 (17–22) long, 5 (5–5) wide, 10 (8–12) long, 2 (1–2) wide.

Spermatheca. Calyx tubular, flaring distally, with apical half thick, 14 (12–16) long, 5 (4–7) wide, atrium connected to the calyx, minor and major ducts invisible.

Chelicera. Movable digit 26 (25–28) long, with three teeth; fixed digit 25 (23–26) long, anterior half with three teeth, with *pilus dentilis*.

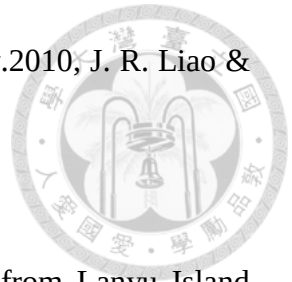
Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/1-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* III (ad2) 24 (21–28), *Sti* III (ad) 18 (17–21), *St* III (d) 14 (12–15), *Sge* IV (ad2) 40 (37–43), *Sti* IV (ad) 24 (21–27), *St* IV (d) 41 (40–41). Macrosetae shovel-shaped with expanded blade.

Specimens examined. Lanyu Weather Station, Lanyu Township, Taitung County (22°02.229' N, 121°33.503' E, 308 m), one female (no. 1209–1, 2) from *Acacia confusa* (Fabaceae), 6.iv.2011, Y. J. Lu (NCHU, NTU). Little Heavenly Lake, Lanyu Township, Taitung County (22°04.650' N, 121°30.615' E, 146 m), one female (no. 452–1) from *Ficus septica* (Moraceae), 4.iv.2010, J. R. Liao & C. C. Ho (TARL). Little Heavenly Lake, Lanyu Township, Taitung County (22°04.650' N, 121°30.615' E, 146 m), one

female (no. 453–11) from *Leucosyke quadrinervia* (Urticaceae), 4.iv.2010, J. R. Liao & C. C. Ho (NMNS).

Distribution. Asia: Taiwan ((Lanyu Island (Tseng 1975)).

Remarks. This species was also described by Tseng (1975) from Lanyu Island based on the material collected from weeds. We also collected from the type locality. These specimens are morphologically similar to the original description, and no clear differences were found. According to original description there is one tooth on each cheliceral digits. However, we found three teeth on each cheliceral digits. In addition, macrosetae on leg IV slightly longer than those of original description (*Sge* IV 30 vs. 39, *Sti* IV 10 vs. 25, and *St* IV 32.5 vs. 41).



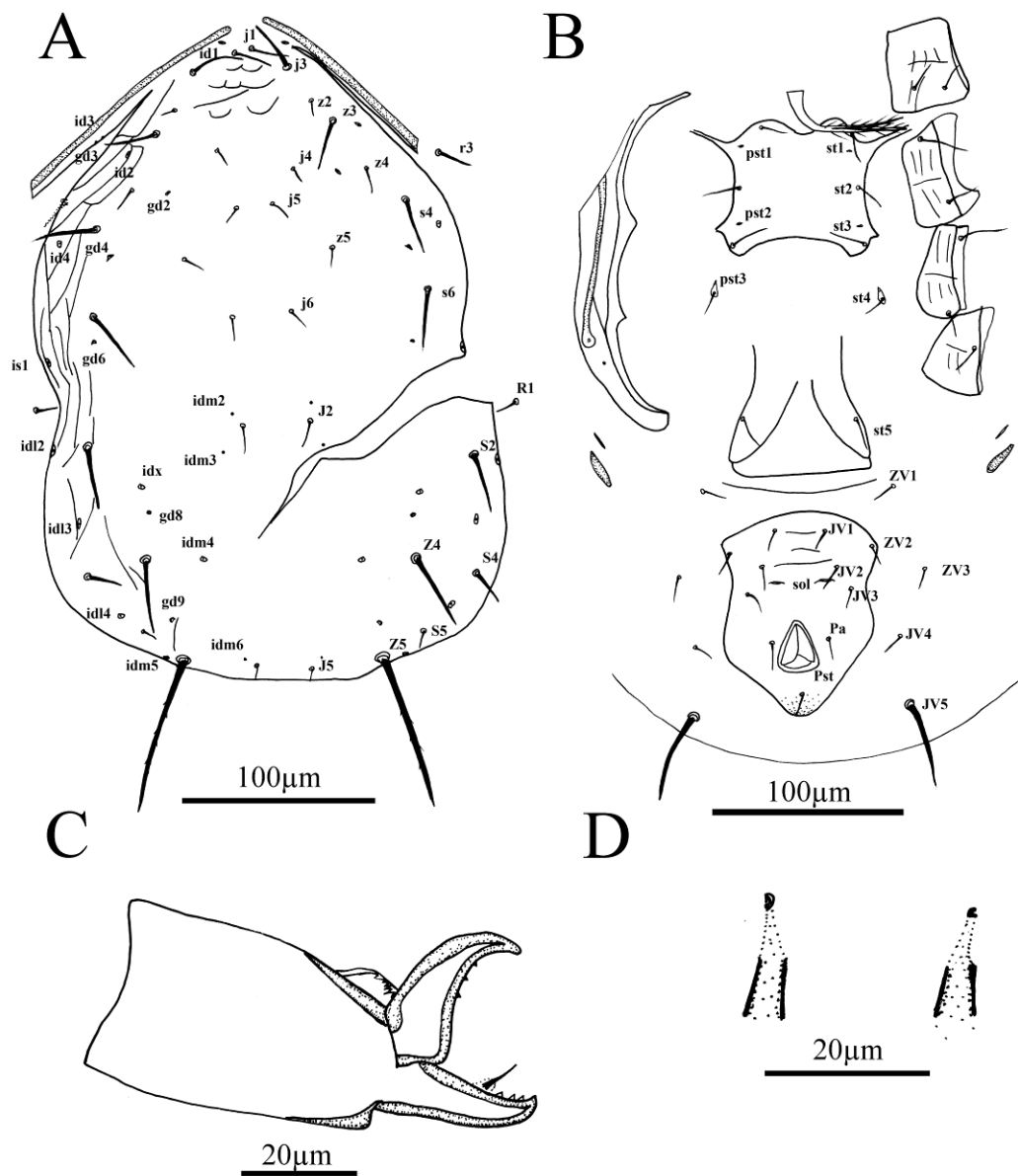


FIGURE 180. *Typhlodromus (Anthoseius) lanyuensis* Tseng, 1975, Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

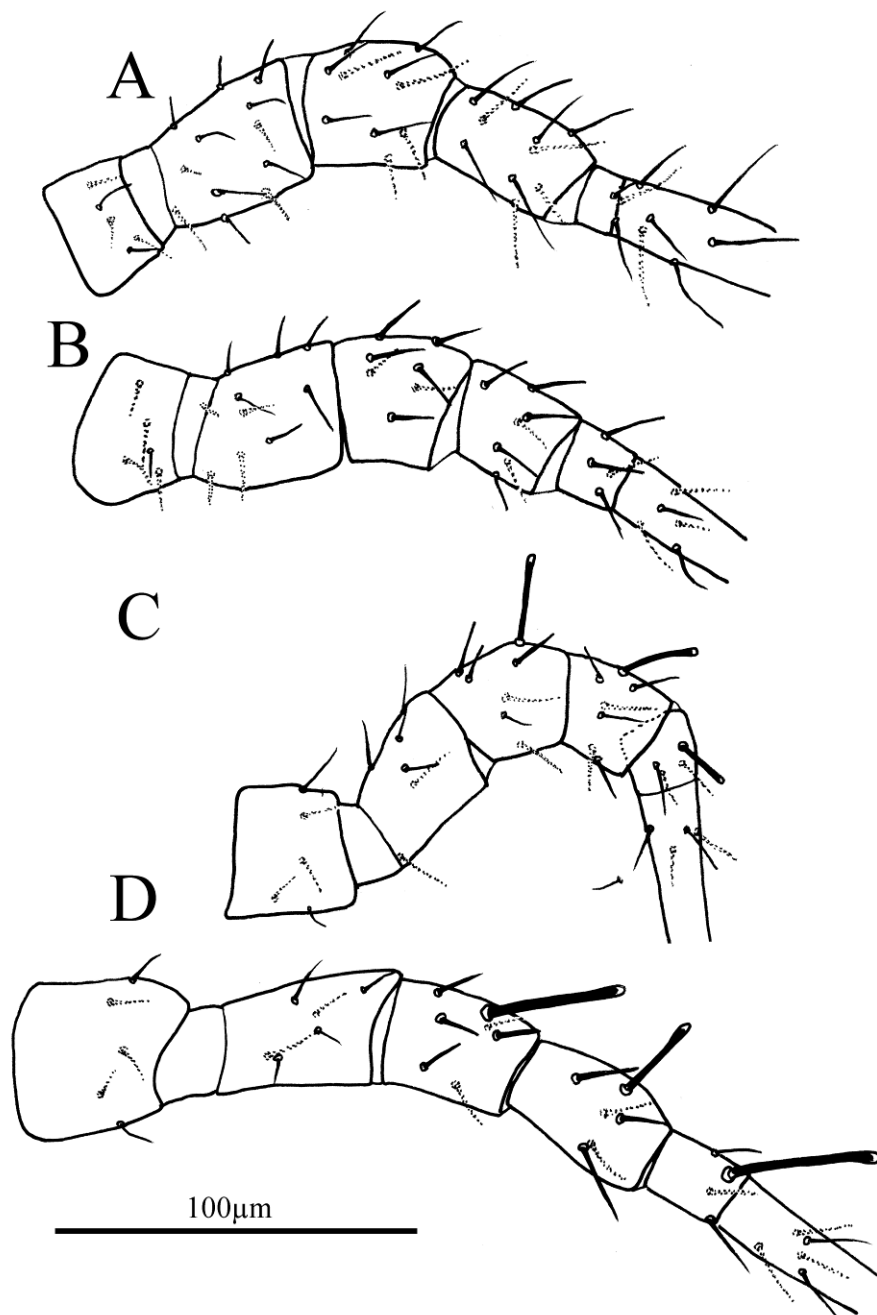


FIGURE 181. *Typhlodromus (Anthoseius) lanyuensis* Tseng, 1975, Female, legs A. leg I dorsal view, B. leg II posterior view, C. leg III posterior view, D. leg IV posterior view.

***Typhlodromus (Anthoseius) neocrassus* Tseng, 1983**

新粗糙盲走蟎



(Figures 182–183)

Typhlodromus (Typhlodromus) neocrassus Tseng, 1983: 67

Typhlodromus (Anthoseius) neocrassus.—Moraes *et al.*, 2004: 339.

Female (n=1)

A lightly sclerotized mite. Idiosomal setal pattern: 12A:8A/JV:ZV.

Dorsum. Dorsal shield nearly oval, constricted at level of *R1*, well sclerotized, strongly reticulated, 356 long (*j1*–*J5* level) and 208 wide at level of *j6*, 221 wide at level of *S4*; four pairs of solenostomes on dorsal shield, (*gd4*, *gd6*, *gd8*, *gd9*), twelve pairs of lyrifissures, (*id1*, *id2*, *id4*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 19, *j3* 20, *j4* 14, *j5* 16, *j6* 16, *J2* 21, *J5* 7, *z2* 15, *z3* 16, *z4* 17, *z5* 17, *Z4* 30, *Z5* 41, *s4* 19, *s6* 23, *S2* 23, *S4* 27, *S5* 26, *r3* 18, *R1* 19. All setae short, thick and serrated, sharp end, except setae *Z4*, *Z5* shovel end.

Peritreme. Peritreme extending beyond *j1* level and curved downward, with one pair of solenostome (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, posterior margin with median projection, much wider than long, 51 long, 88 wide, with two pairs of setae *st1* 18, *st2* 15, and two pairs of lyrifissures (*pst1*, *pst2*), *st3* 12 on membrane. Exopodal shield at coxae I–IV. Metasternal platelets tear-shaped, with one pair of metasternal setae, *st4* 12. Genital shield smooth, posteriorly truncate, with one pair of genital setae *st5* 15, 72 wide at level of genital setae. Distances between *st1*–*st1* 49, *st2*–*st2* 66, *st3*–*st3* 75, *st1*–*st3* 72, *st5*–*st5* 62. Ventrianal shield pentagonal, longer than wide, 128 long, 115 wide at level of *ZV2*, 85 wide at level of anus; with four pairs of pre-anal setae, *JV1* 15, *JV2* 11, *JV3* 11, *ZV2* 11, solenostomes *gv3* small, rounded; *Pa* 8, *Pst* 12 on shield. Setae *JV4* 11, *JV5*

34, ZV1 12, ZV3 8 on interscutal membrane. All setae smooth, JV5 thick, serrated, shovel end. Two pairs of metapodal plates 22 long, 6 wide, 8 long, 2 wide.

Spermatheca. Calyx cup-shaped, 20 long, 20 wide, atrium nodular and directly attached to the calyx, minor and major ducts visible.

Chelicera. Movable digit 32 long, with three teeth; fixed digit 28 long, with five teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/2-1, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* III (ad2) 12, *Sti* III (ad) 15, *St* III (d) 14, *Sge* IV (ad2) 12, *Sti* IV (ad) 14, *St* IV (d) 28. Macrosetae apically shovel-shaped with expanded blade.

Specimens examined. Jiaoxi Township, Yilan County, one female (no. 1107–2) from *Gardenia jasminoides* (Rubiaceae), 27.i.2011, Y. T. Shih (NTU).

Distribution. Asia: Taiwan (Tseng 1983).

Remarks. Tseng (1983) reported this species from guajava (guava, *Psidium guajava*) in Taichung City. This species is characterized by sternal shield with 2 pairs of setae, all setae short, thick, serrated, Z5 with shovel end. Besides, Tseng (1983) provided the illustration of spermatheca is a concentric circle, it cannot be identified the structure of spermatheca. The circumstance is probably causing by slide-making technique, too much medium, so the spermatheca is not lateral view. This study reportes detailed illustration of the spermatheca for the first time.

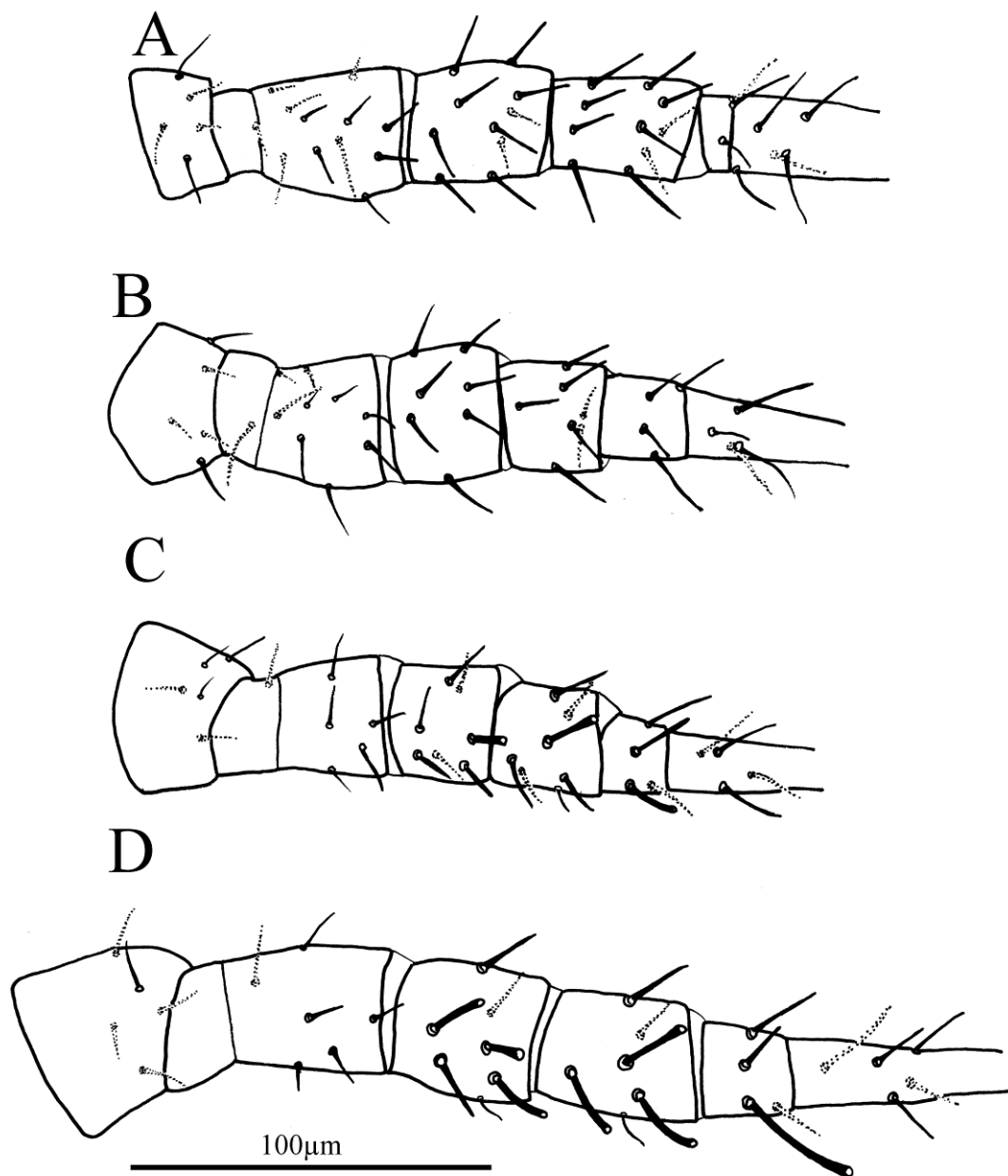


FIGURE 183. *Typhlodromus (Anthoseius) neocrassus* Tseng, 1983, Female, legs A. leg I dorsal view, B. leg II dorsal view, C. leg III anterodorsal view, D. leg IV anterodorsal view.

***Typhlodromus (Anthoseius) obesus* Tseng, 1983**

肥胖盲走蟎



(Figures 184–185)

Typhlodromus (Typhlodromus) obesus Tseng, 1983: 64.

Typhlodromus (Anthoseius) obesus.—Moraes *et al.*, 2004: 340.

Female (n=8)

A lightly sclerotized mite. Idiosomal setal pattern: 12A:8A/JV:ZV.

Dorsum. Dorsal shield nearly oval, slightly constricted at level of *R1*, strongly reticulated; 348 (328–364) long (*j1*–*J5* level) and 181 (171–197) wide at level of *j6*, 181 (162–198) wide at level of *S4*; five pairs of solenostomes on dorsal shield, (*gd2*, *gd4*, *gd6*, *gd8*, *gd9*), 11 pairs of lyrifissures, (*id1*, *id2*, *id4*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *idx*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 19 (15–22), *j3* 15 (14–18), *j4* 11 (9–14), *j5* 11 (9–13), *j6* 13 (9–16), *J2* 13 (11–16), *J5* 9 (7–12), *z2* 14 (12–18), *z3* 14 (12–16), *z4* 15 (13–18), *z5* 11 (8–13), *Z4* 20 (16–23), *Z5* 37 (34–40), *s4* 17 (15–19), *s6* 19 (14–23), *S2* 23 (21–25), *S4* 24 (23–28), *S5* 16 (14–19), *r3* 17 (13–18), *R1* 13 (11–15). Setae *j3*, *j4*, *j5*, *j6*, *J2*, *J5*, *z5* short, smooth, remaining setae thick and serrated, *Z5* shovel-shaped apically with expanded blade.

Peritreme. Peritreme extending to *j1* level; peritremal shield lightly sclerotized, with one pair of solenostomes (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, posterior margin irregular, much wider than long, 54 (50–62) long, 78 (70–86) wide, with two pairs of setae *st1* 21 (18–25), *st2* 19 (17–20), and two pairs of lyrifissures (*pst1*, *pst2*), *st3* 17 (14–18) on membrane. Exopodal shield at coxae II–IV. Metasternal platelets tear-shaped, with one pair of metasternal setae, *st4* 16 (12–21), with one pair of lyrifissures (*pst3*). Genital shield smooth, truncate posteriorly, with one pair of genital setae *st5* 17 (10–21), 64 (58–69) wide at level of

genital setae. Distances between *st1-st1* 47 (45–50), *st2-st2* 56 (53–58), *st3-st3* 67 (63–73), *st1-st3* 69 (66–76), *st5-st5* 54 (46–60). Ventrianal shield pentagonal, smooth, much longer than wide, with slightly waist at *JV2* level, 125 (115–131) long, 92 (79–96) wide at level of *ZV2*, 82 (79–87) wide at level of anus; with four pairs of pre-anal setae, *JV1* 10 (9–11), *JV2* 8 (7–10), *JV3* 8 (7–9), *ZV2* 9 (6–11), solenostomes *gv3* rounded; *Pa* 11 (8–15), *Pst* 13 (9–16) on shield. Setae *JV4* 11 (9–13), *JV5* 35 (31–39), *ZV1* 12 (8–15), *ZV3* 9 8 (7–10) on interscutal membrane. All setae smooth, sharp pointed. Two pairs of metapodal plates 27 (24–29) long, 6 (5–8) wide, 13 (12–14) long, 3 (2–3) wide.

Spermatheca. Calyx bell-shaped, flaring distally, 19 (16–26) long, 14 (12–17) wide, small nodular atrium connected to the calyx, minor and major ducts invisible.

Chelicera. Movable digit 29 (24–32) long, with one tooth; fixed digit 27 (24–28) long, with four teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1/1-1. Macrosetae: *St IV* (d) 24 (22–26). Macrosetae apically shovel-shaped with expanded blade.

Specimens examined. Qiaotou Sugar Factory, Qiaotou Dist., Kaohsiung City (22°45'27.68"N, 120°18'50.8"E, 14m), one female (no. 9–13) from leaves on *Tabebuia chrysantha* (Bignoniaceae), 7.viii.2009, H. T. Fang & Y. H. Chiang (NTU). Lintao Park, Penghu County, five females from *Chloris barbata* (Gramineae), 22.iv.1989, C. C. Ho (NMNS); Liuqiu Isle, Liuqiu Township, Pingtung County, two females from unknown plant, 25.vii.1989, C. C. Ho (TARL); Hsiao Liouciou Island, Liuqiu Township, Pingtung County, one females from *Premna serratifolia* (Verbenaceae), 25.vii.1989, C. C. Ho (NMNS); Hsiao Liouciou Island, Liuqiu Township, Pingtung County, two

females from unknown plant, 25.vii.1989, C. C. Ho (TARL); Guan'ao, Jinsha Township, Kinmen County, one female (TAL091C280) from *Sida rhombifolia* (Malvaceae), 26.x.2002, C. C. Ho (TARL); Guan'ao, Jinsha Township, Kinmen County, one female (TAL091C283) from soil of *Sida rhombifolia* (Malvaceae), 26.x.2002, C. C. Ho (TARL); Sec. 2, Tianxiang St., Zhunan Township, Miaoli County (24°42'418' N, 120°52.218' E, 16m), two females (no. 901–1, 2) from *Bidens pilosa* (Asteraceae), 13.x.2010, J. R. Liao (NMNS, NCHU).

Distribution. Asia: Taiwan (Tseng 1983).

Remarks. Tseng (1983) reported this species has one tooth on movable digit and two teeth on fixed digit; the present study observed one tooth on movable digit but four teeth on fixed digit. Besides, original description reported the chaetotaxy of genu I-IV: 1-2/1-2/2-2, 2-2/0-2/0-1, 1-2/0-2/1-2, 1-2/1-2/1-1). However, we found one seta less in each of genera III, IV and read the chaetotaxy differently. The chaetotaxy of genera I-IV we observed is 2-2/1-2/1-2, 2-2/0-2/0-1, 1-2/1-2/0-1, 1-2/1-2/0-1. Besides, Tseng described the seta Z5 thick and serrated with sharp end; we found the end of Z5 should be in shovel-shape with expanded blade. The circumstance is probably caused by different views of setae.

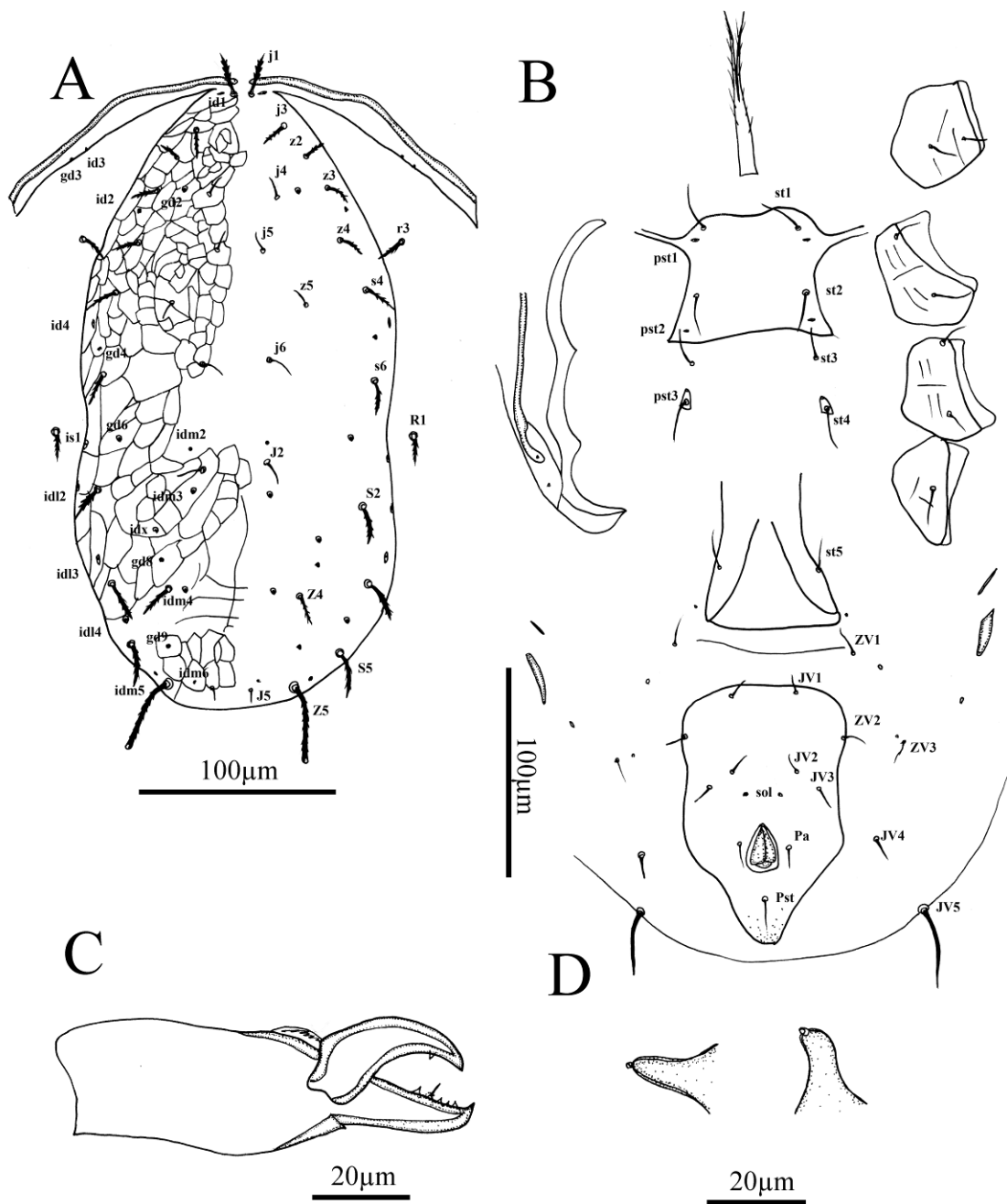


FIGURE 184. *Typhlodromus (Anthoseius) obesus* Tseng, 1983, Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

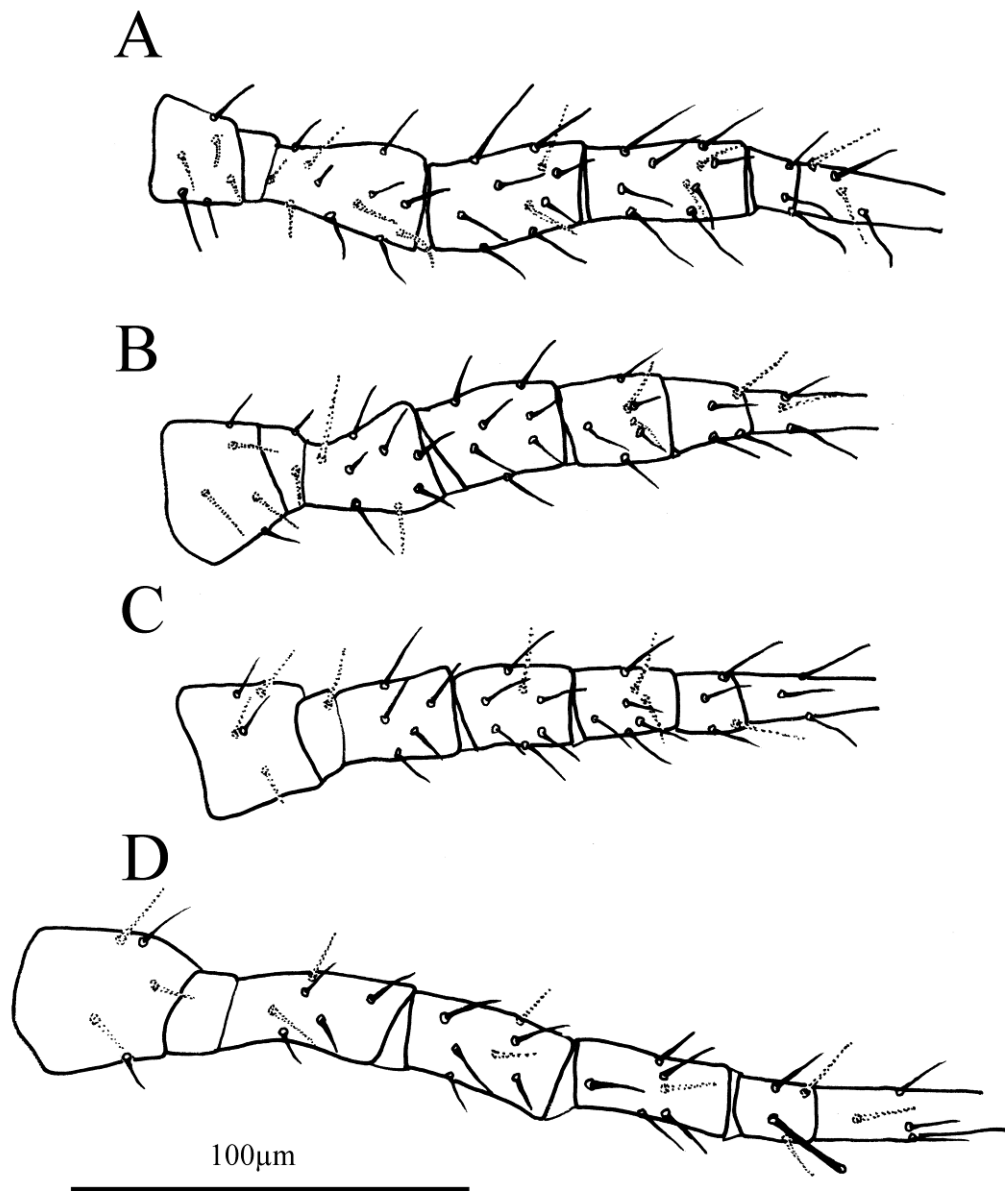


FIGURE 185. *Typhlodromus (Anthoseius) obesus* Tseng, 1983, Female, legs A. leg I anterodorsal view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV posterodorsal view.

***Typhlodromus (Anthoseius) serrulatus* Ehara, 1972**

鋸胸盲走蟎



(Figures 186–189)

Typhlodromus (Anthoseius) serrulatus Ehara, 1972: 142.

Typhlodromus (Typhlodromus) serrulatus—Chang & Tseng, 1978: 342.

Amblydromella serrulata—Moraes *et al.*, 1986: 175.

Amblydromella (Amblydromella) serrulata—Dennmark & Welbourn, 2002: 307.

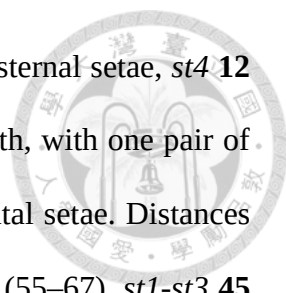
Female (n=10)

A lightly sclerotized mite. Idiosomal setal pattern: 12A:8A/JV:ZV.

Dorsum. Dorsal shield nearly oval, constricted at level of *R1*, strongly reticulated; **294** 301 (287–311) long (*j1–J5* level) and **177** 173 (163–196) wide at level of *j6*, **175** 175 (169–185) wide at level of *S4*; four pairs of solenostomes on dorsal shield, (*gd4*, *gd6*, *gd8*, *gd9*), fourteen pairs of lyrifissures, (*id1*, *id2*, *id4*, *id6*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *idx*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* **15** 13 (10–116), *j3* **12** 16 (14–18), *j4* **10** 12 (9–15), *j5* **12** 12 (9–14), *j6* **17** 14 (11–17), *J2* **16** 16 (13–18), *J5* **4** 8 (4–9), *z2* **12** 12 (10–14), *z3* **12** 14 (12–18), *z4* **13** 15 (10–17), *z5* 14 13 (11–15), *Z4* **20** 23 (20–26), *Z5* **44** 43 (40–45), *s4* **16** 16 (15–19), *s6* **19** 18 (14–23), *S2* **25** 19 (16–25), *S4* **20** 20 (17–24), *S5* **10** 12 (9–13), *r3* **16** 15 (11–17), *R1* **12** 14 (12–15). All setae smooth, sharp end, except seta *Z4* serrated, sharp end, seta *Z5* serrated, shovel-shaped with expanded blade.

Peritreme. Peritreme extending beyond to *j1* level and curved downward; peritremal shield lightly sclerotized, with one pair of solenostomes (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, posterior margin irregular, wider than long, **52** 60 (52–66) long, **75** 74 (67–77) wide, with three pairs of setae *st1* **14** 15 (12–19), *st2* **10** 13 (10–17), *st3* **13** 14 (10–19), and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at



coxae I–IV. Metasternal platelets tear-shaped, with one pair of metasternal setae, *st4* **12** 13 (10–17), with one pair of lyrifissures (*pst3*). Genital shield smooth, with one pair of genital setae *st5* **23** 17 (12–23), **63** 60 (54–63) wide at level of genital setae. Distances between *st1-st1* **55** 45 (41–55), *st2-st2* **66** 55 (50–66), *st3-st3* **67** 62 (55–67), *st1-st3* **45** 55 (45–60), *st5-st5* **56** 52 (49–56). Ventrianal shield pentagonal, with waist at seta *JV3* level, smooth, **99** 97 (92–108) long, **78** 76 (74–80) wide at level of *ZV2*, **66** 70 (66–71) wide at level of anus; with four pairs of pre-anal setae, *JV1* **9** 9 (6–13), *JV2* **9** 9 (7–11), *JV3* **8** 8 (6–9), *ZV2* **5** 8 (5–10), solenostomes *gv3* small, rounded; *Pa* **7** 9 (7–11), *Pst* **10** 9 (8–10) on shield. Setae *JV4* **12** 9 (7–12), *JV5* **22** 26 (22–30), *ZV1* **7** 9 (7–11), *ZV3* **6** 8 (6–9) on interscutal membrane. All setae smooth, sharp pointed, *JV5* shovel-shaped with expanded blade. Two pairs of metapodal plates **18** 20 (17–22) long, **6** 5 (4–6) wide, **10** 8 (6–11) long, **3** 2 (2–3) wide.

Spermatheca. Calyx bell-shaped, **14** 16 (14–18) long, **8** 8 (6–10) wide, with distal half thicker, other membranous, atrium connected to the calyx, minor and major ducts visible.

Chelicera. Movable digit **25** 24 (21–30) long, with three teeth; fixed digit **25** 24 (21–30) long, anterior half with two teeth, posterior half with five teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/2-1, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* IV (ad2) **11** 11 (9–13), *Sti* IV (ad) **13** 13 (11–15), *St* IV (d) **24** 26 (22–30). Macrosetae shovel-shaped with expanded blade.

Male (n=2)

A lightly sclerotized mite. Idiosomal setal pattern: 12A:8A/JV-4:ZV-1,3.

Dorsum. Dorsal shield nearly oval, constricted at level of *R1*, strongly reticulated; 237 (233–242) long (*j1*–*J5* level) and 151 (143–159) wide at level of *j6*, 126 (125–128) wide at level of *S4*, four pairs of solenostomes on dorsal shield, (*gd4*, *gd6*, *gd8*, *gd9*), fourteen pairs of lyrifissures, (*id1*, *id2*, *id4*, *id6*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *idx*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 12 (11–13), *j3* 14 (14–14), *j4* 11 (10–13), *j5* 10 (8–11), *j6* 11 (9–12), *J2* 13 (12–13), *J5* 6 (5–7), *z2* 11 (11–11), *z3* 12 (11–12), *z4* 11 (10–13), *z5* 10 (9–10), *Z4* 19 (18–19), *Z5* 31 (31–32), *s4* 16 (15–16), *s6* 16 (14–17), *S2* 15 (15–16), *S4* 14 (12–19), *S5* 10 (9–11), *r3* 13 (12–13), *R1* 11 (11–11). All setae smooth, sharp end, except seta *Z4* serrated, sharp end, seta *Z5* serrated, shovel-shaped with expanded blade. Setae *r3* and *R1* inserted on dorsal shield.

Peritreme. Peritreme extending to *j1* level; peritremal shield lightly sclerotized.

Venter. Sternogenital shield smooth, lateral slightly reticulated, posterior margin concave, longer than wide, 107 (105–109) long, 62 (56–67) wide at level of *st5*, with five pairs of setae, *st1* 11 (9–13), *st2* 11 (10–13), *st3* 11 (11–11), *st4* 12 (12–12), *st5* 11 (10–11), three pairs of lyrifissures (*pst1*, *pst2*, *pst3*). Distances between *st1*–*st1* 41 (39–43), *st2*–*st2* 49 (48–51), *st3*–*st3* 52 (49–55), *st4*–*st4* 41 (38–44), *st5*–*st5* 32 (32–32), *st1*–*st5* 98 (97–99). Exopodal shield at coxae I–IV. Ventrianal shield subtriangular, slightly reticulated, 94 (93–96) long, 121 (120–122) wide at anterior corner, 58 (57–60) at level of anus, fused with peritremal shield cingulum; with four pairs of pre-anal setae, *JV1* 8 (7–8), *JV2* 7 (7–7), *JV3* 7 (6–9), *ZV2* 11 (9–13), solenostomes *gv3* small, rounded; *Pa* 9 (8–9), *Pst* 9 (8–9) on shield. Setae *JV5* 14 (13–15) on interscutal membrane. All setae smooth, sharp pointed, except *JV5* shovel-shaped with expanded blade.

Chelicera. Movable digit 17 (15–18) long, with two teeth; fixed digit 18 (17–18) long, with four teeth, with *pilus dentilis*. Spermatodactyl L-shaped, shaft 16 (14–18) long, heel rounded, foot 11 (10–12) long, with expanded toe and lateral thorn-like

projection.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/2-1, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* IV (ad2) 10 (8–12), *Sti* IV (ad) 11 (11–11), *St* IV (d) 21 (20–22). Macrosetae shovel-shaped apically with expanded blade.

Specimens examined. JAPAN: Shiroyama, Tokushima City, Shikoku, one holotype female (AC-13091) from *Zelkova serrata* (Ulmaceae), 26.viii.1971, S. Ehara (NSMT); Shiroyama, Tokushima City, Shikoku, two paratype females (ZIHU3559, 3560) from *Zelkova serrata* (Ulmaceae), 26.viii.1971, S. Ehara (HUM); Botanical Garden, Hokkaido University, Sapporo, Hokkaido, one paratype female (ZIHU3561) from *Juglans mandshurica* (Juglandaceae), 7.ix.1967, S. Ehara (HUM).

TAIWAN:

Luye Township, Taitung County, four females (89-Ty-0012, 13, 14, 16) from *Hibiscus* sp. (Malvaceae), 20.ii.1989, Y. J. Wang (TARL); National Chung Hsing University, South Dist., Taichung City, one female from *Gardenia jasminoides* (Rubiaceae), 29.v.1997, C. C. Ho (TARL); National Chung Hsing University, South Dist., Taichung City, two females from *Gardenia jasminoides* (Rubiaceae) associated with *Chrysomphalus aonidum*, 22.viii.1997, C. C. Ho (TARL); Wanfeng Village, Wufeng Dist., Taichung City, one female two males (HAL099B696, 706, 712) from *Acacia confusa* (Fabaceae), 8.viii.2010, C. C. Ho (TARL); Zhanggong N. Lane, Wufeng Dist., Taichung City, nine females one male from *Acacia confusa* (Fabaceae), 14.v.2012, C. C. Ho (TARL); Zhanggong N. Lane, Wufeng Dist., Taichung City, two females two males from leaf of *Acacia confusa* (Fabaceae), 30.v.2012, C. C. Ho (TARL); Nanhua Dist., Tainan City (23°01'27.8" N, 120°27'54" E, 123m), one female one male (HAL101B212)

from *Cinnamomum camphora* (Lauraceae), 24.vii.2012 (TARL); Guanziling, Baihe Dist., Tainan County (23°19.330'N, 120°28.993' E, 451m), one female (no. 1841–1) from unknown plant, 10.viii.2016, J. R. Liao (NTU); Guanziling, Baihe Dist., Tainan County (23°20.336'N, 120°30.443' E, 358m), three females one male (no. 1843–1, 6, 8, 9) from *Mangifera indica* (Anacardiaceae), 10.viii.2016, J. R. Liao (NTU).

Distribution. Asia: China (Fujian (Wu 1981), Wuling Mountain Region (Wu & Lan 1992a)), Japan (Ehara 1972), South Korea (Ryu & Lee 1992), Taiwan (present study), Thailand (Ehara & Bhandhufalck 1977).

Remarks. Ehara (1972) described this species from *Zelkova serrata* (Ulmaceae) in Japan. Chang & Tseng (1978) reported this species in Taiwan, but they provided some differences (e.g. dorsal shield slightly reticulated, seta S5 shorter) based on three Taiwanese specimens. Tseng (1983) considered these specimens should be another species, called *T. (T.) pseudoserrulatus*. However, these two characters are probably misidentified, because of slide-making technique or other reasons. Besides, these specimens were lost after Tseng retired (Liao *et al.* 2017a), and also during the survey of Taiwanese phytoseiid mites, specimens of this species were found, no differences between our specimens and holotype specimens. Therefore, this study proposed the existence of this species in Taiwan, and also considered the species *T. (T.) pseudoserrulatus* is probably junior synonym of present species.

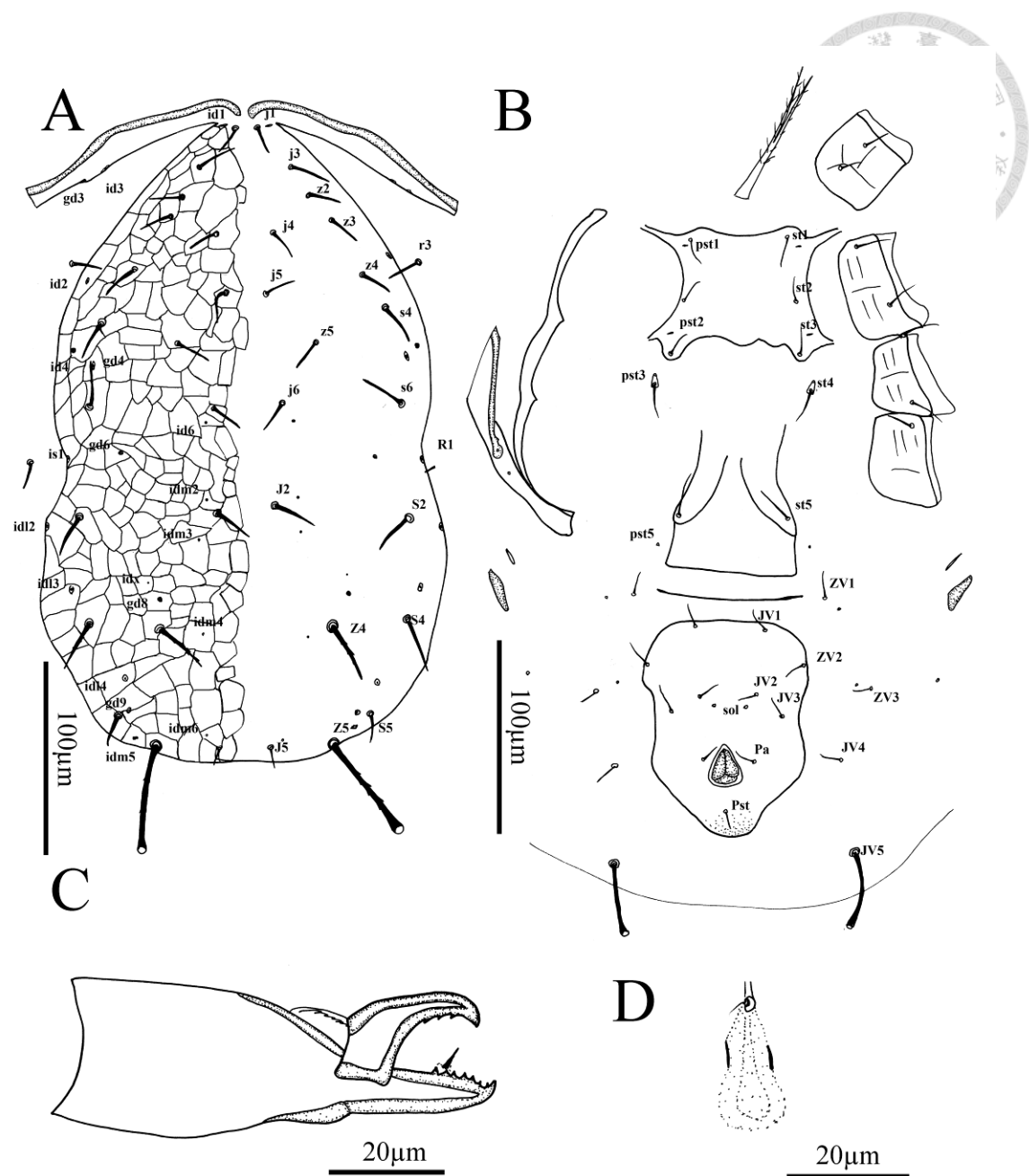


FIGURE 186. *Typhlodromus (Anthoseius) serrulatus* Ehara, 1972, Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

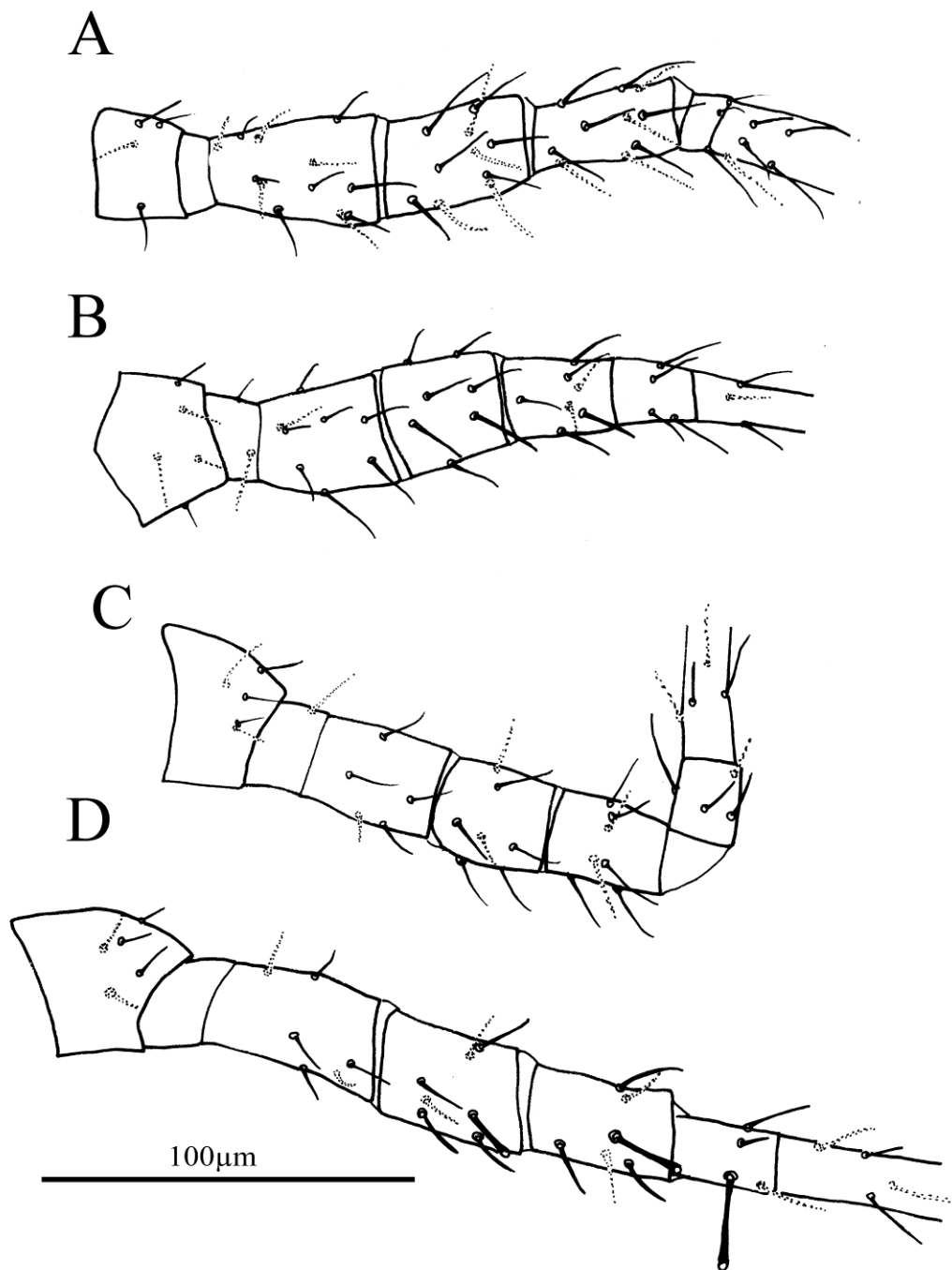


FIGURE 187. *Typhlodromus (Anthoseius) serrulatus* Ehara, 1972, Female, legs A. leg I anteriodorsal view, B. leg II dorsal view, C. leg III anterior view, D. leg IV anterior view.

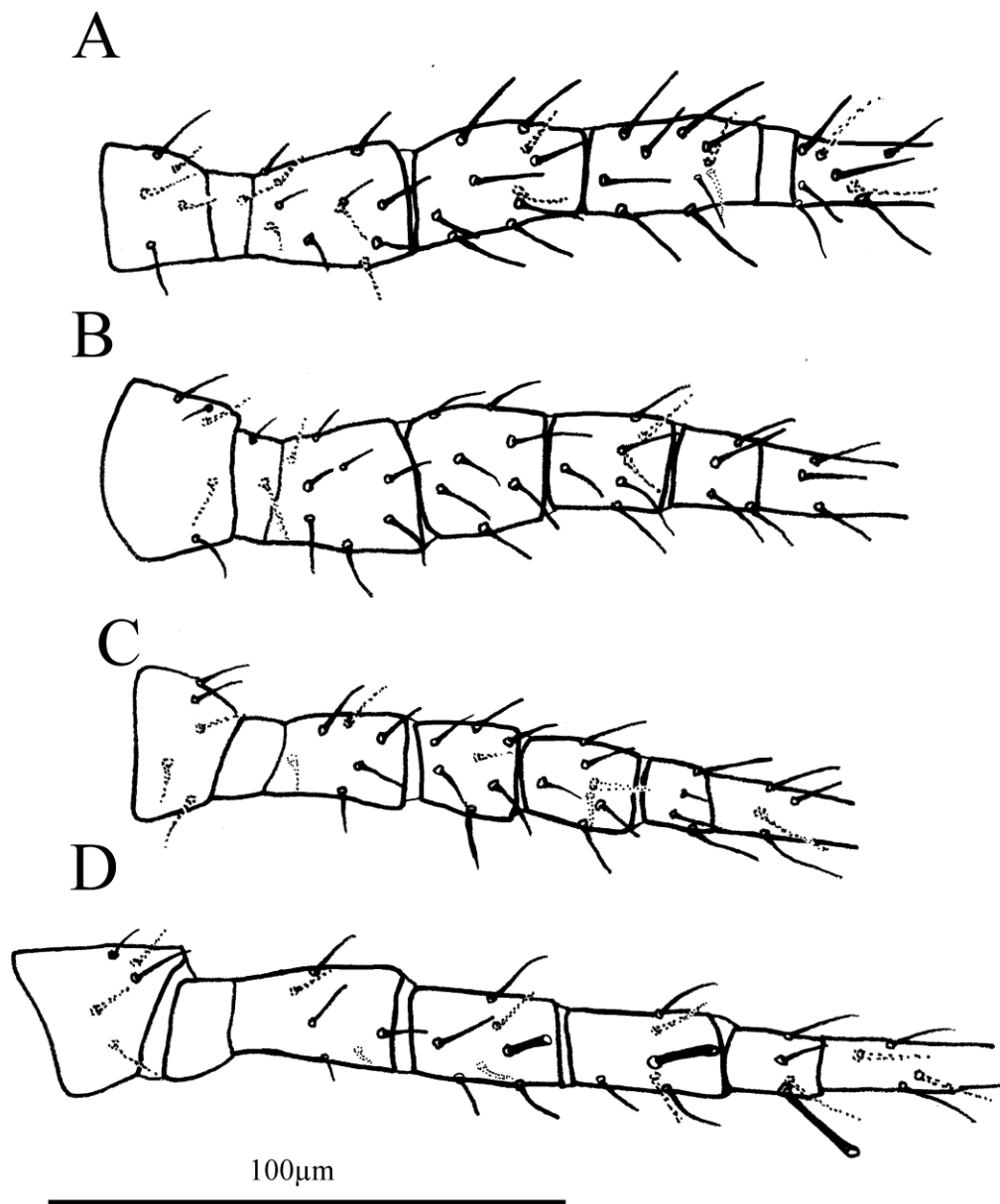


FIGURE 189. *Typhlodromus (Anthoseius) serrulatus* Ehara, 1972, Male, legs A. leg I dorsal view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV anterior view.

Typhlodromus (Anthoseius) ryukyuensis Ehara, 1967

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(Figures 190–191)

Typhlodromus (Anthoseius) ryukyuensis Ehara, 1967a: 69.

Typhlodromus (Typhlodromus) ryukyuensis.—Tseng, 1975: 54.

Amblydromella ryukyuensis.—Moraes *et al.*, 1986: 174.

Amblydromella (Aphanoseia) ryukyuensis.—Denmark & Welbourn, 2002: 308.

Female (n=10)

A lightly sclerotized mite. Idiosomal setal pattern: 12A:8A/JV:ZV.

Dorsum. Dorsal shield nearly oval, constricted at level of *R1*, strongly reticulated; **271** 304 (271–325) long (*j1*–*J5* level) and **179** 196 (179–214) wide at level of *j6*, **195** 190 (165–215) wide at level of *S4*; six pairs of solenostomes on dorsal shield, (*gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), fourteen pairs of lyrifissures, (*id1*, *id2*, *id4*, *id6*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *idx*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* **8** 10 (8–13), *j3* **13** 11 (10–13), *j4* **7** 7 (5–9), *j5* **6** 7 (5–11), *j6* **10** 10 (7–12), *J2* **11** 10 (7–12), *J5* **6** 6 (5–8), *z2* **10** 9 (5–13), *z3* **8** 8 (5–11), *z4* **11** 9 (6–13), *z5* **10** 9 (5–11), *Z4* **18** 16 (14–20), *Z5* **38** 43 (33–49), *s4* **9** 12 (9–17), *s6* **10** 12 (9–14), *S2* **12** 12 (8–16), *S4* **10** 13 (10–15), *S5* **8** 10 (8–13), *r3* 8 11 (8–13), *R1* **8** 9 (8–11). All setae short and thick, sharp end, seta *Z5* shovel end, serrated.

Peritreme. Peritreme extending to *j1* level; peritremal shield lightly sclerotized, with one pair of solenostomes (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, posterior margin straight, much wider than long, **48** 43 (36–52) long, **61** 64 (57–70) wide, with two pairs of setae *st1* **11** 10 (8–12), *st2* **7** 9 (7–13) and two pairs of lyrifissures (*pst1*, *pst2*), *st3* **7** 8 (7–10) on membrane. Exopodal shield at coxae I–IV. Metasternal platelets tear-shaped, with one pair of metasternal

setae, *st4* 7 8 (7–8), with one pair of lyrifissures (*pst3*). Genital shield smooth, with one pair of genital setae *st5* 11 9 (7–13), 55 58 (53–64) wide at level of genital setae. Distances between *st1-st1* 37 40 (36–43), *st2-st2* 43 51 (43–57), *st3-st3* 46 54 (46–58), *st1-st3* 48 52 (48–57), *st5-st5* 48 52 (46–57). Ventrianal shield pentagonal, smooth, 96 96 (94–99) long, 81 78 (70–99) wide at level of ZV2, 77 71 (60–78) wide at level of anus; with four pairs of pre-anal setae, *JV1* ? 7 (5–9), *JV2* ? 7 (5–1), *JV3* ? 8 (5–10), ZV2 8 8 (6–10), solenostomes *gv3* crescentic; *Pa* ? 8 (7–10), *Pst* ? 10 (6–13) on shield. Setae *JV4* ? 7 (4–10), *JV5* ? 16 (13–18), *ZV1* 7 8 (6–13), *ZV3* ? 7 (4–9) on interscutal membrane. All setae smooth, sharp pointed. Two pairs of metapodal plates 23 24 (15–35) long, 4 4 (3–5) wide, 7 7 (6–9) long, 1 2 (1–3) wide.

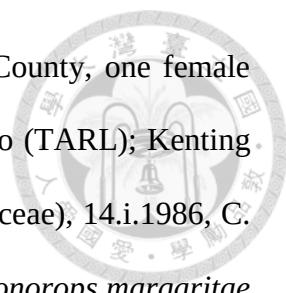
Spermatheca. Calyx cup-shaped, 17 16 (14–19) long, 7 8 (7–10) wide, with apical half thick, other membrane, atrium connected to the calyx with a neck, minor and major ducts visible.

Chelicera. Movable digit ? 18 (17–22) long, with three teeth; fixed digit ? 19 (18–20) long, anterior half with three teeth, with *pilus dentilis*.

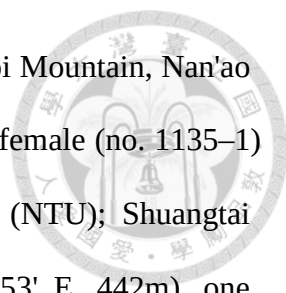
Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* III (ad2) ? 12 (11–13), *Sge* IV (ad2) ? 15 (13–18), *Sti* IV (ad) ? 14 (11–16), *St* IV (d) ? 18 (16–21). Macrosetae apically shovel-shaped.

Specimens examined. JAPAN: Nakijin, Okinawa Pref., one holotype female (ZIHU-3432) one allotype male (ZIHU3432-1) two paratype (ZIHU3432-2, 3) females from *Citrus* sp. (Rutaceae), 25.iv.1966, S. Ehara, K. Tsudome & S. Higashihirati (HUM).

TAIWAN: Kenting, Pingtung County, one female (87-0489) from *Michelia x alba*



(Magnoliaceae), 14.i.1986, C. C. Ho (TARL); Kenting, Pingtung County, one female (87-0495) from *Lupinus polyphyllus* (Fabaceae), 14.i.1986, C. C. Ho (TARL); Kenting park, Pingtung County, one female from *Alocasia macrorrhiza* (Araceae), 14.i.1986, C. C. Ho (TARL); Yangmingshan, Taipei City, one female from *Daemonorops margaritae* (Calameae), 21.vi.1986, C. C. Ho (TARL); Yangmingshan, Taipei City, one female from *Petunia x hybrida* (Solanaceae), 21.vi.1986, C. C. Ho (TARL); Shitou Mountain, Xindian Dist., New Taipei City (24°57.671' N, 121°32.481' E, 55m), one female (no. 474–2) from unknown plant, 17.iv.2010, J. R. Liao (NTU); Shitou Mountain, Xindian Dist., New Taipei City (24°57.568' N, 121°32.564' E, 141m), one female (no. 479–1) from *Prunus campanulata* (Rosaceae), 17.iv.2010, J. R. Liao (NTU); Qingshi Road, Wufeng Township, Hsinchu County (24°33.437' N, 121°07.296' E, 1157m), four females (no. 522–1, 3, 4, 5) from *Morus* sp. (Moraceae), 3.v.2010, J. R. Liao & Y. H. Chiang (NTU); Taigang Road, Jianshi Township, Hsinchu County (24°36.575' N, 121°17.199' E, 1114m), five females (no. 549–2, 3, 4, 5, 6) from *Morus* sp. (Moraceae), 17.v.2010, J. R. Liao & Y. H. Chiang (NTU); Baling Road, Fuxing Dist., Taoyuan City (24°40.515' N, 121°24.001' E, 850m), one female (no. 823–1) from *Morus* sp. (Moraceae), 28.viii.2010, J. R. Liao, C. T. Chen & J. F. Hsieh (NTU); Baling Road, Fuxing Dist., Taoyuan City (24°40.515' N, 121°24.001' E, 850m), one female (no. 824–3) from *Cyclobalanopsis glauca* (Fagaceae), 28.viii.2010, J. R. Liao, C. T. Chen & J. F. Hsieh (NTU); Baling Road, Fuxing Dist., Taoyuan City (24°40.515' N, 121°24.001' E, 850m), one female (no. 825–1) from unknown plant, 28.viii.2010, J. R. Liao, C. T. Chen & J. F. Hsieh (NTU); Yulao, Jianshi Township, Hsinchu County (24°40.117' N, 121°16.745' E, 1322m), one female (no. 1007–1) from *Machilus zuihoensis* (Lauraceae), 11.xii.2010, J. R. Liao (NTU); Shangde, Donghe Township, Taitung County (22°57.629' N, 121°14.138' E, 262m), two females (no. 1096–1, 2)



from unknown plant, 25.i.2011, J. R. Liao & J. F. Hsieh (NTU); Lupi Mountain, Nan'ao Township, Yilan County (24°27.950' N, 121°45.317' E, 165m), one female (no. 1135–1) from *Macaranga tanarius* (Euphorbiaceae), 9.ii.2011, J. R. Liao (NTU); Shuangtai Road, Shuangxi Dist., New Taipei City (24°59.925' N, 121°50.753' E, 442m), one female (no. 1168–1) from *Trema orientalis* (Cannabaceae), 28.ii.2011, J. R. Liao (NTU); Hongtong, Lanyu Township, Taitung County (22°00.791' N, 121°34.034' E, 24m), one female (no. 1205–4) from *Digitaria sanguinalis* (Poaceae), 6.iv.2011, Y. J. Lu (NTU); Jiashian Dist., Kaohsiung City (23°04.377' N, 120°37.327' E, 562m), one female (no. 1316–2) from *Morus* sp. (Moraceae), 25.iv.2011, J. R. Liao (NTU); Lanyu Township, Taitung County (22°02.040' N, 121°33.445' E, 191m), three females (no. 1324–6, 7, 8) from *Morus* sp. (Moraceae), 2.vi.2014, J. F. Hsieh (NTU); Jiantai Roda, Ren'ai Township, Nantou County (23°57.602' N, 121°07.631' E, 1109m), one female (no. 1439–3) from unknown plant, 27.i.2015, J. R. Liao (NTU); Paomagudao, Jiaoxi Township, Yilan County (24°49.656' N, 121°45.928' E, 58m), one female (no. 1549–2) from *Acacia confusa* (Fabaceae), 17.vii.2015, J. R. Liao (NTU).

Distribution. Asia: China (Fujian (Wu, 1981)), Japan (Ehara, 1967b), Taiwan (Ehara, 1970)

Remarks. Ehara (1967b) described this species from *Citrus* sp. in Okinawa. The teeth numbers of both sexes were not recorded in the original description. The present study examined the holotype and allotype specimens, and the chelicerae cannot examine due to position. Besides, Ehara (1967b) described the male spermatodactyl, but the shape did not match with allotype specimen when examining. During the survey, the present study found several male specimens, but all of them in poor condition, spermatodactyl cannot examine. The male of this species need further study in future.

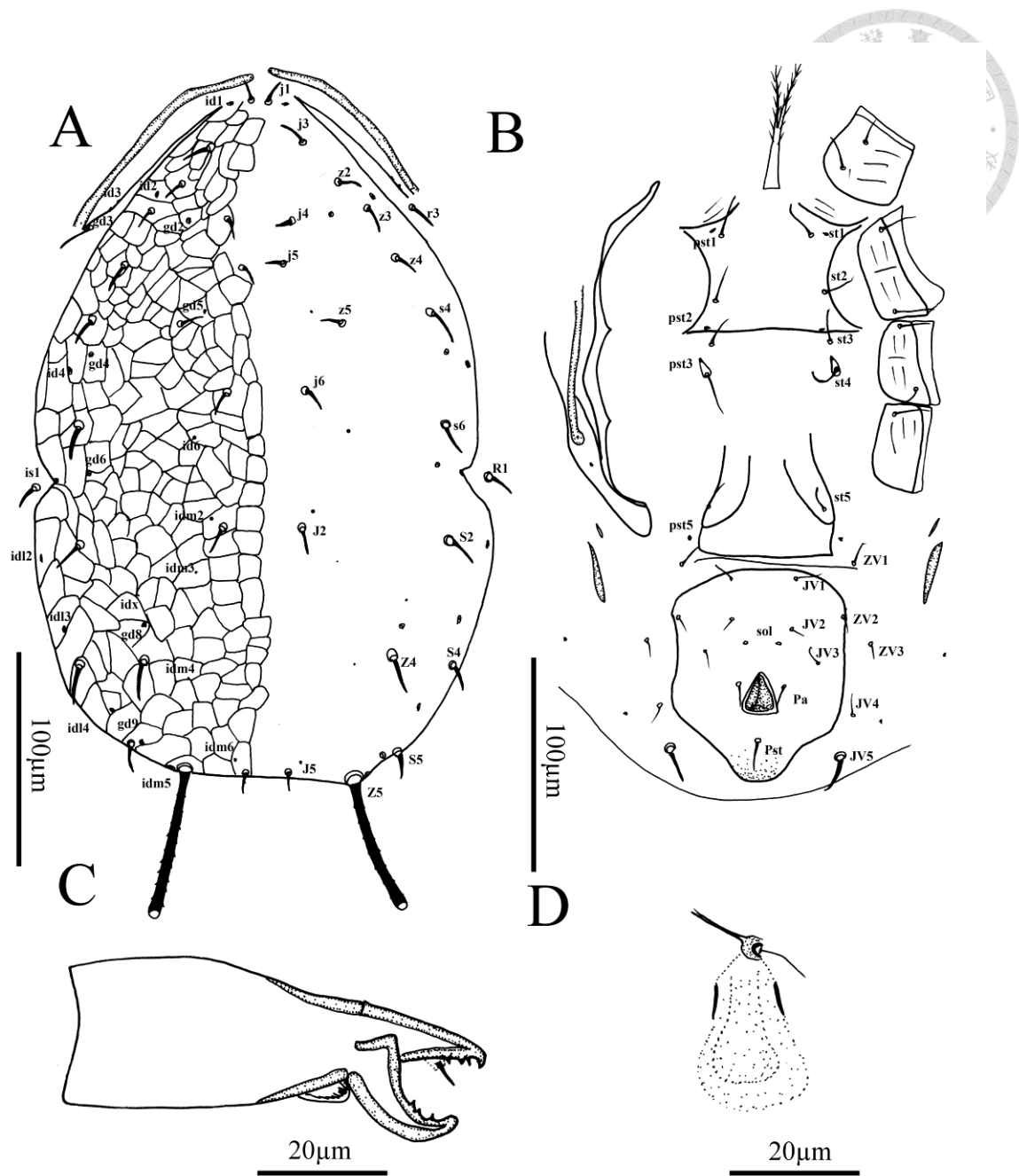


FIGURE 190. *Typhlodromus (Anthoseius) ryukyuensis* Ehara, 1967, Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

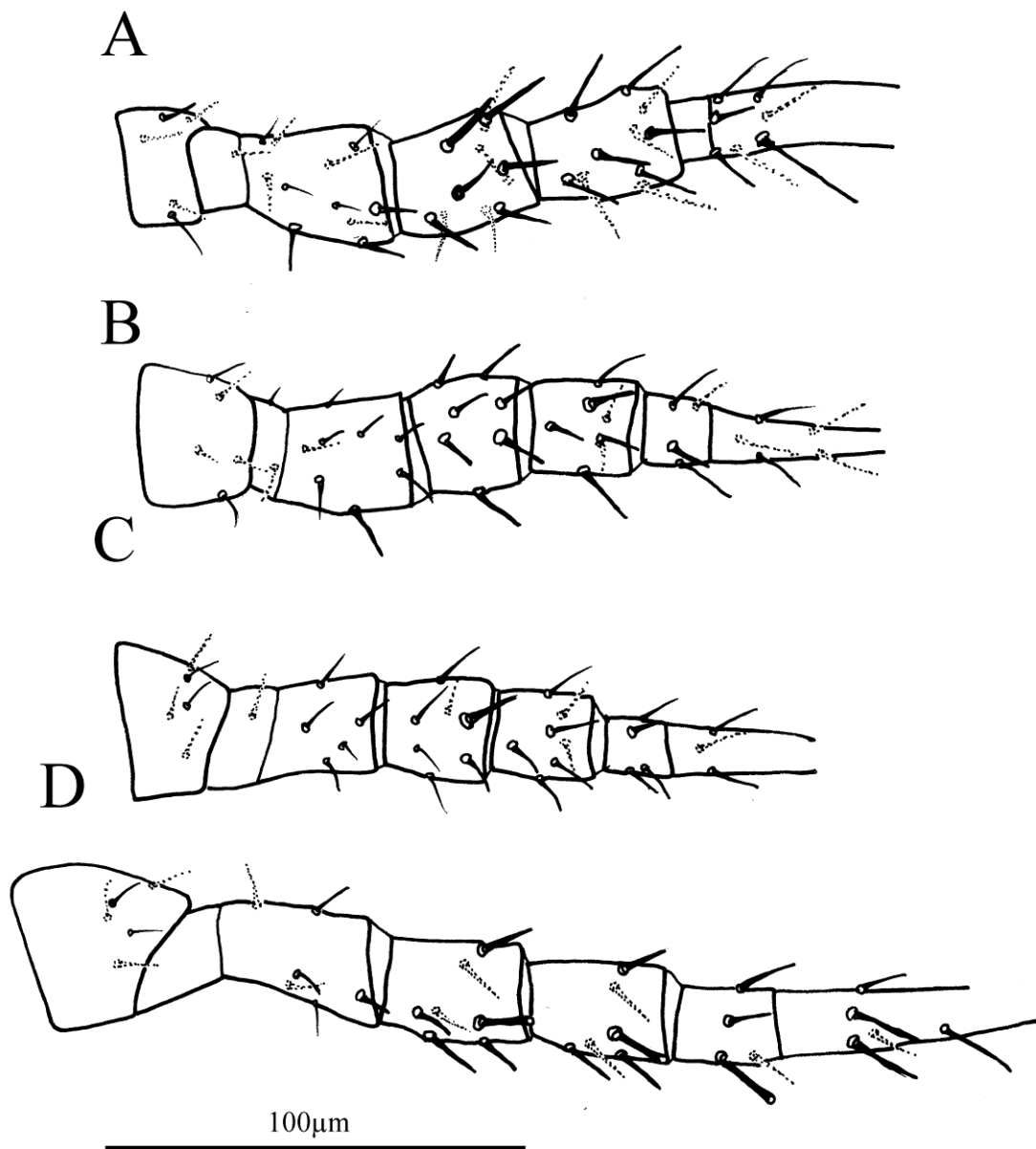


FIGURE 191. *Typhlodromus (Anthoseius) ryukyuensis* Ehara, 1967, Female, legs A. leg I anterior view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV anterior view.

***Typhlodromus (Anthoseius) transvaalensis* (Nesbitt, 1951)**

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(Figures 192–193)

Kampimodromus transvaalensis Nesbitt, 1951: 55.

Typhlodromus (Typhlodromus) transvaalensis.—Chant, 1959b: 60.

Neoseiulus transvaalensis.—Muma, 1961: 295.

Typhlodromus transvaalensis.—Hirschmann, 1962: 4.

Typhlodromus (Neoseiulus) transvaalensis.—Pritchard & Baker, 1962: 222.

Mumaseius transvaalensis.—Abbasova, 1970b: 1410.

Anthoseius (Anthoseius) transvaalensis.—Wainstein & Vartapetov, 1973a: 104.

Anthoseius transvaalensis.—Beglyarov, 1981: 21.

Anthoseius (Clavidromus) transvaalensis.—Kolodochka, 2006: 145.

Typhlodromus (Antoseius) [sic] transvalensis [sic].—Muñoz & Berrío, 2014: 218.

Typhlodromus (Anthoseius) jackmickleyi De Leon, 1958: 75.—(Synonymy according to Muma & Denmark 1968)

Typhlodromus (Anthoseius) pectinatus Athias-Henriot, 1958a: 179 (Synonymy according to Muma & Denmark 1968)

Female (n=4)

A lightly sclerotized mite. Idiosomal setal pattern: 12A:8A/JV-3:ZV.

Dorsum. Dorsal shield nearly oval, constricted at level of *R1*, strongly reticulated; 385 (378–395) long (*j1*–*J5* level) and 222 (212–228) wide at level of *j6*, 221 (199–237) wide at level of *S4*; five pairs of solenostomes on dorsal shield, (*gd2*, *gd4*, *gd6*, *gd8*, *gd9*), sixteen pairs of lyrifissures, (*id1*, *id1a*, *id2*, *id4*, *id6*, *idm1*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *idx*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 31 (30–33), *j3* 35 (33–38), *j4* 26 (24–27), *j5* 28 (22–32), *j6* 34 (33–35), *J2* 40 (39–42), *J5* 8 (8–9), *z2* 22 (21–24), *z3* 34

(30–36), *z4* 38 (37–39), *z5* 23 (21–26), *Z4* 52 (44–58), *Z5* 59 (56–64), *s4* 43 (40–48), *s6* 46 (43–51), *S2* 52 (50–56), *S4* 50 (41–56), *S5* 12 (9–13), *r3* 33 (31–34), *R1* 31 (27–35).

All setae serrated except setae *J5*, *S5*, setae *j1*, *j4*, *j5*, *J5*, *z5* with sharp pointed, other setae end with shovel-shaped apically.

Peritreme. Peritreme extending to *z4* level; peritremal shield lightly sclerotized, reticulated, with one pair of solenostomes (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, posterior margin with median projection, 95 (81–104) long, 88 (80–101) wide, with two pairs of setae *st1* 30 (27–35), *st2* 27 (23–31) and two pairs of lyrifissures (*pst1*, *pst2*), *st3* 26 (20–29) on membrane. Exopodal shield at coxae I–IV. Metasternal platelets tear-shaped, with one pair of metasternal setae, *st4* 23 (22–24), with one pair of lyrifissures (*pst3*). Genital shield smooth, with one pair of genital setae *st5* 23 17 (12–23), 85 (82–91) wide at level of genital setae. Distances between *st1-st1* 58 (57–60), *st2-st2* 65 (64–67), *st3-st3* 82 (80–86), *st1-st3* 76 (70–81), *st5-st5* 80 (78–81). Ventrianal shield much longer than wide, with waist, slightly reticulated, 126 (123–127) long, 82 (78–84) wide at level of *ZV2*, 79 (76–81) wide at level of anus; with four pairs of pre-anal setae, *JV1* 16 (13–18), *JV2* 21 (16–24), *ZV2* 20 (18–23), solenostomes *gv3* crescentic; *Pa* 14 (11–16), *Pst* 9 10 (8–12) on shield. Setae *JV4* 14 (7–18), *JV5* 57 (51–61), *ZV1* 25 (23–29), *ZV3* 15 (12–19) on interscutal membrane. All setae smooth, sharp pointed, *JV5* serrated, shovel-shaped. Two pairs of metapodal plates 34 (33–37) long, 3 (2–4) wide, 10 (8–13) long, 3 (2–3) wide.

Spermatheca. Calyx elongated, funnel-shaped, 33 (27–39) long, 11 (7–14) wide, with apical half thick, other membrane, atrium connected to the calyx without neck, minor and major ducts visible.

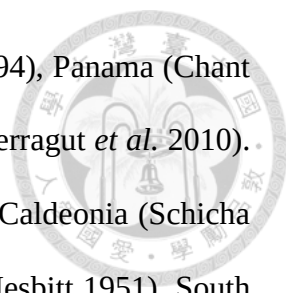
Chelicera. Movable digit 30 (29–32) long, with one tooth; fixed digit 27 (24–31) long, anterior half with two teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/2-1, 2-2/2-2/1-2, 2-2/2-2/1-1, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* IV (ad2) 26 (23–30), *Sti* IV (ad) 18 (15–21), *St* IV (d) 45 (43–49). Macrosetae apically shovel-shaped.

Specimens examined. PHILIPPINES: UPLB campus, Laguna Province, Luzon, one female from *Sandoricum koetjape* (Meliaceae), x.1998, L. A. Corpuz-Raros (UPLB-MNH); Pintor, Gamu City, Isabela Province, Luzon, one female (LACR 5670) from house dust sample from bedroom, 19.x.2007, L. A. Corpuz-Raros (UPLB-MNH); Polillo Island, Sibulan watershed, one female (22, 23, 27) from litter from old growth forest, 4.vi.2008, ILLit Jr (UPLB-MNH); Samal Island, Davao del Norte, one female (LACR 5741) from litter, 17.v.2009, W. Sm. Gruezo (UPLB-MNH).

TAIWAN: TARI, Wufeng Dist., Taichung City, one female from laboratory rear colony of *Phytoseiulus persimilis* by acarid mites, 22.xi.1989, C. C. Ho (TARL); Songpu, Yuli Township, Hualien County, one female (TAL092F062) from Chicken, 4.xi.2003, C. C. Ho (TARL); Shangyi, Jinhu Township, Kinmen County, one female (TAL094M022) from *Allium scorodoprasum* (Alliaceae), 4.vii.2005, C. C. Ho (TARL); Lantan, East Dist., Chiayi City, one female (TAL094B423) from soil of *Acacia* sp. (Fabaceae), 25.viii.2005, S. F. Lin (TARL).

Distribution. Africa: Azerbaijan (Abbasova 1970), Cameroon (Moraes *et al.* 1989a), Cape Verde (Ueckermann 1992), Egypt (Zaher 1986), Kenya (Ueckermann *et al.* 2008), Reunion Island (Quilici *et al.* 2000), South Africa (Nesbitt 1951). Asia: Iran (Hajizadeh & Mortazavi 2015), Israel (Amitai & Swirski 1978), Japan (Ehara & Kishimoto 2007), Jordan (Amitai & Swirski 1978), Philippines (Schicha & Corpuz-Raros 1992), Singapore (Corpuz-Raros 1995b), Taiwan (Tseng 1983). Central



America: Costa Rica (Denmark *et al.* 1999), Cuba (Cuervo *et al.* 1994), Panama (Chant 1959b). Europe: Georgia (Wainstein & Vartapetov 1973a), Spain (Ferragut *et al.* 2010). Oceania: Australia (Schicha 1987), Hawaii (Wainstein 1983), New Caldeonia (Schicha 1981a). North America: Mexico (Denmark & Evans 2011), USA (Nesbitt 1951). South America: Argentina (Cédola & Castresana 2014), Brazil (Denmark & Muma 1973), Colombia (Moraes & Mesa 1988), Peru (Guanilo *et al.* 2008b).

Remarks. Nesbitt (1951) described this species from peanut in South Africa, and the paratype from rat. The habitat of paratype was considered as accidental habitat. The present study found several habitats, including plants, house dust, litter, laboratory rear of *Phytoseiulus persimilis* by acarid mites. Nesbitt (1951) reported this species has one tooth on movable digit, one tooth on fixed digit; the present study found one tooth on movable digit, two teeth on fixed digit.

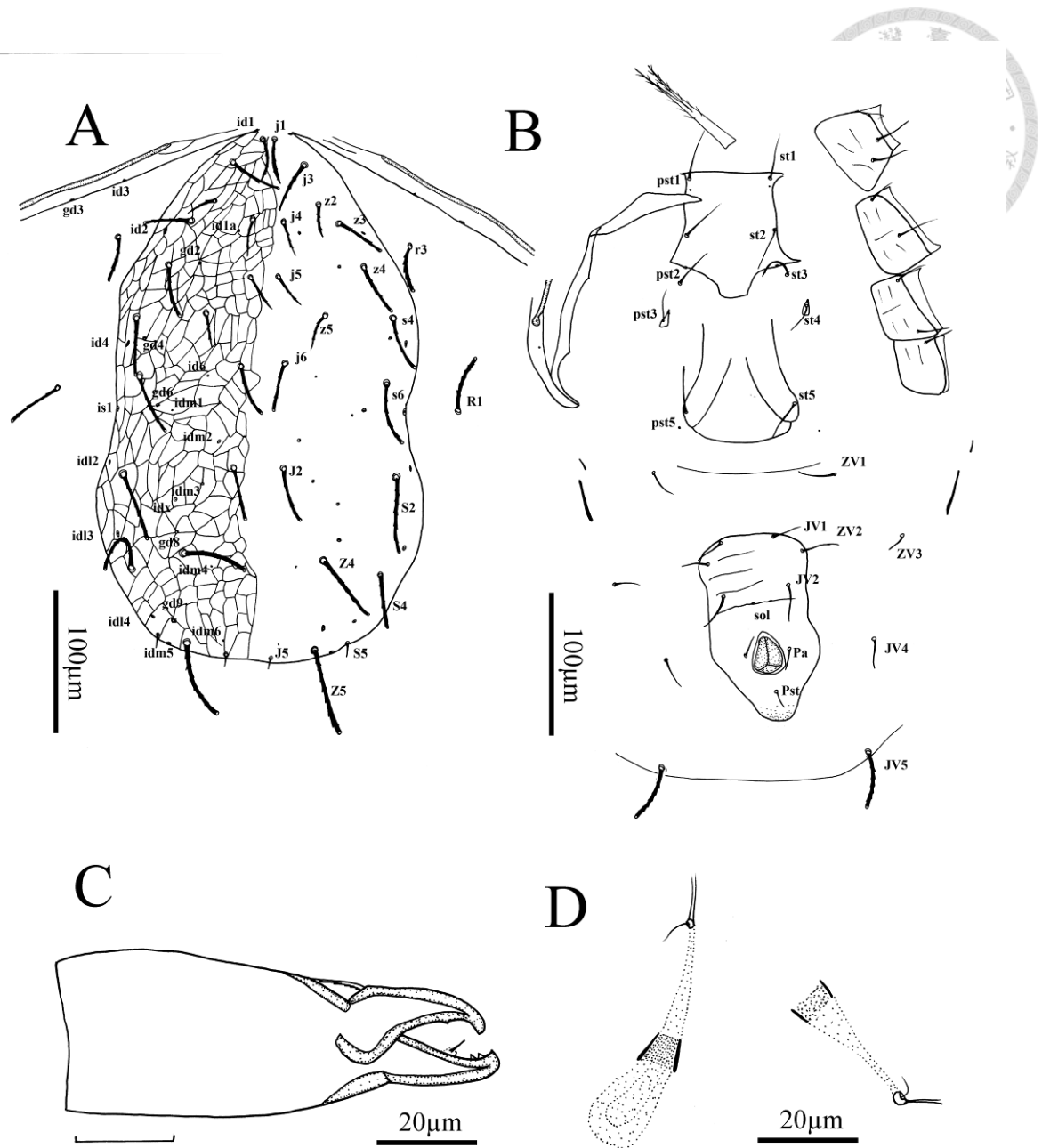


FIGURE 192. *Typhlodromus (Anthoseius) transvaalensis* (Nesbitt, 1951), Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

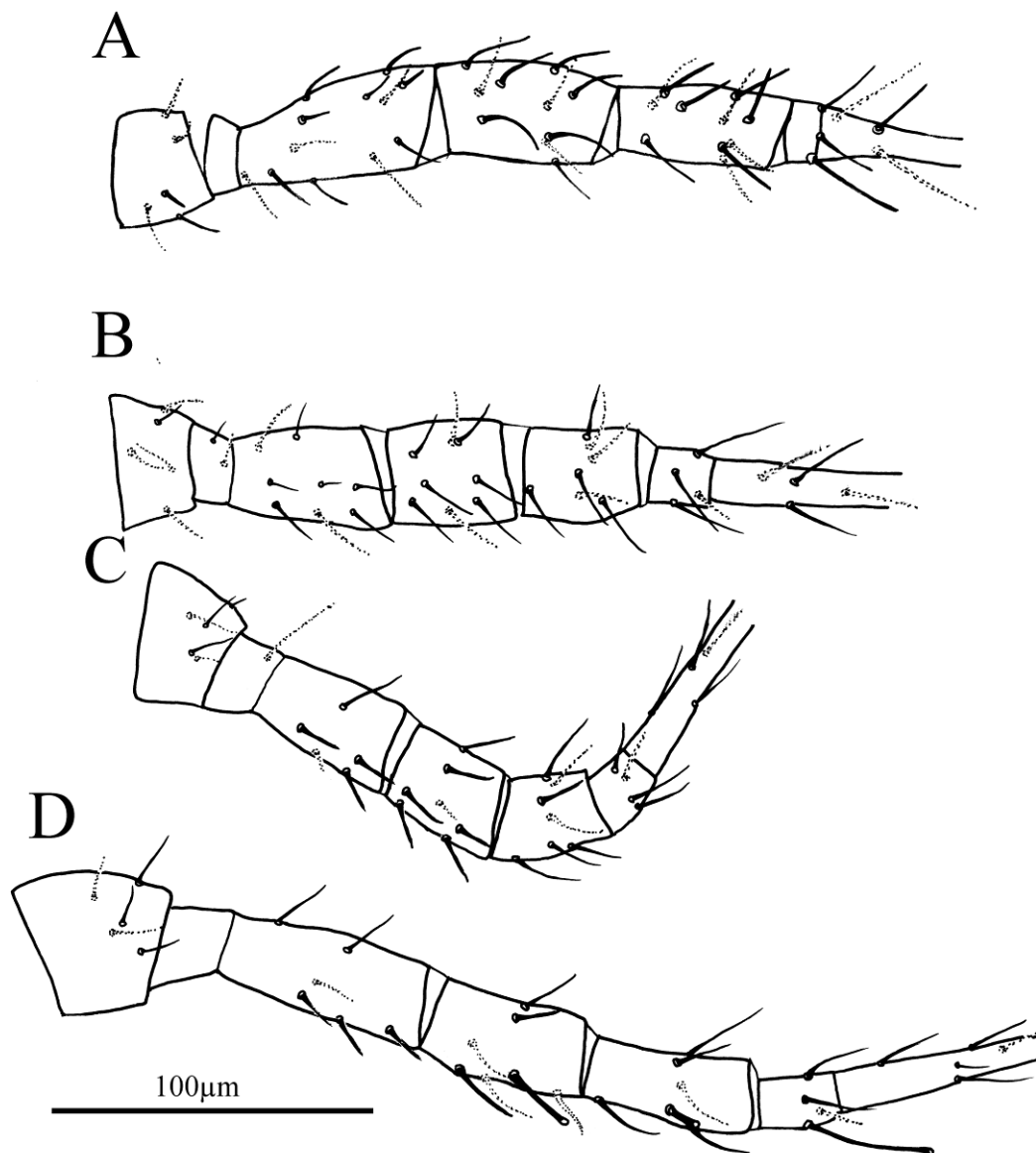


FIGURE 193. *Typhlodromus (Anthoseius) transvaalensis* (Nesbitt, 1951), Female, legs
A. leg I dorsal view, B. leg II anterior view, C. leg III anterior view, D. leg IV anterior
view.

***Typhlodromus (Anthoseius) tridentiger* Tseng, 1975**

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(Figures 194–197)

Typhlodromus (Typhlodromus) tridentiger Tseng, 1975: 64.

Amblydromella tridentiger Moraes *et al.*, 1986: 177.

Amblydromella (Amblydromella) tridentiger Denmark & Welbourn, 2002: 307.

Female (n=10)

A lightly sclerotized mite. Idiosomal setal pattern: 12A:8A/JV:ZV.

Dorsum. Dorsal shield nearly oval, constricted at level of *R1*, laterally reticulated; 324 (304–340) long (*j1*–*J5* level) and 202 (190–212) wide at level of *j6*, 195 (178–210) wide at level of *S4*; six pairs of solenostomes on dorsal shield, (*gd1*, *gd2*, *gd4*, *gd6*, *gd8*, *gd9*), twelve pairs of lyrifissures, (*id1*, *id2*, *id4*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*); length of setae: *j1* 20 (13–23), *j3* 20 (18–23), *j4* 11 (9–14), *j5* 11 (9–13), *j6* 17 (15–20), *J2* 22 (17–24), *J5* 7 (5–9), *z2* 11 (9–14), *z3* 15 (11–18), *z4* 18 (16–19), *z5* 11 13 (10–16), *Z4* 30 (27–32), *Z5* 42 (39–49), *s4* 20 (15–23), *s6* 22 (21–25), *S2* 23 (22–25), *S4* 19 (17–23), *S5* 9 (7–10), *r3* 12 (9–15), *R1* 11 (8–16). All setae smooth, shovel-shaped apically except for *S5*, *J5* short and normal, *Z5* which are distinct shovel-shaped apically with expanded blade.

Peritreme. Peritreme extending to *j1* level; peritremal shield lightly sclerotized, with one pair of solenostomes (*gd3*), one pair of lyrifissures (*id3*).

Venter. Sternal shield smooth, posterior margin concave, wider than long, 60 (52–65) long, 85 (82–89) wide, with three pairs of setae *st1* 19 (17–21), *st2* 15 (13–19), *st3* 16 (12–19), and two pairs of lyrifissures (*pst1*, *pst2*). Exopodal shield at coxae II–IV. Metasternal platelets tear-shaped, with one pair of metasternal setae, *st4* 16 (12–19), with one pair of lyrifissures (*pst3*). Genital shield smooth, truncate posteriorly, with one

pair of genital setae *st5* 17 (13–20), 73 (65–79) wide at level of genital setae. Distances between *st1-st1* 48 (44–52), *st2-st2* 63 (60–66), *st3-st3* 72 (66–75), *st1-st3* 61 (58–64), *st5-st5* 60 (55–67). Ventrianal shield pentagonal, smooth, with slightly waist at *JV2* level, 101 (93–112) long, 87 (76–94) wide at level of *ZV2*, 67 (64–72) wide at level of anus; with four pairs of pre-anal setae, *JV1* 12 (9–15), *JV2* 11 (9–15), *JV3* 10 (8–14), *ZV2* 11 (7–15), solenostomes *gv3* crescentic; *Pa* 9 (7–11), *Pst* 9 (8–11) on shield. Setae *JV4* 8 (7–10), *JV5* 29 (27–32), *ZV1* 13 (9–18), *ZV3* 9 (7–12) on interscutal membrane. All setae smooth, sharp pointed, *JV5* shovel-shaped. Two pairs of metapodal plates 19 (17–21) long, 4 (3–6) wide, 8 (5–10) long, 2 (1–3) wide.

Spermatheca. Calyx bell-shaped, with apical half straight and thick, 17 (14–22) long, 8 (6–10) wide, atrium nodular and connected to the calyx without neck, minor and major ducts invisible.

Chelicera. Movable digit 26 (24–27) long, with three teeth; fixed digit 25 (23–29) long, with five teeth, with *pilus dentilis*.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/2-1, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* III (ad2) 14 (14–16), *Sti* III (ad) 11 (10–13), *St* III (ad) 9 (7–10), *Sge* IV (ad2) 24 (22–26), *Sti* IV (ad) 13 (11–17), *St* IV (d) 23 (22–24). Macrosetae apically shovel-shaped with expanded blade.

Male (n=2)

A lightly sclerotized mite. Idiosomal setal pattern: 13A:8B/JV-4: ZV-1, 3.

Dorsum. Dorsal shield nearly oval, constricted at level of *R1*, with lateral reticulation; 228 (224–233) long (*j1-J5* level) and 156 (152–160) wide at level of *j6*, 131 (126–135) wide at level of *S4*, six pairs of solenostomes on dorsal shield, (*gd1*, *gd2*,

gd4, gd6, gd8, gd9), twelve pairs of lyrifissures, (*id1, id2, id4, idm2, idm3, idm4, idm5, idm6, is1, idl2, idl3, idl4*); length of setae: *j1* 14 (13–15), *j3* 14 (13–14), *j4* 9 (8–9), *j5* 8 (8–9), *j6* 11 (8–14), *J2* 16 (14–17), *J5* 5 (4–5), *z2* 9 (8–10), *z3* 10 (9–10), *z4* 12 (11–12), *z5* 9 (9–9), *Z4* 20 (18–21), *Z5* 28 (28–28), *s4* 16 (15–16), *s6* 16 (14–18), *S2* 17 (17–17), *S4* 17 (16–18), *S5* 13 (13–13), *r3* 8 (8–9), *R1* 9 (8–10). All setae smooth, shovel-shaped apically except for *S5, J5* short and normal, *Z5* distinct shovel-shaped apically with expanded blade. Setae *r3* and *R1* inserted on dorsal shield.

Peritreme. Peritreme extending to *j1* level; peritremal shield lightly sclerotized.

Venter. Sternogenital shield smooth, lateral slightly reticulated, posterior margin straight, longer than wide, 107 (107–108) long, 61 (59–64) wide at level of *st5*, with five pairs of setae, *st1* 11 (10–13), *st2* 11 (11–11), *st3* 11 (10–11), *st4* 13 (13–14), *st5* 13 (13–13), three pairs of lyrifissures (*pst1, pst2, pst3*). Distances between *st1-st1* 38 (36–40), *st2-st2* 54 (53–56), *st3-st3* 56 (56–56), *st4-st4* 39 (39–40), *st5-st5* 35 (34–35), *st1-st5* 98 (95–101). Exopodal shield at coxae II–IV. Ventrianal shield subtriangular, with striation, 96 (95–96) long, 129 (126–132) wide at anterior corner, 50 (48–53) at level of anus, fused with peritremal shield cingulum; with four pairs of pre-anal setae, *JV1* 9 (8–9), *JV2* 8 (7–9), *JV3* 10 (8–11), *ZV2* 8 (8–8), solenostomes *gv3* crescentic; *Pa* 7 (6–9), *Pst* 7 (5–9) on shield. Setae *JV5* 15 (14–16) on interscutal membrane. All setae smooth, sharp pointed, *JV5* shovel-shaped.

Chelicera. Movable digit 16 (15–18) long, with one tooth; fixed digit 16 (15–17) long, with three teeth, with *pilus dentilis*. Spermatodactyl L-shaped, shaft 16 (15–18) long, heel rounded, foot 8 (6–9) long, with expanded toe and lateral thorn-like projection.

Legs. Coxal formula 2-2-2-1. Chaetotaxy (femur to basitarsus): leg I, 2-3/2-2/2-1, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1;

leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* III (ad2) 12 (10–13), *Sti* III (ad) 7 (7–8), *St* III (ad) 6 (5–6), *Sge* IV (ad2) 16 (15–17), *Sti* IV (ad) 9 (8–10), *St* IV (d) 17 (16–18). Macrosetae apically shovel-shaped with expanded blade.

Specimens examined. Hongtuo Water Plant, Lanyu Township, Taitung County (22°02.042' N, 121°33.040' E, 71 m), five females three males (no. 461–2, 3, 4, 5, 6, 7, 8, 9) from *Macaranga sinensis* (Euphorbiaceae), 4.iv.2010, J. R. Liao & C. C. Ho (NTU); Lanyu Township, Taitung County, two females from *Macaranga tanarius* (Euphorbiaceae), 16.vi.1987, C. C. Ho (TARL); Lanyu Township, Taitung County, one female two males from *Morus alba* (Moraceae), 16.vi.1987, C. C. Ho (TARL); Ludao Township, Taitung County, one female (TAL078C0027) from *Hibiscus tiliaceus* (Malvaceae), 16.vi.1987, C. C. Ho (TARL); Lanyu Township, Taitung County (22°00.791' N, 121°34.034' E, 25 m), one male (no. 425–7) from *Macaranga tanarius* (Euphorbiaceae), 2.iv.2010, J. R. Liao & C. C. Ho (NTU); Lanyu Township, Taitung County (22°04.513' N, 121°30.477' E, 95 m), two females (no. 440–5, 6) from *Mallotus japonicus* (Euphorbiaceae), 3.iv.2010, J. R. Liao & C. C. Ho (NTU); Lanyu Township, Taitung County (22°04.788' N, 121°30.782' E, 67 m), one female (no. 443–1) from *Aglaia chittagonga* (Meliaceae), 3.iv.2010, J. R. Liao & C. C. Ho (NTU); Dongqing Water Plant, Lanyu Township, Taitung County (22°03.549' N, 121°33.569' E, 81 m), three females (no. 448–1, 2, 3) from *Morus* sp. (Moraceae), 3.iv.2010, J. R. Liao & C. C. Ho (NTU); Lanyu Weather Station, Lanyu Township, Taitung County (22°02.128' N, 121°33.552' E, 308 m), six females (no. 450–1, 2, 3, 4, 5, 6) from *Acacia confusa* (Fabaceae), 3.iv.2010, J. R. Liao & C. C. Ho (NTU); Lanyu Township, Taitung County (22°00.881' N, 121°33.970' E, 33 m), one female (no. 462–15) from *Morus alba* (Moraceae), 4.iv.2010, J. R. Liao & C. C. Ho (NTU); Lanyu Township, Taitung County

(22°00.791' N, 121°34.034' E, 26 m), one female (no. 463–19) from *Trema orientalis* (Cannabaceae), 4.iv.2010, J. R. Liao & C. C. Ho (NTU); Lanyu Township, Taitung County (22°00.791' N, 121°34.034' E, 26 m), one female (no. 468–7) from *Premna serratifolia* (Verbenaceae), 4.iv.2010, J. R. Liao & C. C. Ho (NMNS); Lanyu Township, Taitung County (22°00.978' N, 121°33.830' E, 19 m), one female (no. 1207–2) from *Morus* sp. (Moraceae), 6.iv.2011, Y. J. Lu (NCHU).

Distribution. Asia: Taiwan ((Lanyu Island (Tseng 1975), Ludao (present study)).

Remarks. This species was described by Tseng (1975) from Lanyu Island on unknown plant. Most specimens we collected were also found in type locality and others were found in neighboring islands Ludao. These specimens are morphologically similar to the original description, however, two differences were observed; Tseng (1975) reported two macrosetae on genu IV, and three macrosetae on tibia IV, as oppose to our observation (only one macrosetae on each segment). In addition, we observed additional two teeth on proximal end of fixed digit, well away from *pilus dentilis* in female.

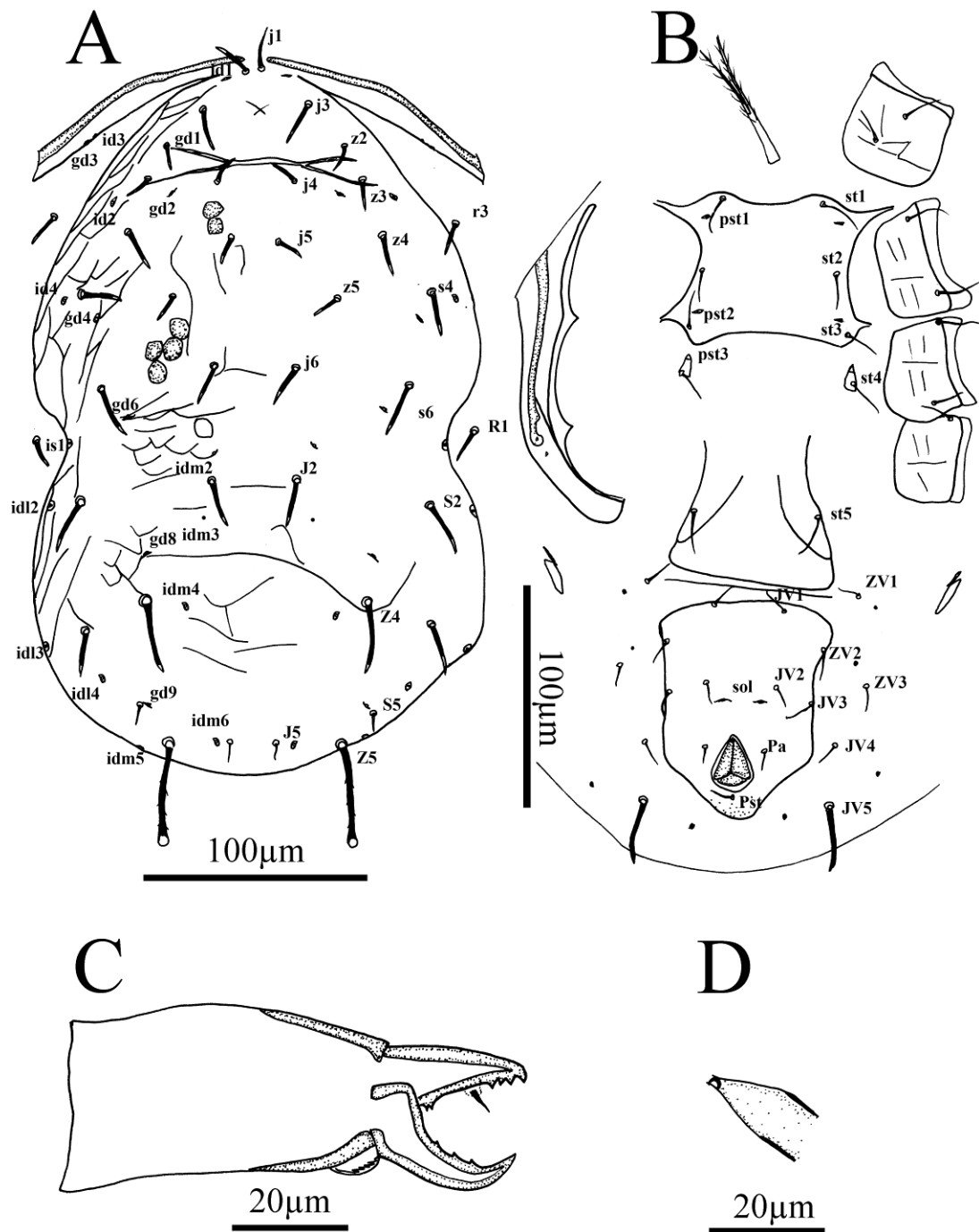


FIGURE 194. *Typhlodromus (Anthoseius) tridentiger* Tseng, 1975, Female, A. dorsal shield, B. ventral idiosoma, C. chelicera, D. spermatheca.

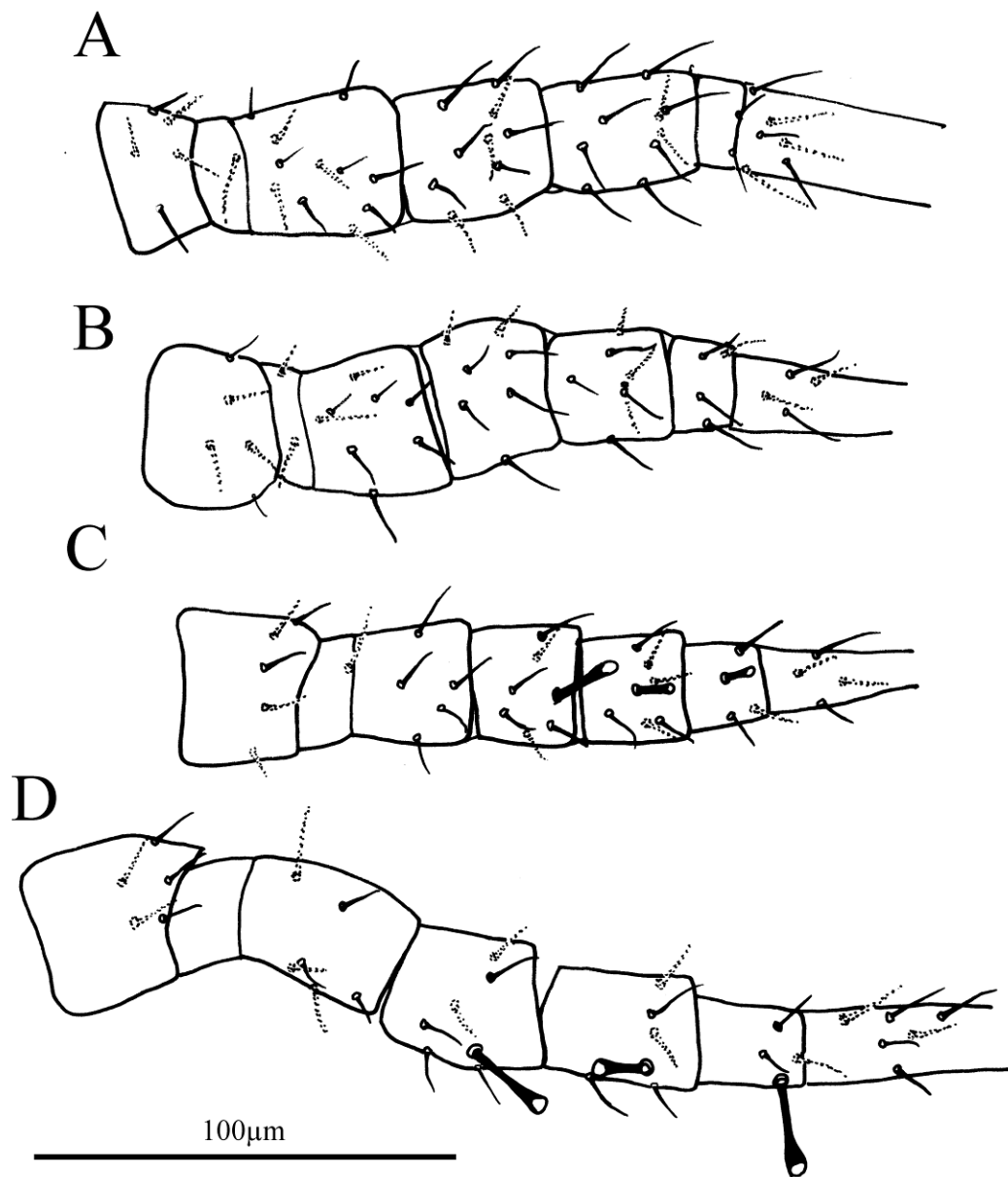


FIGURE 195. *Typhlodromus (Anthoseius) tridentiger* Tseng, 1975, Female, legs A. leg I anterior view, B. leg II anterior view, C. leg III posterior view, D. leg IV posterodorsal view.

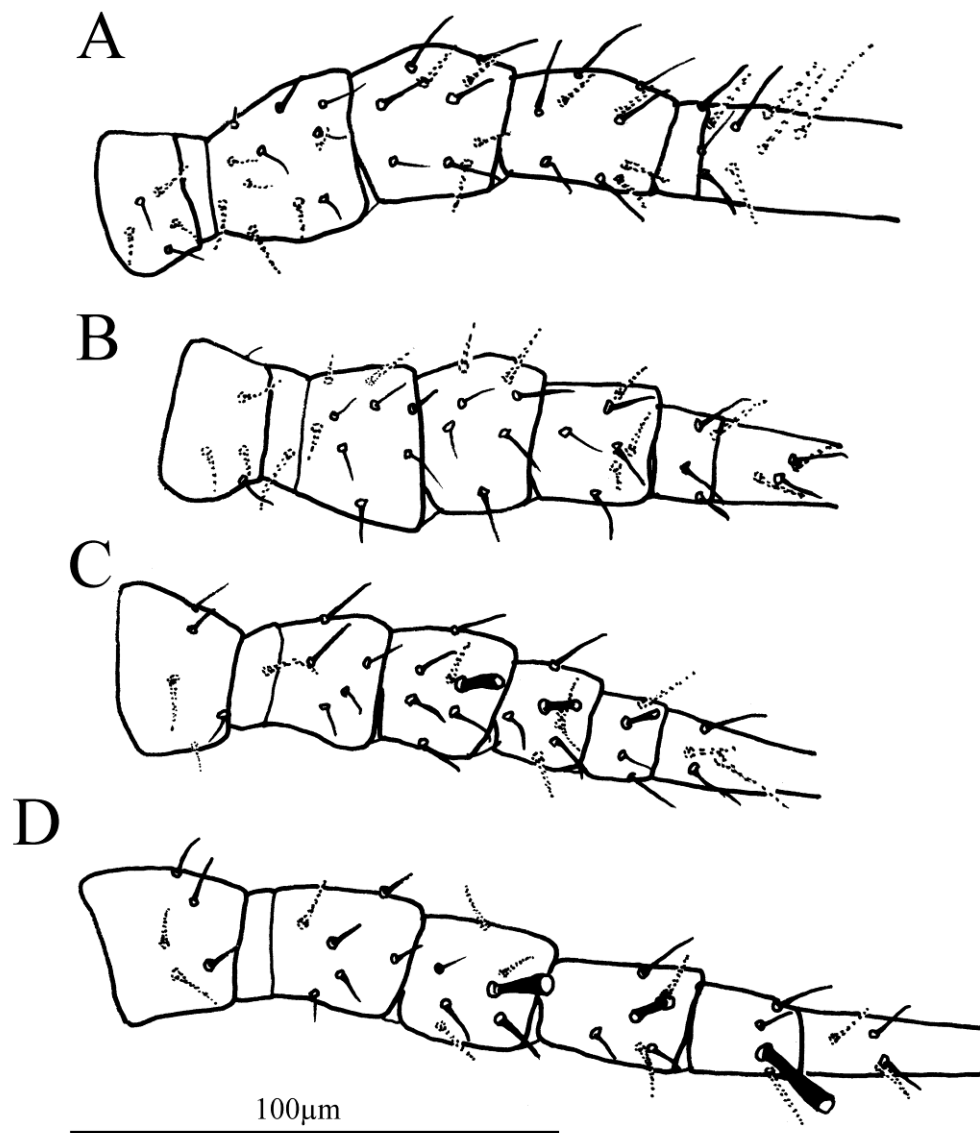


FIGURE 197. *Typhlodromus (Anthoseius) tridentiger* Tseng, 1975, Male, legs A. leg I dorsal view, B. leg II dorsal view, C. leg III dorsal view, D. leg IV dorsal view.

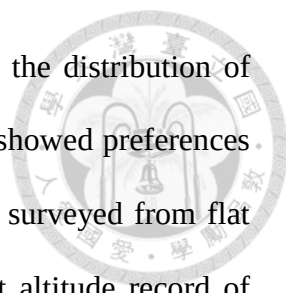
Chapter 5 Discussion

5.1 Biodiversity of phytoseiid mites from Taiwan



Phytoseiid mites have received considerable attention for their role as biological control agents of phytophagous mites and other arthropods (e.g. thrips, whiteflies and scale insects) (Huffaker *et al.* 1970; McMurtry *et al.* 1970; 2013). Until now, more than 2,700 species and 90 genera have been recorded in the world (Demite *et al.* 2019). Before the present study, about 52 species had been recorded in Taiwan that focused on city or suburban areas, and highly correlation with agriculture (Ehara 1970; Lo 1970; Tseng 1972; 1973; 1975; 1976; 1983; Chang & Tseng 1978). In present study, 62 phytoseiid species have been reported from Taiwan and neighboring islands, including 5 new species and 5 new recorded species have been reported (Liao *et al.* 2017a; 2017c; 2018).

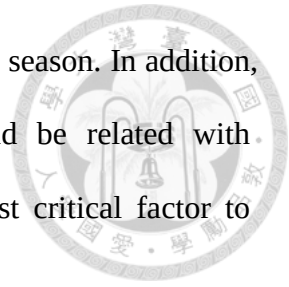
Phytoseiids exploited the foliage habitat of higher plants extensively, and can be discovered from any places covered with vegetation with diverged habitats from tundra to tropical rain forest (Chant 1985; McMurtry *et al.* 2013). Diversity and distribution of phytoseiids are related with their habitat plants. For example, the lifestyle III-d—generalist predators living in confined spaces on monocotyledonous plants. Two species *Neoseiulus baraki*, *N. taiwanicus* belonged to this group in Taiwan. These species are strongly related with monocotyledonous plants, can be discovered in the leaf sheaf of rice. In some cases, phytoseiids are related with plant's structure (e.g. domatia, trichome). In addition, some species show highly correlation with habitat plant, the two species *Macrocaudus multisetatus*, *Evanseoseius macfarlanei* both occur on floating plant and *Macroseius biscutatus* occur on pitcher of pitcher plant (Muma & Denmark 1967; McMurtry *et al.* 2013).



Tsolakis et al. (2000) reported the altitude is a key factor for the distribution of phytoseiid mites (Tsolakis *et al.* 2000). Some of phytoseiid species showed preferences to different altitude. During the investigation of Taiwan, the author surveyed from flat ground to high altitude area, more than 3,000m. The most highest altitude record of phytoseiid mites is around 2,500m in Cuifeng (翠峰), Nantou County. Some species (e.g. *Scapulaseius okinawanus*) are distributed from flat ground to higher mountain. However, some species only be found in high mountain area, For example, *S. tienhsianensis* was reported only in type locality Tienhsian (in 2,000m) (Tseng 1983), and our specimens also collected in neighboring mountain area more than 2,000m. As a consequence, altitude plays an important role for the distribution of phytoseiids.

The geographical and temperature factors are another important roles in the distribution of phytoseiid mites, although most species are widespread. These two factors should be discussed together. Because the Southern Taiwan is tropical area rather than Northern Taiwan. *Amblyseius largoensis* species group is an interesting case. There are two species *A. eharai*, *A. herbicolus* can be discovered in whole Taiwan. In addition, *A. largoensis* only distributed in Southern Taiwan. Ho *et al.* (1995) reported the geographical distribution between *Neoseiulus longispinosus* and *N. womersleyi*. *N. longispinosus* only distributed in Southern Taiwan except Lishan, Taichung. But *N. womersleyi* can be found in whole Taiwan. Temperature is also a key factor for distribution of phytoseiid mites. The phytoseiid mites start from the developmental threshold of 10 to 30°C (Ho *et al.* 1995). Taiwan situate at the boundary of subtropic and tropic areas, temperature are usually warming and suitable for occurrence of phytoseiid mites. Thus, it is easy to collect phytoseiid mites here. However, temperature was lower due to cold snap during winter 2010 to spring 2011 and lead to lower densities of phytoseiid mites than previous investigation. Even the most common

species, *A. herbicolus* and *E. ovalis* are also difficult to collect in the season. In addition, the previous mentions of factors, geography and altitude, could be related with temperature. As a consequence, the temperature could be the most critical factor to affect the distribution of phytoseiid mites.



5.2 Tseng's specimens mystery

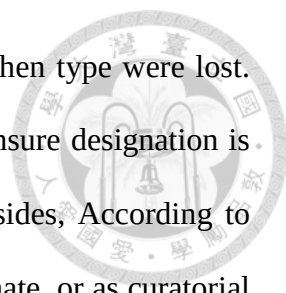
Yi-Hsiung Tseng made great taxonomic work of several different taxonomic groups of mite fauna; who provided important basis of mite researches in Taiwan. He described 47 phytoseiids including 20 endemic species. Collections of Tseng, including type specimens, were deposited at the Tainan Branch of the Bureau of Commodity Inspection and Quarantine (BCIQ) (Tseng 1983). However, the Tainan Branch of BCIQ no longer possesses Tseng's collections and type specimens. All collections of Tseng, including type specimens, were missing after he retired (BAPHIQ 2009) except one specimen (*A. maai*) deposited in H. A. Denmark's collection (Döker 2017 personal communication), Thus one purpose of this study is to redescribe species named by Tseng.

Naming a neotype to ascertain its identity and noting the conditions required by the International Code of Zoological Nomenclature (ICZN) for designation are necessary. Some examples already existed in the Phytoseiidae. Duso & Fontana (2001) reported for instance well-known controversy regarding the identity of *Phytoseius plumifer* (Canestrini & Fanzago) resulting from the loss of type materials. After original description, acarologists subsequently provided controversial descriptions for this species on the basis of their own specimens. This study investigated the type locality and designated a neotype for this species to solve the problem. By contrast, Thor (1930) described *Lasioseius* (*Lasioseius*) *magnanalis* Thor from Svalbard but did not designate

any type specimens. Chant (1959b) transferred the species "*magnanalis*" into family Phytoseiidae but he considered this species dubious because of the vague original description. Kolodochka & Gwiazdowicz (2014) discussed the fate of Thor's specimens as all specimens were lost after he died. They designated a neotype *Neoseiulus magnanalis* (Thor) to clarify its identity.

The present study conducted a survey in Taiwan and surrounding islands. Collecting the species described by Y. H. Tseng. Therefore, type localities and type habitat plants of these species were visited. However, some difficulties were faced because of typing errors in localities label. The old vague phonetic English transcription of the localities, and the use of general descriptive terms for plants (e.g., weeds, grasses). In addition, landscape greatly changed in the past 30 years. During these investigations, *A. alpinia*, *A. bellatulus*, *A. maai* (now *A. tamatavensis*), *Paraphytoseius hyalinus* (now *Parap. cracentis*), *S. tienhsainensis*, *T. (A.) changi*, *T. (A.) gracilentus*, *T. (A.) lanyuensis*, *T. (A.) neocrassus*, *T. (A.) obesus*, *T. (A.) pseudoserrulatus* (should be *serrulatus*), *T. (A.) tridentiger* were found, and also *A. pascalis* borrowed from GIABR. Therefore, Liao *et al.* (2017b) designated a neotype and also redescribed *Amblyseius belltulus* for maintain species status of this species, besides, the present study provided redescrptions of these species. However, *A. trisetosus*, *Proprioseiopsis pubes*, *Neoseiulus monomacrosetus*, *N. spineus*, *Okiseius formosanus*, *S. vestificus*, *Phytoseius rugatus*, *T. (A.) eleglidus* could not be found. Therefore, the present study provided redescrptions of these species based on original descriptions.

Tseng provided vague and simple descriptions and all specimens were lost (Liao *et al.* 2017b); it seems designation of neotype is necessary for clarifying the species status of all species described by Tseng. Escobar (2018) reported a fire at the Museu Nacional in Rio de Janeiro, Brazil. This fire destroyed many specimens, including type specimens.



Generally, we will consider to designate neotypes for all species when type were lost. However, Article 75.3 of the Code (2) sets out 7 requirements to ensure designation is well executed, not alway necessary when type specimens lost. Besides, According to Article 75.2, neotype designation is invalid, if we just want to designate, or as curatorial routine (International Commission on Zoological Nomenclature 1999). Therefore, it should be considered the neccessarity if the species is not type species of taxonomic group. In addition, if the species is common for publics such as *Homo sapiens*, is it necessary to designate neotype when type missing? Therefore, the redescrptions of these species are provided solely in present study but not designate neotypes.

5.3 Additional characters in Taxonomy of Phytoseiidae

Several additionally morphological characters were described for Taxonomy of Phytoseiidae in present study, including all leg setation, solenostomes, lyrifissures, and also some additional measurements (e.g. distances between *st1-st1*). These characters are discussing on the following sections, separately.

1. Leg setation: Acarologists usually described leg IV from genu to tibia in previous studies, sometimes only described macrosetae, and also number of seta on genu II. Evans (1963) reported the leg chaetotaxy of Gamasina. In present study, these species show almost same seta numbers on each leg segments (except genu II and III). Coxal formula is 2, 2, 2, 1. Trochanter formula is 5, 5, 5, 5. Femur formula is 12, 10, 6, 6. Genu formula is 10, 7, 7, 7. Tibia formula is 10, 7, 7, 6. Tarsus formula is 4, 4, 4, 4. In addition, the al1 on femur I and al1 on femur II are minute, and easy to ignore due to microscope quality. Additionally, leg chaetotaxies are same both sexes. The most common chaetotaxy is leg I, 2-3/2-2/2-1, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/1-2/1-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1,

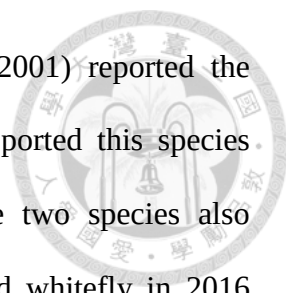
1-1/1-2/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/1-0, 1-1/1-1. Femur I are three types: 2-3/2-2/2-1, 2-3/1-2/2-2, 2-3/2-2/1-2.

2. Solenostomes and lyrifissures: these characters are difficult to recognize due to microscope and specimens quality. Solenostomes *gd1*, *gd3*, *gd4*, *gd8*, *gd9* seems to be stable characters, always present in these species of present study. Solenostome *gd1* is easy ignored because of the crack of dorsal shield occurred near seta *j3* level. In some species (e.g. *Phytoseius coheni*, *Paraphytoseius* spp.), setae *Z4*, *Z5* strong and serrated, these setae will overlap solenostome *gd9*. On the other hand, lyrifissures *id1*, *id2*, *id3*, *id4*, *id6*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *is1*, *idl2*, *idl3*, *idl4*, *idl5* are observed as stable characters, always present, but difficult to recognize.

3. Distances between setae: Distances of *st1-st1*, *st2-st2*, *st3-st3*, *st1-st3*, *st5-st5* are reported in present study. These measurements seem correlated with body size of phytoseiid, and the body size will be affected by some factors (e.g. temperature, food nutrition). Prasad & Tixier (2016) reported distances between setae are helpful to distinct closely species of genus *Paraphytoseius*. Although this study was focused on dorsal setae, the ventral setae may need further experiment for test the taxonomic value.

5.4 Any possible potential predator species?

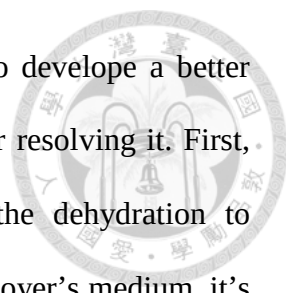
Taiwanese researchers focused on three introduced species (*Neoseiulus californicus*, *N. fallacis*, *Phytoseiulus persimilis*) and several local phytoseiids for biological control of pests in the past (e.g. *N. longispinosus*, *N. womersleyi*). During the survey, potential biological control agent of phytoseiid species have been observed, including *N. barkeri*, *Proprioseiopsis aetus*. *N. barkeri* is widely used for controlling thrips in some countries (e.g. China). Fouly (1997) evaluated biological control potential of *P. aetus*, this species could be promising biological control agent for phytophagous mites (e.g.



Tetranychus urticae, *Polyphagotarsonemus latus*). Ho & Chen (2001) reported the biological control potential of *P. asetus*. Emmert *et al.* (2008) reported this species could be a useful predator for *Frankliniella occidentalis*. These two species also occurred in a cucumber greenhouse and fed on aphids, thrips and whitefly in 2016 investigation in Puli, Nantou County. Faraji (2018 personal communication) also provided suggestions about *N. barkeri*, this species occurred in field, however, not on trees and bushes but on soil, decayed weeds and litters. The best place to collect *N. barkeri* is corners of indoor greenhouses and farmer's barns. This species will be found in the hidden habitats with growing fungi and astigmatic mites. In our experience, *P. asetus* is also found in similar microhabitats during phytoseiid survey. They show lifestyle subtype III-e, can be found on low-growing plant and also soil, litter, and also moving to leaf when preys occur. In short, these species could provide good efficiency for controlling pests, and they also can be reared in laboratory by astigmatic mites. They may become successful biological control agents in future but need further experiments.

5.5 Mite slide preparation

Hoyer's medium is most commonly used for mounts of specimens in Acarology. This mounting medium have many advantages, such as easy to use and can clear the inside body of weakly sclerotized mites (Zhang 2003; Wu *et al.* 2009). However, the disadvantage of Hoyer's medium is the characteristic that water-soluble medium. Causing specimens are broken easily, turned to blackend or full of bubbles (Saito *et al.* 1993; Zhang 2003). This circumstance is very common in old specimens, even in some specimens only made one or several years. These specimens are usually in poor condition for examining, full of mold and bubble. Acarologists applied the glyptal to seal around the cover slip for permanent mounting to overcome this problem. However,



this puzzle is still unresolved. Therefore, some researchers tried to develop a better mounting fluid (e.g. Saito *et al.* 1993). There are two directions for resolving it. First, Hoyer's medium is still using for mounting and also adding the dehydration to mounting media. Second, development of mounting method without Hoyer's medium, it's better to use resin-based media, such as Canada balsam or Euparal for slide preservation. Saito *et al.* (1993) proposed a method to make a permanent slide by Canada balsam. However, the method was not concerned due to the relatively poor optical properties and the procedure of mounting by Canada balsam is complicated, and the mite samples are missing easily when dehydration (Zhang 2003). No matter what, the improvement of mounting method is still necessary.

Some of my own specimens are in poor condition even made only two or three years (in NTU); and the specimens borrowed from HUM, NSMT, or UPLB-MNH, are still in good condition even made in 1950s, and some specimens without using glyptal or nail varnish. One possible inference is preservation condition. During the visiting of NSMT, specimens deposited in strict controlled area, and also provided a good temperature and humidity. Therefore, controlling of temperature and humidity of deposited area is probably the key point for maintain the condition of specimens.

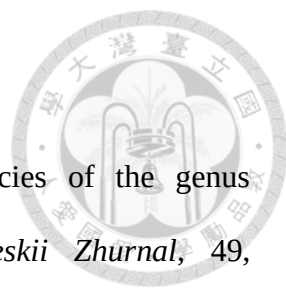


Chapter 6 Conclusion



In this taxonomic study, 62 phytoseiid species were reported in Taiwan and surrounding islands. Among them, 5 new species and 5 new recorded species are reported (Liao *et al.* 2017a; 2017c; 2018). Although 9 species were not found during these investigations, the present study tried the best to describe all these species based on all specimens and references. Comprehensive collection data recorded for future application purpose. Clearly taxonomic illustration and biological data of each species has been presented, as far as possible, in a standardized way to make it easy for even non-specialist taxonomists of phytoseiids to determine the identity of species. Hope this study can provide contribution for the future application in taxonomy, agriculture, and other studies.

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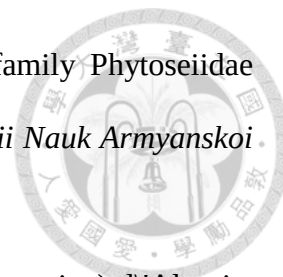
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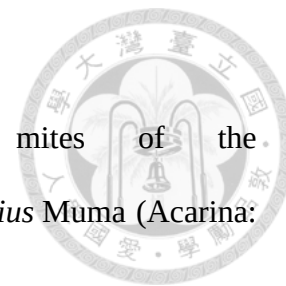
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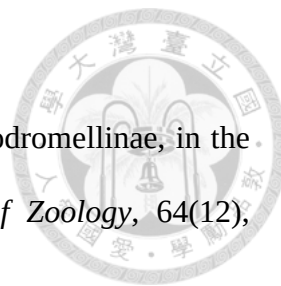
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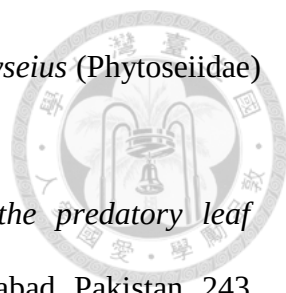
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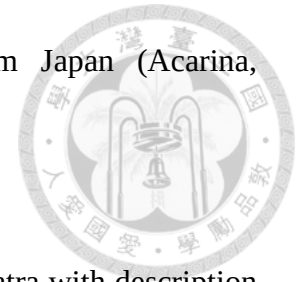
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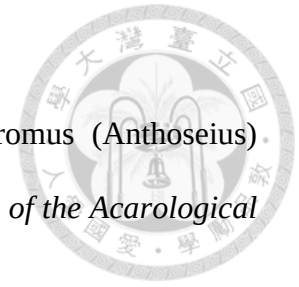
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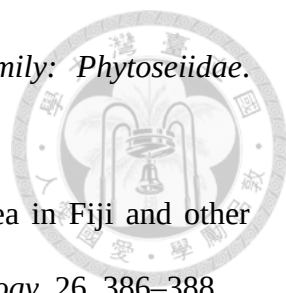
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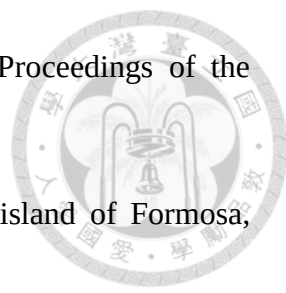
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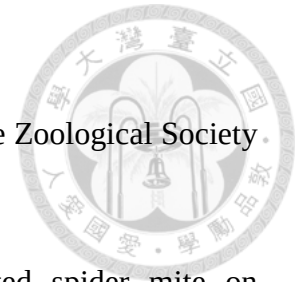
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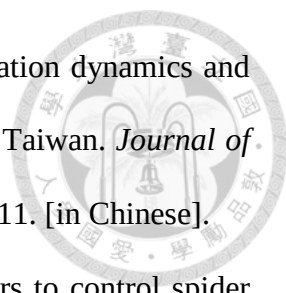
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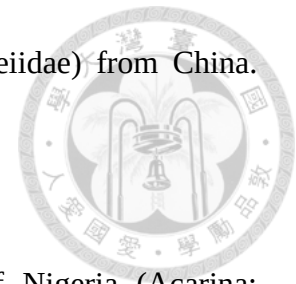
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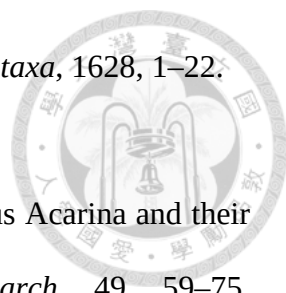
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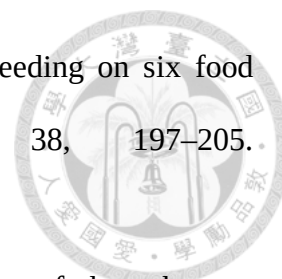
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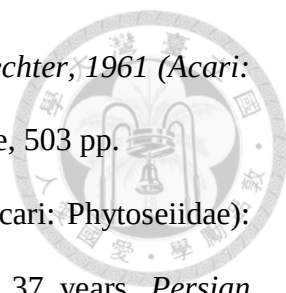
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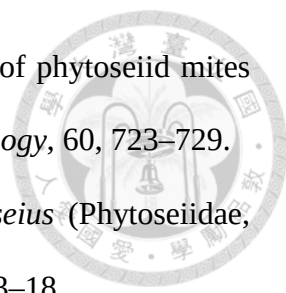
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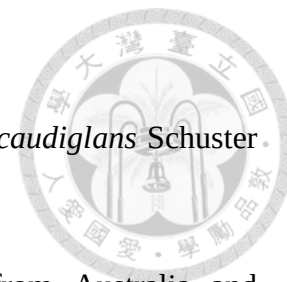
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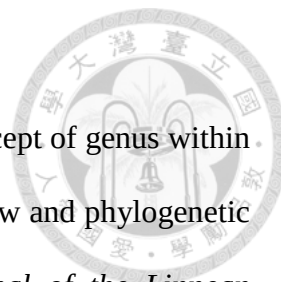
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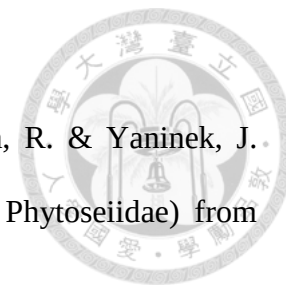
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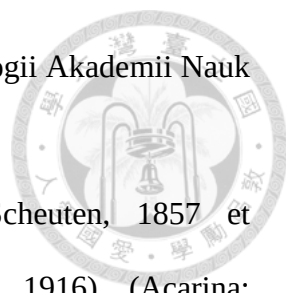
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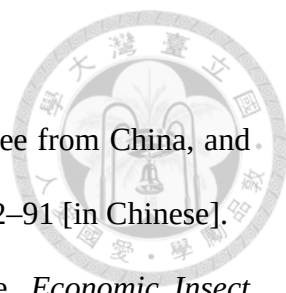
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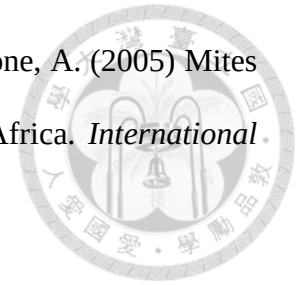
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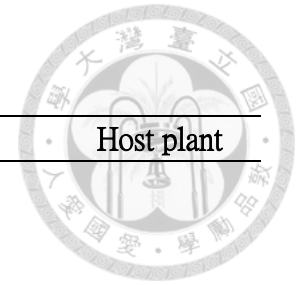
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Appendix I. Comparison of systems of nomenclature for different systems

Seta positiuon		Garman (1948)	Athias-Henriot (1957)	Hirschmann (1957)	Wainstein (1962)	Linquist & Evans (1965)	Rowell <i>et al.</i> (1978)	Chant & Yoshida-Shaul (1989)
Dorsalcentral series	podonotal	D1	D1	i1	D1	j1	j1	j1
		D2	D4	i3	D2	j4	j4	j4
		D3	D5	i4	D3	j5	j5	j5
		D4	D6	i5	D4	j6	j6	j6
	opithosomal	D5	D8	I2		J2		J1
		D6	D11	I5		J5	J2	J2
					D6			J4
					D7		J5	J5
Mediolateral series	podonotal	M1	M5	z2	AM2	z5	z5	z5
		M2	M6	z3	AM3	z6	z6	z6
	opithosomal	M3	M9	Z3	PM1	Z3	Z3	Z3
		M4	M10	Z4	PM2	Z4	Z4	Z4
Lateral series	podonotal	L1	L1	r2	AM1	s1	j3	j3
		L2	L2	r3	AL1	s2	z2	z2
		L3	L3	s4	AL2	s3	z3	z3
		L4	L4	s5	AL3	s4	z4	z4
					AL4			
		L5	L5	s6	AL5	s5	s4	s4
		L6	L6	s7	AL6	s6	s6	s6
	opithosomal				ML			Z1
		L7	L7	S1	PL1	S1	Z1	Z2
		L8	L8	S2	PL2	S2	S2	S2
		L9	L10	S3	PL3	S3	S4	S4
		L10	L11	S4	PL4	S4	S5	S5
		L11	M11	S5	PM3	S5	Z5	Z5
Marginal series	podonotal	S1	S1	r5	AS	r3	r3	r3
				r7		r5		r5
	opithosomal	S2	S2	Rx1	PS	R1	R1	R1

Appendix II. Collection data from Y. H. Tseng



Species	Collection time	Locality	Host plant
Subfamily Amblyseiinae			
Tribe Amblyseiini			
Subtribe Amblyseiina			
<i>Amblyseius alpinia</i>	19-VI-1981	高雄內門	月桃
<i>Amblyseius bellatulus</i>	9-IX-1979	名間	桑
<i>Amblyseius herbicolus</i>		全台分布	
<i>Amblyseius pascalis</i>	13-III-1980	梨山	雜草
	23-X-1980	武陵農場	梨子
<i>Amblyseius maai</i>	30-XII-1971	台南縣	鳳梨
	16-IX-1972	台南	土牛膝
<i>Amblyseius trisetosus</i>	13-II-1981	南投廬山	落葉
Subtribe Arrenosiina			
<i>Paraamblyseius formosanus</i>	4-IV-1966	屏東墾丁	臺灣黃藤
	11-XI-1971	屏東墾丁	福木
<i>Phytoscutus salebrosus</i>	28-XI-1967	臺北木柵	柑橘
	28-XI-1971	苗栗大湖	柑橘
Subtribe Proprioseiopsina			
<i>Proprioseiopsis asetis</i>	3-VII-1980	臺中興大	雜草
<i>Proprioseiopsis ovatus</i>	28-IX-1975	嘉義大埔	雜草
	20-IV-1979	臺中市	雜草
	11-IX-1981	高雄寶來	未知
	19-IX-1981	臺中后里	未知
	7-III-1982	南投埔里	雜草
<i>Proprioseiopsis pubes</i>	4-X-1972	台南市	茉莉
Tribe Euseiini			
Subtribe Euseiina			
<i>Euseius ovalis</i>		全台分布	
Tribe Indoseiulini			
<i>Gynaeseius liturivorus</i>	26-X-1978	青年公園	木瓜
Tribe Neoseiulini			
<i>Neoseiulus baraki</i>	7-XII-1976	臺北縣公館	禾草葉鞘
	未知	臺中縣大里	禾草葉鞘
	9-VII-1979	高雄縣左營	玉米
	23-X-1980	高雄縣阿蓮	水稻葉鞘
<i>Neoseiulus barkeri</i>	13-VII-1979	花蓮玉里	西瓜
<i>Neoseiulus longispinosus</i>	未知		
<i>Neoseiulus makuwa</i>	1-XII-1976	台北公館	小麥葉鞘內
	7-IX-1977	三芝	細毛鴨嘴草

Appendix II. (Continued)

	8-XII-1978	北縣	地衣
<i>Neoseiulus monomacrosetus</i>	22-I-1971	台南縣	鳳梨
	30-VI-1979	高雄旗山	玉米葉
	10-IX-1980	臺中興大	禾草
<i>Neoseiulus spineus</i>	20-IX-1972	臺中后里	葡萄
<i>Neoseiulus taiwanicus</i>	24-III-1966	高雄	鳳梨
	3-VI-1972	屏東	鳳梨
<i>Neoseiulus womersleyi</i>		全台分布	
Tribe Kampimodromini			
Subtribe Kampimodromina			
<i>Okiseius formosanus</i>	未知	未知	未知
	未知	未知	桑
<i>Okiseius subtropicus</i>	19-II-1971	嘉義	未知
	14-I-1972	嘉義	桑
Subtribe Paraphytoseiina			
<i>Paraphytoseius hyalinus</i>	11-II-1972	嘉義	懸鉤子
	18-II-1972	嘉義	懸鉤子
<i>Paraphytoseius orientalis</i>	11-XI-1971	屏東墾丁	未知
Tribe Typhlodromipsini			
<i>Typhlodromips anuwati</i>	31-X-1978	南投關刀溪山	梨
	25-XI-1978	臺中	亞洲梨
<i>Typhlodromips newsami</i>	9-XII-1978	苗栗 關刀山	荔枝
	18-IX-1978	臺中霧峰	楊桃 柑橘
	23-IX-1978	台中市	朱萇
	22-X-1978	台中縣頭汴坑	番石榴
<i>Typhlodromips okinawanus</i>			溫帶水果
<i>Typhlodromips tienhsainensis</i>	4-X-1976	花蓮縣天祥	花
<i>Typhlodromips vestificus</i>	2-I-1974	嘉義	月桃
	4-I-1972	嘉義	破布子
	2-II-1972	嘉義	未知
	2-II-1974	花蓮玉里	桑
Subfamily Phytoseiinae			
<i>Phytoseius coheni</i>	31-X-1968	臺北	柑橘
	9-XI-1967	臺北	柑橘
	10-I-1968	臺北	柑橘
	28-II-1968	臺北	番石榴
	13-X-1968	臺北	柳樹
	26-II-1969	臺北	番石榴
	20-II-1974	宜蘭	未知

Appendix II. (Continued)

	21-II-1974	臺中梨山	李屬
<i>Phytoseius hongkongensis</i>	未知		
<i>Phytoseius minutus</i>	19-III-1972	花蓮縣 花蓮市	泡桐
	19-I-1972	嘉義頂六	竹
	16-IX-1972	台南學甲	土牛膝
	22-II-1974	花蓮玉里	茄子
<i>Phytoseius hawaiiensis</i>	2-IV-1966	高雄鳳山	金龜樹
	1-I-1971	屏東竹田	葡萄
	7-I-1972	台南市	葡萄
<i>Phytoseius rugatus</i>	1-I-1972	台南市	金合歡樹
Subfamily Typhlodrominae			
Tribe Chanteiini			
<i>Chanteius contiguus</i>	22-II-1974	花蓮玉里	蕨
Tribe Typhlodromini			
<i>Neoseiulella compta</i>	22-II-1972	蘭嶼	相思樹
<i>Neoseiulella eleglidus</i>	29-III-1980	嘉義番路鄉半天岩	荔枝
<i>Typhlodromus (Anthoseius) changi</i>	25-I-1972	嘉義內埔	檳榔
<i>Typhlodromus (Anthoseius) gracilentus</i>	30-VII-1973	高雄縣	銀樺
<i>Typhlodromus (Anthoseius) lanyuensis</i>	22-III-1972	蘭嶼	雜草
<i>Typhlodromus (Anthoseius) neocrassus</i>	7-I-1979	臺中市	番石榴
<i>Typhlodromus (Anthoseius) obesus</i>	18-XI-1978	花蓮	未知
<i>Typhlodromus (Anthoseius) pseudoserrulatus</i>	12-VIII-1978	屏東楓港	龍眼
<i>Typhlodromus (Anthoseius) ryukyuensis</i>	4-IV-1966	屏東墾丁	省藤
	4-IV-1966	屏東墾丁	臺灣梭羅樹
	7-I-1972	台南	朱堇
<i>Typhlodromus (Anthoseius) transvaalensis</i>	21-II-1976	嘉義竹崎	豆
<i>Typhlodromus (Anthoseius) tridentiger</i>	20-III-1972	蘭嶼	未知

Appendix III. Habitat plant list of Phytoseiidae from Taiwan

Phytoseiidae		Habitat plant		
Genus	Species	Family	Genus	Species
<i>Gynaeseius</i>	<i>liturivorus</i>	Caricaceae	<i>Carica</i>	<i>papaya</i>
		Euphorbiaceae	<i>Manihot</i>	<i>esculenta</i>
		Fabaceae	<i>Glycine</i>	<i>max</i>
		Rosaceae	<i>Pyrus</i>	sp.
<i>Gynaeseius</i>	<i>santosoi</i>	Euphorbiaceae	<i>Maccaranga</i>	<i>tanarius</i>
		Moraceae	<i>Morus</i>	<i>alba</i>
<i>Euseius</i>	<i>aizawai</i>	Anacardiaceae	<i>Mangifera</i>	<i>indica</i>
		Aracea	<i>Colocasia</i>	<i>esculenta</i>
		Araliaceae	<i>Schefflera</i>	<i>octophylla</i>
		Arecaceae	<i>Cocos</i>	<i>nucifera</i>
		Bignoniaceae	<i>Tabebuia</i>	<i>chrysantha</i>
		Caricaceae	<i>Carica</i>	<i>papaya</i>
		Ebenaceae	<i>Diospyros</i>	sp.
		Euphorbiaceae	<i>Bischofia</i>	<i>javanica</i>
		Euphorbiaceae	<i>Maccaranga</i>	<i>tanarius</i>
		Fabaceae	<i>Bauhinia</i>	<i>blakeana</i>
		Fabaceae	<i>Bauhinia</i>	<i>variegata</i>
		Fagaceae	<i>Quercus</i>	<i>glauc</i>
		Lauraceae	<i>Cinnamomum</i>	<i>osmophloeum</i>
		Lauraceae	<i>Litsea</i>	sp.
		Lauraceae	<i>Machilus</i>	<i>zuihensis</i>
		Lauraceae	<i>Phoebe</i>	<i>formosana</i>
		Magnoliaceae	<i>Michelia</i>	<i>compressa</i>
		Malvaceae	<i>Pachira</i>	<i>aquatica</i>
		Moraceae	<i>Ficus</i>	sp.
		Moraceae	<i>Morus</i>	<i>alba</i>
		Poaceae	<i>Dendrocalamus</i>	<i>latiforus</i>
		Rosaceae	<i>Prunus</i>	<i>campanulata</i>
		Rutaceae	<i>Tetradium</i>	<i>glabrifolium</i>
		Sapindaceae	<i>Dimocarpus</i>	<i>longan</i>
		Solanaceae	<i>Solanum</i>	<i>nigrum</i>
		Staphyleaceae	<i>Turpinia</i>	<i>formosana</i>
		Urticaceae	<i>Debregeasia</i>	<i>edulis</i>
		Urticaceae	<i>Debregeasia</i>	<i>orientalis</i>

Appendix III. (Continued)



<i>Euseius</i>	<i>circellatus</i>	Asteraceae	<i>Conyza</i>	<i>sumatrensis</i>
		Euphorbiaceae	<i>Mallotus</i>	<i>japonicus</i>
		Fabaceae	<i>Pueraria</i>	<i>lobata</i>
		Moraceae	<i>Broussonetia</i>	<i>papyrifera</i>
<i>Euseius</i>	<i>dalensis</i>	Poaceae	<i>Bambusa</i>	<i>oldhamii</i>
		Poaceae	<i>Dendrocalamus</i>	<i>latiflorus</i>
<i>Euseius</i>	<i>macaranga</i>	Asteraceae	<i>Bidens</i>	<i>pilosa</i>
		Asteraceae	<i>Ageratum</i>	<i>conyzoides</i>
		Euphorbiaceae	<i>Macaranga</i>	<i>tanarius</i>
		Euphorbiaceae	<i>Vernicia</i>	<i>fordii</i>
		Euphorbiaceae	<i>Mallotus</i>	<i>japonicus</i>
		Lamiaceae	<i>Callicarpa</i>	<i>formosana</i>
		Moraceae	<i>Morus</i>	sp.
		Papilionaceae	<i>Milletia</i>	<i>pinnata</i>
		Ulmaceae	<i>Trema</i>	<i>orientalis</i>
		Urticaceae	<i>Boehmeria</i>	<i>nivea</i>
		Euphorbiaceae	<i>Macaranga</i>	<i>tanarius</i>
		Fabaceae	<i>Bauhinia</i>	<i>variegata</i>
<i>Euseius</i>	<i>oolong</i>	Euphorbiaceae	<i>Macaranga</i>	<i>tanarius</i>
		Fabaceae	<i>Bauginia</i>	<i>purpurea</i>
		Theaceae	<i>Camellia</i>	<i>sinensis</i>
<i>Euseius</i>	<i>ovalis</i>	Asteraceae	<i>Ageratum</i>	<i>houstoniamum</i>
		Boraginaceae	<i>Cordia</i>	<i>dichotoma</i>
		Brassicaceae	<i>Brassica</i>	<i>rapa</i>
		Burseraceae	<i>Canarium</i>	<i>album</i>
		Crassulaceae	<i>Bryophyllum</i>	<i>pinnatum</i>
		Euphorbiaceae	<i>Bischofia</i>	<i>javanica</i>
		Euphorbiaceae	<i>Macaranga</i>	<i>tanarius</i>
		Fabaceae	<i>Bauhinia</i>	<i>variegata</i>
		Lauraceae	<i>Cinnamomum</i>	<i>camphora</i>
		Leguminosae	<i>Phaseolus</i>	<i>lunatus</i>
		Lygodiaceae	<i>Lygodium</i>	<i>japonicum</i>
		Lythraceae	<i>Lagerstroemia</i>	<i>speciosa</i>
		Moraceae	<i>Morus</i>	<i>alba</i>
		Moraceae	<i>Morus</i>	sp.
		Moraceae	<i>Broussonetia</i>	<i>papyrifera</i>
		Passifloraceae	<i>Passiflora</i>	<i>edulis</i>
		Polygonaceae	<i>Persicaria</i>	<i>chinensis</i>

Appendix III. (Continued)



		Rosaceae	<i>Pyrus</i>	sp.
		Rutaceae	<i>Citrus</i>	<i>sinensis</i>
		Salicaceae	<i>Salix</i>	<i>chaenomeloides</i>
		Sapindaceae	<i>Koelreuteria</i>	<i>henryi</i>
		Solanaceae	<i>Lycium</i>	<i>chinense</i>
		Staphyleaceae	<i>Turpinia</i>	<i>formosana</i>
		Urticaceae	<i>Debregeasia</i>	<i>orientalis</i>
		Vitaceae	<i>Vitis</i>	<i>vinifera</i>
<i>Euseius</i>	<i>paraovalis</i>	Euphorbiaceae	<i>Macaranga</i>	<i>sinensis</i>
		Euphorbiaceae	<i>Macaranga</i>	<i>tanarius</i>
		Moraceae	<i>Morus</i>	<i>alba</i>
		Ulmaceae	<i>Trema</i>	<i>orientalis</i>
<i>Euseius</i>	<i>sojaensis</i>	Arecaceae	<i>Cocos</i>	<i>nucifera</i>
		Caricaceae	<i>Carica</i>	<i>papaya</i>
		Cupressaceae	<i>Calocedrus</i>	<i>formosana</i>
		Fabaceae	<i>Bauhinia</i>	<i>variegata</i>
		Fabaceae	<i>Pueraria</i>	<i>lobata</i>
		Lauraceae	<i>Machilus</i>	<i>zuihensis</i>
		Lauraceae	<i>Machilus</i>	sp.
		Malvaceae	<i>Pachira</i>	<i>aquatica</i>
		Moraceae	<i>Morus</i>	<i>australis</i>
		Moraceae	<i>Morus</i>	sp.
		Poaceae	<i>Dendrocalamus</i>	<i>latiflorus</i>
		Rosaceae	<i>Prunus</i>	<i>campanulata</i>
		Rosaceae	<i>Prunus</i>	<i>persica</i>
		Rosaceae	<i>Prunus</i>	<i>salicina</i>
		Rosaceae	<i>Prunus</i>	<i>serrulata</i>
		Rosaceae	<i>Prunus</i>	sp.
		Rosaceae	<i>Pyrus</i>	<i>communis</i>
		Staphyleaceae	<i>Turpinia</i>	<i>foromsana</i>
<i>Paraphytoseius</i>	<i>chihpenensis</i>	Urticaceae	<i>Debregeasia</i>	<i>orientalis</i>
		Euphorbiaceae	<i>Macaranga</i>	<i>tanarius</i>
<i>Paraphytoseius</i>	<i>cracentis</i>	Euphorbiaceae	<i>Mallotus</i>	<i>paniculatus</i>
		Euphorbiaceae	<i>Mallotus</i>	<i>japonicus</i>
		Fabaceae	<i>Pueraria</i>	<i>lobata</i>
		Lamiaceae	<i>Callicarpa</i>	<i>formosana</i>
		Melastomataceae	<i>Melastoma</i>	<i>malabathricum</i>
		Moraceae	<i>Broussonetia</i>	<i>papyrrifera</i>
		Rosaceae	<i>Rubus</i>	<i>formosensis</i>

Appendix III. (Continued)

<i>Paraphytoseius</i>	<i>hualienensis</i>	Vitaceae	<i>Ampelopsis</i>	<i>brevipedunculata</i>
		Melastomataceae	<i>Melastoma</i>	<i>candidum</i>
<i>Paraphytoseius</i>	<i>orientalis</i>	Asteraceae	<i>Blumea</i>	<i>balsamifera</i>
		Boraginaceae	<i>Ehretia</i>	<i>macrophylla</i>
		Euphorbiaceae	<i>Macaranga</i>	<i>tanarius</i>
		Euphorbiaceae	<i>Mallotus</i>	<i>paniculatus</i>
		Meliaceae	<i>Sandoricum</i>	<i>koetjape</i>
		Moraceae	<i>Broussonetia</i>	<i>papyrifera</i>
		Moraceae	<i>Morus</i>	sp.
<i>Okiseius</i>	<i>subtropicus</i>	Araliaceae	<i>Schefflera</i>	<i>octophylla</i>
		Cupressaceae	<i>Cupressus</i>	sp.
		Euphorbiaceae	<i>Macaranga</i>	<i>tanarius</i>
		Euphorbiaceae	<i>Mallotus</i>	<i>japonicus</i>
		Euphorbiaceae	<i>Mallotus</i>	<i>paniculatus</i>
		Euphorbiaceae	<i>Ricinus</i>	<i>communis</i>
		Fabaceae	<i>Acacia</i>	<i>confusa</i>
		Fabaceae	<i>Pueraria</i>	<i>lobata</i>
		Malvaceae	<i>Hibiscus</i>	<i>rosa-sinensis</i>
		Malvaceae	<i>Hibiscus</i>	sp.
		Malvaceae	<i>Hibiscus</i>	<i>tiliaceus</i>
		Melastomataceae	<i>Melastoma</i>	<i>candidum</i>
		Moraceae	<i>Morus</i>	sp.
		Polygonaceae	<i>Polygonum</i>	<i>perfoliatum</i>
		Rosaceae	<i>Prunus</i>	sp.
		Theaceae	<i>Schima</i>	<i>superba</i>
		Viticoideae	<i>Vitex</i>	sp.
<i>Okiseius</i>	<i>formosanus</i>	unknown		
<i>Amblyseius</i>	<i>alpinia</i>	Adoxaceae	<i>Viburnum</i>	<i>luzonicum</i>
		Bignoniaceae	<i>Tabebuia</i>	<i>chrysantha</i>
		Canabaceae	<i>Trema</i>	<i>orientalis</i>
		Cupressaceae	<i>Cunninghamia</i>	<i>lanceolata</i>
		Fagaceae	<i>Quercus</i>	<i>variabilis</i>
		Malvaceae	<i>Hibiscus</i>	<i>rfragilis</i>
		Poaceae	<i>Miscanthus</i>	<i>transmorrissonensis</i>
		Rosaceae	<i>Prunus</i>	sp.
		Rosaceae	<i>Rhaphiolepis</i>	<i>indica</i>
		Rutaceae	<i>Citrus</i>	<i>nobilis</i>
		Salicaceae	<i>Salix</i>	<i>argyracea</i>
		Theaceae	<i>Schima</i>	<i>superba</i>

Appendix III. (Continued)



<i>Amblyseius</i>	<i>bellatulus</i>	Urticaceae	<i>Debregeasia</i>	<i>orientalis</i>
		Amaranthaceae	<i>Alternanthera</i>	<i>sessilis</i>
		Amaryllidaceae	<i>Allium</i>	<i>fistulosum</i>
		Asteraceae	<i>Ageratum</i>	<i>conyzoides</i>
		Asteraceae	<i>Ageratum</i>	<i>houstonianum</i>
		Asteraceae	<i>Eclipta</i>	<i>prostrata</i>
		Brassicaceae	<i>Rorippa</i>	<i>indica</i>
		Calophyllaceae	<i>Calophyllum</i>	<i>inophyllum</i>
		Caprifoliaceae	<i>Sambucus</i>	<i>formosana</i>
		Convolvulaceae	<i>Ipomoea</i>	<i>acuminate</i>
		Cucurbitaceae	<i>Lagenaria</i>	<i>siceraria</i>
		Fabaceae	<i>Arachis</i>	<i>hypogaea</i>
		Fabaceae	<i>Vigna</i>	<i>unguiculata</i>
		Meliaceae	<i>Toona</i>	<i>sinensis</i>
		Myrtaceae	<i>Psidium</i>	<i>guajava</i>
		Poaceae	<i>Bothriochloa</i>	<i>ischaemum</i>
		Poaceae	<i>Oryza</i>	<i>sativa</i>
		Poaceae	<i>Zea</i>	<i>mays</i>
		Polygonaceae	<i>Polygonum</i>	<i>perfoliatum</i>
		Rhamnaceae	<i>Ziziphus</i>	<i>auritiana</i>
		Solanaceae	<i>Solanum</i>	<i>melongena</i>
		Vitaceae	<i>Ampelopsis</i>	<i>brevipedunculata</i>
		Zingiberaceae	<i>Zingiber</i>	<i>officinale</i>
<i>Amblyseius</i>	<i>eharai</i>	Amaranthaceae	<i>Achyranthes</i>	<i>aspera</i>
		Anacardiaceae	<i>Rhus</i>	<i>javanica</i>
		Anacardiaceae	<i>Mangifera</i>	<i>indica</i>
		Annonaceae	<i>Annona</i>	<i>atemoya</i>
		Arecaceae	<i>Arenga</i>	<i>tremula</i>
		Asteraceae	<i>Ageratum</i>	<i>houstonianum</i>
		Asteraceae	<i>Bidens</i>	<i>pilosa</i>
		Asteraceae	<i>Crassocephalum</i>	<i>crepidioides</i>
		Boraginaceae	<i>Cordia</i>	<i>dichotoma</i>
		Cannabaceae	<i>Humulus</i>	<i>scandens</i>
		Cannabaceae	<i>Trema</i>	<i>orientalis</i>
		Caricaceae	<i>Carica</i>	<i>papaya</i>
		Convolvulaceae	<i>Ipomoea</i>	<i>indica</i>
		Cucurbitaceae	<i>Lagenaria</i>	<i>siceraria</i>
		Cupressaceae	<i>Cunninghamia</i>	<i>lanceolata</i>
		Ebenaceae	<i>Diospyros</i>	<i>kaki</i>

Appendix III. (Continued)



Euphorbiaceae	<i>Bischofia</i>	<i>javanica</i>
Euphorbiaceae	<i>Bridelia</i>	<i>pulcherrima</i>
Euphorbiaceae	<i>Euphorbia</i>	<i>tanarius</i>
Euphorbiaceae	<i>Macaranga</i>	<i>communis</i>
Euphorbiaceae	<i>Ricinus</i>	<i>fordii</i>
Euphorbiaceae	<i>Vernicia</i>	<i>pinnata</i>
Fabaceae	<i>Millettia</i>	<i>formosa</i>
Fabaceae	<i>Lespedeza</i>	<i>kusanoi</i>
Lauraceae	<i>Machilus</i>	<i>zuihoensis</i>
Lauraceae	<i>Machilus</i>	<i>nobilis</i>
Lauraceae	<i>Laurus</i>	<i>acuminata</i>
Lauraceae	<i>Litsea</i>	<i>azedarach</i>
Meliaceae	<i>Melia</i>	<i>erecta</i>
Moraceae	<i>Ficus</i>	<i>fistulosa</i>
Moraceae	<i>Ficus</i>	<i>irisana</i>
Moraceae	<i>Ficus</i>	sp.
Moraceae	<i>Morus</i>	<i>paradisiaca</i>
Musaceae	<i>Musa</i>	<i>guajava</i>
Myrtaceae	<i>Psidium</i>	<i>samarangense</i>
Myrtaceae	<i>Syzygium</i>	sp.
Pinaceae	<i>Pinus</i>	<i>oldhamii</i>
Poaceae	<i>Bambusa</i>	<i>sativa</i>
Poaceae	<i>Oryza</i>	<i>makinoi</i>
Poaceae	<i>Phyllostachys</i>	<i>bicolor</i>
Poaceae	<i>Sorghum</i>	<i>cocos</i>
Polyporaceae	<i>Poria</i>	<i>grata</i>
Ranunculaceae	<i>Clematis</i>	<i>chinensis</i>
Ranunculaceae	<i>Coptis</i>	<i>japonica</i>
Risaceae	<i>Eriobotrya</i>	<i>campanulata</i>
Rosaceae	<i>Prunus</i>	
Rosaceae	<i>Pyrus</i>	<i>pyrifolia</i>
Rutaceae	<i>Citrus</i>	<i>reticulata</i>
Sapindaceae	<i>Dimocarpus</i>	<i>longan</i>
Solanaceae	<i>Solanum</i>	<i>erianthum</i>
Solanaceae	<i>Solanum</i>	<i>melongena</i>
Staphyleaceae	<i>Turpinia</i>	<i>formosana</i>
Theaceae	<i>Camellia</i>	<i>sinensis</i>
Urticaceae	<i>Boehmeria</i>	<i>nivea</i>
Urticaceae	<i>Dendrocnide</i>	<i>meyeniana</i>

Appendix III. (Continued)



<i>Amblyseius</i>	<i>herbicolus</i>	Verbenaceae	<i>Lantana</i>	<i>camara</i>
		Vitaceae	<i>Vitis</i>	<i>vinifera</i>
		Actinidiaceae	<i>Saurauia</i>	<i>tristyla</i>
		Anacardiaceae	<i>Mangifera</i>	<i>indica</i>
		Annonaceae	<i>Annona</i>	<i>atemoya</i>
		Asteraceae	<i>Ageratum</i>	<i>houstonianum</i>
		Asteraceae	<i>Crassocephalum</i>	<i>crepidioides</i>
		Asteraceae	<i>Bidens</i>	<i>pilosa</i>
		Betulaceae	<i>Carpinus</i>	<i>kawakamii</i>
		Euphorbiaceae	<i>Bischofia</i>	<i>javanica</i>
		Euphorbiaceae	<i>Bridelia</i>	<i>balansae</i>
		Fabaceae	<i>Lespedeza</i>	<i>formosa</i>
		Hydrangeaceae	<i>Hydrangea</i>	sp.
		Lamiaceae	<i>Callicarpa</i>	<i>formosana</i>
		Lauraceae	<i>Machilus</i>	<i>zuihoensis</i>
		Moraceae	<i>Broussonetia</i>	<i>papyrifera</i>
		Moraceae	<i>Morus</i>	sp.
		Poaceae	<i>Phyllostachys</i>	<i>makinoi</i>
		Polygonaceae	<i>Polygonum</i>	<i>chinense</i>
		Rosaceae	<i>Rubus</i>	sp.
		Rosaceae	<i>Prunus</i>	<i>persica</i>
		Rosaceae	<i>Prunus</i>	sp.
		Sapindaceae	<i>Euphorbia</i>	<i>longan</i>
		Taxodiaceae	<i>Tawania</i>	<i>cryptomerioides</i>
		Ulmaceae	<i>Ulmus</i>	<i>uyematsui</i>
		Urticaceae	<i>Boehmeria</i>	sp.
		Urticaceae	<i>Oreocnide</i>	<i>pedunculata</i>
<i>Amblyseius</i>	<i>largoensis</i>	Anacardiaceae	<i>Mangifera</i>	<i>indica</i>
		Annonaceae	<i>Annona</i>	<i>squamosa</i>
		Arecaceae	<i>Areca</i>	<i>catechu</i>
		Arecaceae	<i>Cocos</i>	<i>nucifera</i>
		Arecaceae	<i>Trachycarpus</i>	<i>fortune</i>
		Bignoniaceae	<i>Tabebuia</i>	<i>chrysantha</i>
		Fabaceae	<i>Millettia</i>	<i>pinnata</i>
		Fabaceae	<i>Vigna</i>	<i>ungiculata</i>
		Lauraceae	<i>Persea</i>	<i>aamericana</i>
		Malvaceae	<i>Pachira</i>	<i>aquatic</i>
		Moraceae	<i>Morus</i>	sp.
		Myrtaceae	<i>Syzygium</i>	<i>samarangense</i>

Appendix III. (Continued)



		Sapindaceae	<i>Dimocarpus</i>	<i>longan</i>
		Urticaceae	<i>Boehmeria</i>	<i>nivea</i>
<i>Amblyseius</i>	<i>pascalis</i>	unknown		
<i>Amblyseius</i>	<i>trisetosus</i>	unknown		
<i>Amblyseius</i>	<i>tamatavensis</i>	Amaranthaceae	<i>Alternanthera</i>	<i>nodiflora</i>
		Anacardiaceae	<i>Mangifera</i>	<i>indica</i>
		Arecaceae	<i>Areca</i>	<i>catechu</i>
		Arecaceae	<i>Cocos</i>	<i>nucifera</i>
		Asparagaceae	<i>Cordyline</i>	<i>terminalis</i>
		Asteraceae	<i>Ageratum</i>	<i>houstonianum</i>
		Asteraceae	<i>Artemisia</i>	<i>princeps</i>
		Asteraceae	<i>Erigeron</i>	<i>canadensis</i>
		Asteraceae	<i>Ixeris</i>	<i>laevigata</i>
		Asteraceae	<i>Osteospermum</i>	sp.
		Cucurbitaceae	<i>Cucumis</i>	<i>sativus</i>
		Cucurbitaceae	<i>Luffa</i>	<i>cylindrica</i>
		Cupressaceae	<i>Platycladus</i>	<i>orientalis</i>
		Euphorbiaceae	<i>Euphorbia</i>	<i>pulcherrima</i>
		Euphorbiaceae	<i>Macaranga</i>	<i>tanarius</i>
		Euphorbiaceae	<i>Mallotus</i>	<i>japonicus</i>
		Fabaceae	<i>Acacia</i>	<i>confusa</i>
		Fabaceae	<i>Phaseolus</i>	<i>vulgaris</i>
		Fabaceae	<i>Pueraria</i>	<i>lobata</i>
		Lamiaceae	<i>Platostoma</i>	<i>palustre</i>
		Lamiaceae	<i>Salvia</i>	<i>officinalis</i>
		Malpighiaceae	<i>Malpighia</i>	<i>emarginata</i>
		Moraceae	<i>Morus</i>	<i>alba</i>
		Myrtaceae	<i>Psidium</i>	<i>guajava</i>
		Orchidaceae	<i>Aranthera</i>	sp.
		Orchidaceae	<i>Vanda</i>	sp.
		Piperaceae	<i>Piper</i>	<i>betle</i>
		Piperaceae	<i>Piper</i>	<i>nigrum</i>
		Rhamnaceae	<i>Ziziphus</i>	<i>mauritiana</i>
		Rosaceae	<i>Prunus</i>	<i>persica</i>
		Rosaceae	<i>Prunus</i>	sp.
		Rosaceae	<i>Pyrus</i>	sp.
		Sapindaceae	<i>Euphoria</i>	<i>longan</i>
		Solanaceae	<i>Solanum</i>	<i>melongena</i>
		Strelitziaceae	<i>Strelizia</i>	<i>reginae</i>

Appendix III. (Continued)



		Theaceae	<i>Camellia</i>	<i>sinensis</i>
		Urticaceae	<i>Boehmeria</i>	<i>nivea</i>
		Verbenaceae	<i>Lantana</i>	<i>camara</i>
		Vitaceae	<i>Ampelopsis</i>	<i>glandulosa</i>
		Vitaceae	<i>Vitis</i>	<i>vinifera</i>
<i>Paraamblyseius</i>	<i>formosanus</i>	Arecaceae	<i>Calamus</i>	<i>margaritae</i>
		Melastomataceae	<i>Melastoma</i>	<i>candidum</i>
<i>Phytoscutus</i>	<i>salebrosus</i>	Altingiaceae	<i>Liquidambar</i>	<i>formosana</i>
		Lauraceae	<i>Litsea</i>	sp.
		Melastomataceae	<i>Melastoma</i>	<i>candidum</i>
		Moraceae	<i>Morus</i>	sp.
		Rutaceae	<i>Citrus</i>	sp.
<i>Proprioseiopsis</i>	<i>asetus</i>	Amaranthaceae	<i>Alternanthera</i>	<i>nodiflora</i>
		Amaryllidaceae	<i>Allium</i>	<i>fistulosum</i>
		Asteraceae	<i>Emilia</i>	<i>sonchifolia</i>
		Asteraceae	<i>Hemistepta</i>	<i>lyrata</i>
		Asteraceae	<i>Tridax</i>	<i>procumbens</i>
		Convolvulaceae	<i>Cucumis</i>	<i>melo</i>
		Convolvulaceae	<i>Cuscuta</i>	<i>austrias</i>
		Cucurbitaceae	<i>Ipomoea</i>	<i>acuminate</i>
		Magnoliaceae	<i>Michelia</i>	<i>compressa</i>
		Malvaceae	<i>Sida</i>	<i>rhombifolia</i>
		Poaceae	<i>Oryza</i>	<i>sativa</i>
		Poaceae	<i>Saccharum</i>	<i>sinensis</i>
		Poaceae	<i>Zea</i>	<i>mays</i>
		Proteaceae	<i>Leucadendron</i>	<i>leucocephala</i>
		Solanaceae	<i>Solanum</i>	<i>melongena</i>
		Theaceae	<i>Camellia</i>	<i>sinensis</i>
		Vitaceae	<i>Vitis</i>	<i>vinifera</i>
		Zingiberaceae	<i>Zingiber</i>	<i>officinale</i>
<i>Proprioseiopsis</i>	<i>ovatus</i>	Apiaceae	<i>Centella</i>	<i>asiatica</i>
		Amaranthaceae	<i>Alternanthera</i>	<i>nodiflora</i>
		Asteraceae	<i>Ageratum</i>	<i>conyzoides</i>
		Asteraceae	<i>Ageratum</i>	<i>houstonianum</i>
		Asteraceae	<i>Hemistepta</i>	<i>lyrata</i>
		Oxalidaceae	<i>Oxalis</i>	<i>corymbosa</i>
		Verbenaceae	<i>Lantana</i>	<i>camara</i>
<i>Proprioseiopsis</i>	<i>pubes</i>	unknown		
<i>Neoseiulus</i>	<i>baraki</i>	Apocynaceae	<i>Nerium</i>	<i>oleander</i>

Appendix III. (Continued)



<i>Neoseiulus</i>	<i>barkeri</i>	Gleicheniaceae	<i>Dicranopteris</i>	<i>linearis</i>
		Poaceae	<i>Echinochloa</i>	<i>colona</i>
		Poaceae	<i>Imperata</i>	<i>cylindrica</i>
		Poaceae	<i>Saccharum</i>	sp.
		Adoxaceae	<i>Sambucus</i>	<i>formosana</i>
		Amaranthaceae	<i>Kochia</i>	sp.
		Amaranthaceae	<i>Achyranthes</i>	<i>obtusifolia</i>
		Amaryllidaceae	<i>Allium</i>	<i>fistulosum</i>
		Apiaceae	<i>Anthriscus</i>	<i>cerefolium</i>
		Arecaceae	<i>Livistona</i>	<i>chinensis</i>
		Asparagaceae	<i>Asparagus</i>	<i>officinalis</i>
		Asteraceae	<i>Artemisia</i>	<i>argyi</i>
		Asteraceae	<i>Chrysanthemum</i>	sp.
		Asteraceae	<i>Crossostephium</i>	<i>chinensis</i>
		Asteraceae	<i>Lactuca</i>	<i>sativa</i>
		Bromeliaceae	<i>Ananas</i>	<i>comosus</i>
		Caricaceae	<i>Carica</i>	<i>papaya</i>
		Cucurbitaceae	<i>Citrullus</i>	<i>vulgaris</i>
		Cucurbitaceae	<i>Cucumis</i>	<i>sativus</i>
		Fabaceae	<i>Arachis</i>	<i>hypogaea</i>
		Fabaceae	<i>Mimosa</i>	<i>pudica</i>
		Fagaceae	<i>Cyclobalanopsis</i>	<i>glauca</i>
		Lamiaceae	<i>Ocimum</i>	<i>sanctum</i>
		Lamiaceae	<i>Perilla</i>	<i>frutescens</i>
		Lamiaceae	<i>Thymes</i>	sp.
		Malvaceae	<i>Sida</i>	<i>rhombifolia</i>
		Moraceae	<i>Morus</i>	<i>alba</i>
		Moraceae	<i>Morus</i>	sp.
		Pinaceae	<i>Larix</i>	<i>kaempferi</i>
		Plumbaginaceae	<i>Limonium</i>	sp.
		Poaceae	<i>Saccharum</i>	<i>sinensis</i>
		Poaceae	<i>Sorghum</i>	<i>bicolor</i>
		Rosaceae	<i>Malus</i>	<i>pumila</i>
		Rutaceae	<i>Citrus</i>	sp.
		Solanaceae	<i>Capsicum</i>	<i>annuum</i>
		Solanaceae	<i>Solanum</i>	<i>melongena</i>
		Vitaceae	<i>Vitis</i>	<i>vinifera</i>
<i>Neoseiulus</i>	<i>longispinosus</i>	Apocynaceae	<i>Asclepias</i>	<i>curassavica</i>
		Cannabaceae	<i>Trema</i>	<i>orientalis</i>

Appendix III. (Continued)

<i>Neoseiulus</i>	<i>makuwa</i>	Caricaceae	<i>Carica</i>	<i>papaya</i>
		Euphorbiaceae	<i>Manihot</i>	<i>esculenta</i>
		Fabaceae	<i>Bauhinia</i>	<i>variegata</i>
		Poaceae	<i>Phyllostachys</i>	<i>makinoi</i>
		Vitaceae	<i>Ampelopsis</i>	sp.
		Vitaceae	<i>Vitis</i>	<i>vinifera</i>
		Amaranthaceae	<i>Alternanthera</i>	<i>nodiflora</i>
		Amaranthaceae	<i>Amaranthus</i>	<i>spinosus</i>
		Asteraceae	<i>Ageratum</i>	<i>houstonianum</i>
		Asteraceae	<i>Lactuca</i>	<i>sativa</i>
		Brassicaceae	<i>Brassica</i>	<i>rapa</i>
		Cucurbitaceae	<i>Cucumis</i>	<i>melo</i>
		Cucurbitaceae	<i>Luffa</i>	<i>cylindrica</i>
		Euphorbiaceae	<i>Euphorbia</i>	<i>hirta</i>
		Fabaceae	<i>Glycine</i>	<i>max</i>
		Oxalidaceae	<i>Averrhoa</i>	<i>carambola</i>
		Poaceae	<i>Oryza</i>	<i>sativa</i>
		Poaceae	<i>Triticum</i>	<i>aestivum</i>
		Rosaceae	<i>Rubus</i>	<i>hayatakoidzumii</i>
		Theaceae	<i>Camellia</i>	<i>sinensis</i>
		Vitaceae	<i>Vitis</i>	<i>vinifera</i>
<i>Neoseiulus</i>	<i>monomacrosetus</i>	unknown		
<i>Neoseiulus</i>	<i>spineus</i>	unknown		
<i>Neoseiulus</i>	<i>taiwanicus</i>	Bromeliaceae	<i>Ananas</i>	<i>comosus</i>
<i>Neoseiulus</i>	<i>womersleyi</i>	Poaceae	<i>Oryza</i>	<i>sativa</i>
		Anacardiaceae	<i>Mangifera</i>	<i>indica</i>
		Anacardiaceae	<i>Rhus</i>	<i>chinensis</i>
		Annonaceae	<i>Annona</i>	<i>suqamosa</i>
		Apiaceae	<i>Angelica</i>	<i>hirsutiflora</i>
		Apocynaceae	<i>Asclepias</i>	<i>curassavica</i>
		Araucariaceae	<i>Araucaria</i>	<i>cunninghamii</i>
		Aristolochiaceae	<i>Aristolochia</i>	<i>kankauensis</i>
		Asteraceae	<i>Conyza</i>	<i>sumatrensis</i>
		Caricaceae	<i>Carica</i>	<i>papaya</i>
		Cucurbitaceae	<i>Luffa</i>	<i>aegyptiaca</i>
		Euphorbiaceae	<i>Euphorbia</i>	<i>pulcherrima</i>
		Euphorbiaceae	<i>Ricinus</i>	<i>communis</i>
		Fabaceae	<i>Crotalaria</i>	<i>pallida</i>
		Malvaceae	<i>Sida</i>	<i>rhombifolia</i>

Appendix III. (Continued)

<i>Scapulaseius</i>	<i>anuwati</i>	Moraceae	<i>Broussonetia</i>	<i>papyrifera</i>
		Moraceae	<i>Morus</i>	sp.
		Orchidaceae	<i>Phalaaenopsis</i>	sp.
		Oxalidaceae	<i>Oxalis</i>	<i>corniculata</i>
		Plumbaginaceae	<i>Plumbago</i>	<i>zeylanica</i>
		Pinaceae	<i>Pinus</i>	sp.
		Poaceae	<i>Miscanthus</i>	sp.
		Poaceae	<i>Sorghum</i>	<i>bicolor</i>
		Poaceae	<i>Setaria</i>	<i>palmifolia</i>
		Rutaceae	<i>Citrus</i>	sp.
		Solanaceae	<i>Lycopersicon</i>	<i>esculentum</i>
		Solanaceae	<i>Solanum</i>	<i>aculeatissimum</i>
		Verbenaceae	<i>Verbena</i>	<i>officinalis</i>
		Vitaceae	<i>Vitis</i>	<i>vinifera</i>
		Euphorbiaceae	<i>Macaranga</i>	<i>tanarius</i>
		Lythraceae	<i>Lagerstroemia</i>	<i>subcostata</i>
		Moraceae	<i>Morus</i>	sp.
		Rosaceae	<i>Rubus</i>	<i>taiwanianus</i>
		Rubiaceae	<i>Coffea</i>	sp.
<i>Scapulaseius</i>	<i>cantonensis</i>	Urticaceae	<i>Boehmeria</i>	<i>densiflora</i>
		Actinidiaceae	<i>Saurauia</i>	<i>tristyla</i>
		Anacardiaceae	<i>Mangifera</i>	<i>indica</i>
		Asteraceae	<i>Ageratum</i>	<i>houstonianum</i>
		Boraginaceae	<i>Corida</i>	<i>dichotoma</i>
		Cannabaceae	<i>Celtis</i>	<i>sinensis</i>
		Cannabaceae	<i>Trema</i>	<i>orientalis</i>
		Euphorbiaceae	<i>Acalypha</i>	<i>grandis</i>
		Euphorbiaceae	<i>Acalypha</i>	<i>wilkesiana</i>
		Euphorbiaceae	<i>Mallotus</i>	<i>japonicus</i>
		Euphorbiaceae	<i>Vernicia</i>	<i>fordii</i>
		Lythraceae	<i>Pemphis</i>	<i>acidula</i>
		Malvaceae	<i>Hibiscus</i>	<i>tiliaceus</i>
		Malvaceae	<i>Malvaviscus</i>	<i>arboreus</i>
		Meliaceae	<i>Swietenia</i>	<i>macrophylla</i>
		Moraceae	<i>Ficus</i>	<i>benhalensis</i>
		Moraceae	<i>Morus</i>	<i>alba</i>
		Moraceae	<i>Morus</i>	sp.
		Myrtaceae	<i>Eucalyptus</i>	sp.
		Piperaceae	<i>Piper</i>	<i>betle</i>

Appendix III. (Continued)

<i>Scapulaseius</i>	<i>okinawanus</i>	Poaceae	<i>Dendrocalamus</i>	<i>latiflorus</i>
		Poaceae	<i>Miscanthus</i>	sp.
		Poaceae	<i>Zea</i>	<i>mays</i>
		Rosaceae	<i>Prunus</i>	<i>salicina</i>
		Rosaceae	<i>Prunus</i>	<i>serrulata</i>
		Rutaceae	<i>Citrus</i>	<i>sinensis</i>
		Solanaceae	<i>Lycium</i>	<i>chinensis</i>
		Theaceae	<i>Camellia</i>	<i>sinensis</i>
		Urticaceae	<i>Boehmeria</i>	<i>densiflora</i>
		Urticaceae	<i>Debregeasia</i>	<i>orientalis</i>
		Urticaceae	<i>Leucosyke</i>	<i>quadrinervia</i>
		Verbenaceae	<i>Lantana</i>	<i>camara</i>
		Verbenaceae	<i>Vitex</i>	<i>negundo</i>
		Vitaceae	<i>Ampelopsis</i>	<i>brevipedunculata</i>
		Amaranthaceae	<i>Achyranthes</i>	<i>aspera</i>
		Amaranthaceae	<i>Alternanthera</i>	<i>nodiflora</i>
		Apocynaceae	<i>Asclepia</i>	<i>curassavica</i>
		Asteraceae	<i>Ageratum</i>	<i>houstonianum</i>
		Asteraceae	<i>Ageratum</i>	sp.
		Asteraceae	<i>Crassocephalum</i>	<i>crepidiodes</i>
		Asteraceae	<i>Crassocephalum</i>	<i>rubens</i>
		Asteraceae	<i>Emilia</i>	<i>sonchifolia</i>
		Asteraceae	<i>Erigeron</i>	<i>coulteri</i>
		Asteraceae	<i>Gnaphalium</i>	<i>affine</i>
		Asteraceae	<i>lactuca</i>	<i>formosana</i>
		Asteraceae	<i>Tridax</i>	<i>procumbens</i>
		Asteraceae	<i>Xanthium</i>	<i>strumarium</i>
		Cannabaceae	<i>Humulus</i>	<i>japonicus</i>
		Cannabaceae	<i>Trema</i>	<i>orientalis</i>
		Cucurbitaceae	<i>Citrullus</i>	<i>vulgaris</i>
		Cucurbitaceae	<i>Cucumis</i>	<i>sativus</i>
		Euphorbiaceae	<i>Acalypha</i>	<i>grandis</i>
		Euphorbiaceae	<i>Mallotus</i>	<i>paniculatus</i>
		Fabaceae	<i>Aracjos</i>	<i>hypogea</i>
		Fabaceae	<i>Mimosa</i>	<i>pudica</i>
		Lamiaceae	<i>Hyptis</i>	<i>rhomboides</i>
		Lamiaceae	<i>Platostoma</i>	<i>palustre</i>
		Lythraceae	<i>Punica</i>	<i>granatum</i>
		Malvaceae	<i>Malvaviscus</i>	<i>arboreus</i>

Appendix III. (Continued)



		Malvaceae	<i>Sida</i>	<i>rhombifolia</i>
		Melastomataceae	<i>Melastoma</i>	<i>candidum</i>
		Moraceae	<i>Morus</i>	<i>alba</i>
		Plantaginaceae	<i>Plantago</i>	<i>major</i>
		Poaceae	<i>Setaria</i>	<i>palmifolia</i>
		Poaceae	<i>Zea</i>	<i>mays</i>
		Polygonaceae	<i>Polygonum</i>	<i>persicaria</i>
		Polygonaceae	<i>Rumex</i>	<i>japonicus</i>
		Rhamnaceae	<i>Ziziphus</i>	<i>mauritiana</i>
		Rhamnaceae	<i>Ziziphus</i>	<i>jujuba</i>
		Rosaceae	<i>Prunus</i>	<i>persica</i>
		Rubiaceae	<i>Citrus</i>	<i>sinensis</i>
		Rubiaceae	<i>Hedyotis</i>	<i>diffusa</i>
		Solanaceae	<i>Lycium</i>	<i>chinensis</i>
		Solanaceae	<i>Solanum</i>	<i>nigrum</i>
		Theaceae	<i>Camellia</i>	<i>sinensis</i>
		Verbenaceae	<i>Verbena</i>	<i>officinalis</i>
		Vitaceae	<i>Ampelopsis</i>	<i>brevipedunculata</i>
		Vitaceae	<i>Cayratia</i>	<i>japonica</i>
<i>Scapulaseius</i>	<i>tienhsainensis</i>	Asteraceae	<i>Lactuca</i>	<i>formosana</i>
		Poaceae	<i>Miscanthus</i>	<i>floridulus</i>
		Rosaceae	<i>Prunus</i>	sp.
		Poaceae	<i>Yushania</i>	<i>niitakayamensis</i>
<i>Scapulaseius</i>	<i>vestificus</i>	unknown		
<i>Phytoseius</i>	<i>coheni</i>	Leguminosae	<i>Pithecolobium</i>	<i>dulce</i>
		Verbenaceae	<i>Lantana</i>	<i>camara</i>
		Rhamnaceae	<i>Ziziphus</i>	<i>mauritiana</i>
<i>Phytoseius</i>	<i>crinitus</i>	Cannabaceae	<i>Celtis</i>	<i>sinensis</i>
		Cannabaceae	<i>Trema</i>	<i>orientalis</i>
		Euphorbiaceae	<i>Mallotus</i>	<i>paniculatus</i>
		Malvaceae	<i>Hibiscus</i>	<i>tiliaceus</i>
		Moraceae	<i>Morus</i>	<i>alba</i>
		Moraceae	<i>Ficus</i>	<i>pumila</i>
		Myrtaceae	<i>Psidium</i>	<i>guajava</i>
		Verbenaceae	<i>Lantana</i>	<i>camara</i>
<i>Phytoseius</i>	<i>hongkongensis</i>	Fabaceae	<i>Pueraria</i>	<i>lobata</i>
		Verbenaceae	<i>Lantana</i>	<i>camara</i>
<i>Phytoseius</i>	<i>minutus</i>	unknown		
<i>Phytoseius</i>	<i>rugatus</i>	unknown		

Appendix III. (Continued)



<i>Phytoseius</i>	<i>sonunensis</i>	Fabaceae	<i>Pueraria</i>	<i>lobata</i>
<i>Chantieus</i>	<i>contiguus</i>	Actinidiaceae	<i>Saurauia</i>	<i>tristyla</i>
		Anacardiaceae	<i>Mangifera</i>	<i>indica</i>
		Aquifoliaceae	<i>Ilex</i>	<i>pedunculosa</i>
		Araliaceae	<i>Schefflera</i>	<i>octophylla</i>
		Arecaceae	<i>Arenga</i>	<i>tremula</i>
		Cannabaceae	<i>Trema</i>	<i>orientalis</i>
		Ericaceae	<i>Rhododendron</i>	sp.
		Euphorbiaceae	<i>Mallotus</i>	<i>paniculatus</i>
		Fabaceae	<i>Acacia</i>	<i>confusa</i>
		Fabaceae	<i>Pueraria</i>	<i>montana</i>
		Lauraceae	<i>Actinodaphne</i>	<i>pedicellata</i>
		Lauraceae	<i>Machilus</i>	<i>kusanoi</i>
		Moraceae	<i>Ficus</i>	<i>fistulosa</i>
		Moraceae	<i>Morus</i>	sp.
		Piperaceae	<i>Piper</i>	<i>kadsura</i>
		Poaceae	<i>Bambusa</i>	<i>oldhamii</i>
		Poaceae	<i>Phyllostachys</i>	<i>makinoi</i>
		Polygonaceae	<i>Phymatosorus</i>	<i>scolopendria</i>
		Polypodiaceae	<i>Polygonum</i>	<i>chinensis</i>
		Rutaceae	<i>Citrus</i>	<i>nobilis</i>
		Sapindaceae	<i>Dodonaea</i>	<i>viscosa</i>
		Urticaceae	<i>Boehmeria</i>	<i>densiflora</i>
		Urticaceae	<i>Boehmeria</i>	<i>nivea</i>
		Urticaceae	<i>Debregeasia</i>	<i>orientalis</i>
		Urticaceae	<i>Dendrocnide</i>	sp.
		Urticaceae	<i>Elatostema</i>	<i>herbaceifolium</i>
<i>Neoseiulella</i>	<i>compta</i>	Casuarinaceae	<i>Casuarina</i>	<i>equisetifolia</i>
		Fabaceae	<i>Astragalus</i>	<i>sinicus</i>
		Verbenaceae	<i>Premna</i>	<i>serratifolia</i>
<i>Typhlodromus</i>	<i>changi</i>	Poaceae	<i>Arundo</i>	<i>formosana</i>
		Poaceae	<i>Bambusa</i>	<i>oldhamii</i>
		Poaceae	<i>Phyllostachys</i>	<i>makinoi</i>
<i>Typhlodromus</i>	<i>crossostephium</i>	Asteraceae	<i>Crossostephium</i>	<i>chinensis</i>
<i>Typhlodromus</i>	<i>eleglidus</i>	unknown		
<i>Typhlodromus</i>	<i>gracilentus</i>	Rubiaceae	<i>Lasianthus</i>	<i>wallcichii</i>
<i>Typhlodromus</i>	<i>lanyuensis</i>	Fabaceae	<i>Acacia</i>	<i>confusa</i>
		Moraceae	<i>Ficus</i>	<i>septica</i>
		Urticaceae	<i>Leucosyke</i>	<i>quadrinervia</i>

Appendix III. (Continued)

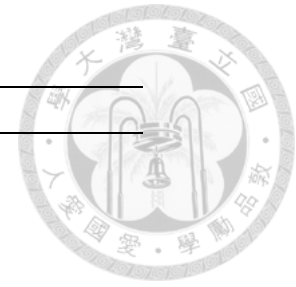


<i>Typhlodromus</i>	<i>neocrassus</i>	Rubiaceae	<i>Gardenia</i>	<i>jasminoides</i>
<i>Typhlodromus</i>	<i>obesus</i>	Bignoniaceae	<i>Tabebuia</i>	<i>chrysantha</i>
		Gramineae	<i>Chloris</i>	<i>barbata</i>
		Verbenaceae	<i>Premna</i>	<i>serratifolia</i>
		Malvaceae	<i>Sida</i>	<i>rhubifolia</i>
		Asteraceae	<i>Bidens</i>	<i>pilosa</i>
<i>Typhlodromus</i>	<i>serrulatus</i>	Anacardiaceae	<i>Mangifera</i>	<i>indica</i>
		Fabaceae	<i>Acacia</i>	<i>confusa</i>
		Juglandaceae	<i>Juglans</i>	<i>mandshurica</i>
		Lauraceae	<i>Cinnamomum</i>	<i>camphora</i>
		Malvaceae	<i>Hibiscus</i>	sp.
		Rubiaceae	<i>Garddenia</i>	<i>jasminoides</i>
		Ulmaceae	<i>Zelkova</i>	<i>serrata</i>
<i>Typhlodromus</i>	<i>ryukyuensis</i>	Araceae	<i>Alocaasia</i>	<i>macrorrhiza</i>
		Calameae	<i>Ddaemonorops</i>	<i>margaritae</i>
		Cannabaceae	<i>Trema</i>	<i>orientalis</i>
		Euphorbiaceae	<i>Macaranga</i>	<i>tanarius</i>
		Fabaceae	<i>Acacia</i>	<i>confusa</i>
		Fabaceae	<i>Lupinus</i>	<i>polyphyllus</i>
		Fagaceae	<i>Cyclobalanopsis</i>	<i>glauca</i>
		Lauraceae	<i>Machilus</i>	<i>zuihoensis</i>
		Magnoliaceae	<i>Michelia</i>	<i>alba</i>
		Moraceae	<i>Morus</i>	sp.
		Poaceae	<i>Digitaria</i>	<i>sanguinalis</i>
		Rosaceae	<i>Prunus</i>	<i>campanulata</i>
		Rutaceae	<i>Citrus</i>	sp.
		Solanaceea	<i>Petunia</i>	<i>hybrida</i>
<i>Typhlodromus</i>	<i>transvaalensis</i>	Alliaceae	<i>Allium</i>	<i>scorodoprasum</i>
		Fabaceae	<i>Acacia</i>	sp.
		Meliaceae	<i>Sandoricum</i>	<i>koetijape</i>
<i>Typhlodromus</i>	<i>tridentiger</i>	Cannabaceae	<i>Trema</i>	<i>orientalis</i>
		Euphorbiaceae	<i>Macaranga</i>	<i>sinensis</i>
		Euphorbiaceae	<i>Macaranga</i>	<i>tanarius</i>
		Euphorbiaceae	<i>Mallotus</i>	<i>japonicus</i>
		Fabaceae	<i>Acacia</i>	<i>confusa</i>
		Malvaceae	<i>Hibiscus</i>	<i>tiliaceus</i>
		Meliaceae	<i>Aglaia</i>	<i>chittagonga</i>
		Moraceae	<i>Morus</i>	<i>alba</i>
		Moraceae	<i>Morus</i>	sp.

Appendix III. (Continued)

Poaceae	<i>Digitaria</i>	<i>sanguinalis</i>
Rosaceae	<i>Prunus</i>	<i>campanulata</i>
Rutaceae	<i>Citrus</i>	sp.
Solanaceae	<i>Petunia</i>	<i>hybrida</i>
Verbenaceae	<i>Premna</i>	<i>serratifolia</i>

Appendix IV. List of Phytoseiidae from Taiwan



Species

Subfamily Amblyseiinae, 1961

Tribe Indoseiulini Ehara

Genus *Gynaeseius* Wainstein

Gynaeseius liturivorus (Ehara, 1982)

Gynaeseius santosoi (Ehara, 2005)

Tribe Euseiini Chant & McMurtry

Genus *Euseius* Wainstein

Euseius aizawai (Ehara & Bhandhufalck, 1977)

Euseius circellatus (Wu & Li, 1983)

Euseius daluensis Liao & Ho, 2017a

Euseius macaranga Liao & Ho, 2017a

Euseius nicholsi (Ehara & Lee, 1971)

Euseius oolong Liao & Ho, 2018

Euseius ovalis (Evans, 1953)

Euseius paraovalis Liao & Ho, 2017a

Euseius sojaensis (Ehara, 1964)

Tribe Kampimodromini Kolodochka, 1988

Subtribe Paraphytoseiina Chant & McMurtry, 2003

Genus *Paraphytoseius* Swirski & Schechter, 1961

Paraphytoseius chihpenensis Ho & Lo, 1989

Paraphytoseius cracentis (Corpuz & Rimando, 1966)

Paraphytoseius hualienensis Ho & Lo, 1989

Paraphytoseius orientalis (Narayanan, Kaur & Ghai, 1960)

Subtribe Kampimodromina Chant & McMurtry, 2003b

Genus *Okiseius* Ehara, 1967

Okiseius subtropicus Ehara, 1967

Okiseius formosanus Tseng, 1972

Tribe Amblyseiini Muma, 1961

Subtribe Amblyseiina Chant & McMurtry, 2004a

Genus *Amblyseius* Berlese, 1914

Amblyseius alpinia Tseng, 1983

Amblyseius bellatulus Tseng, 1983

Amblyseius eharai Amitai & Swirski, 1983

Amblyseius herbicolus (Chant, 1959b)

Amblyseius pascalis Tseng, 1983

Amblyseius trisetosus Tseng, 1983

Amblyseius tamatavensis Bloomers, 1974

Subtribe Arrenoseiina Chant & McMurtry, 2004b

Genus *Paraamblyseius* Muma, 1962



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- Paraamblyseius formosanus* (Ehara, 1970)
- Genus *Phytoscutus* Muma, 1961**
- Phytoscutus salebrosus* (Chant, 1960)
- Subtribe *Proprioseiopsina* Chant & McMurtry, 2004a**
- Genus *Proprioseiopsis* Muma, 1959b**
- Proprioseiopsis asetus* (Chant, 1959b)
- Proprioseiopsis ovatus* (Garman, 1958)
- Proprioseiopsis pubes* (Tseng, 1976)
- Tribe *Neoseiulini* Chant & McMurtry, 2003a**
- Genus *Neoseiulus* Hughes, 1948**
- Neoseiulus baraki* (Athias-Henriot, 1966)
- Neoseiulus barkeri* Hughes, 1948
- Neoseiulus longispinosus* (Evans, 1952)
- Neoseiulus monomacrosetus* (Tseng, 1976)
- Neoseiulus spineus* (Tseng, 1976)
- Neoseiulus taiwanicus* (Ehara, 1970)
- Neoseiulus womersleyi* (Schicha, 1975)
- Tribe *Typhlodromipsini* Chant & McMurtry, 2005c**
- Genus *Scapulaseius* Karg & Oomen-Kalsbeek, 1987**
- Scapulaseius anuwati* (Ehara & Bhandhufalck, 1977)
- Scapulaseius cantonensis* (Schicha, 1982)
- Scapulaseius okinawanus* (Ehara, 1967)
- Scapulaseius tienhsainensis* (Tseng, 1983)
- Scapulaseius vestificus* (Tseng, 1976)
- Subfamily *Phytoseiinae* Berlese, 1913**
- Genus *Phytoseius* Ribaga, 1904**
- Phytoseius coheni* Swirski & Shechter, 1961
- Phytoseius crinitus* Swirski & Shechter, 1961
- Phytoseius hongkongensis* Swirski & Shechter, 1961
- Phytoseius minutus* Narayanan, Kaur & Ghai, 1960
- Phytoseius rugatus* Tseng, 1976
- Phytoseius sonunensis* Ryu & Ehara, 1993
- Subfamily *Typhlodrominae* Wainstein, 1962**
- Tribe *Chantiini* Chant & McMurtry, 1994**
- Genus *Chanteius* Wainstein, 1962**
- Chanteius contiguus* (Chant, 1959a)
- Tribe *Typhlodromini* Wainstein, 1962**
- Genus *Neoseiulella* Muma, 1961**
- Neoseiulella compta* (Corpuz, 1966)
- Genus *Typhlodromus* Scheuten, 1857**
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Subgenus *Anthoseius* De Leon, 1959b

- Typhlodromus (Anthoseius) changi* Tseng, 1975
Typhlodromus (Anthoseius) crossostemphium Liao & Ho, 2017c
Typhlodromus (Anthoseius) eleglidus Tseng, 1983
Typhlodromus (Anthoseius) gracilentus Tseng, 1975
Typhlodromus (Anthoseius) lanyuensis Tseng, 1975
Typhlodromus (Anthoseius) neocrassus Tseng, 1983
Typhlodromus (Anthoseius) obesus Tseng, 1983
Typhlodromus (Anthoseius) serrulatus Ehara, 1972
Typhlodromus (Anthoseius) ryukyuensis Ehara, 1967
Typhlodromus (Anthoseius) transvaalensis (Nesbitt, 1951)
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