



THESIS APPROVAL

GRADUATE SCHOOL, KASETSART UNIVERSITY

Doctor of Philosophy (Tropical Agriculture)

DEGREE

Tropical Agriculture

Agriculture

FIELD

FACULTY

TITLE: Morphological Characterizations of Some Tetranychid Mites (Acari: Tetranychidae) of Thailand with Description of Three New Species

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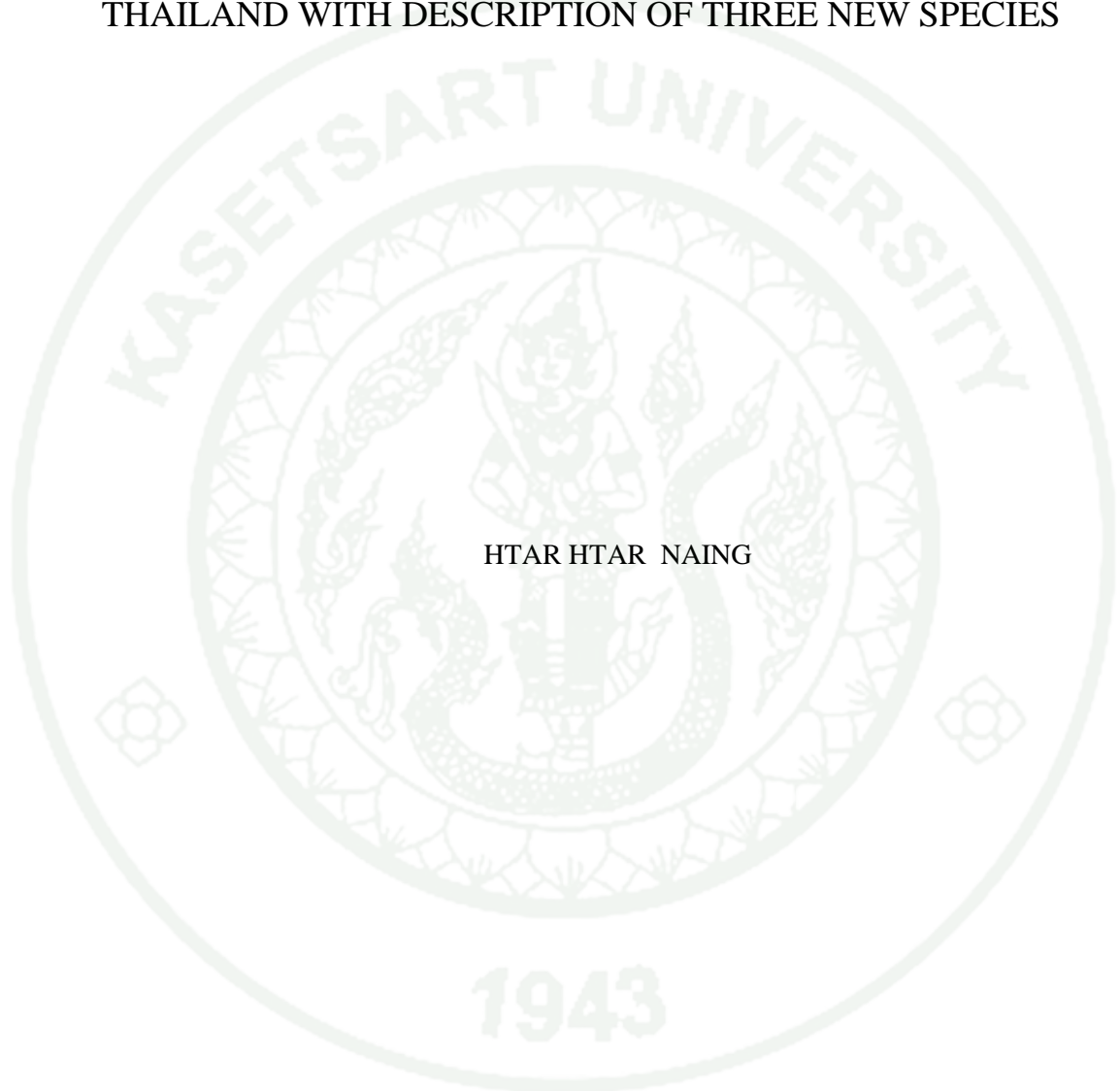
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THESIS

MORPHOLOGICAL CHARACTERIZATIONS OF SOME
TETRANYCHID MITES (ACARI: TETRANYCHIDAE) OF
THAILAND WITH DESCRIPTION OF THREE NEW SPECIES



HTAR HTAR NAING

A Thesis Submitted in Partial Fulfillment of
the Requirements for the Degree of
Doctor of Philosophy (Tropical Agriculture)
Graduate School, Kasetsart University

2014

Htar Htar Naing 2014: Morphological Characterizations of Some Tetranychid Mites (Acari: Tetranychidae) of Thailand with Description of Three New Species. Doctor of Philosophy (Tropical Agriculture), Major Field: Tropical Agriculture, Department of Tropical Agriculture. Thesis Advisor: Professor Angsumarn Chandrapatya, Ph.D. 247 pages.

Twenty five species of 8 genera were described in Thailand spider mite samples. Among these, two species of *Tetranychus* and one species of *Schizotetranychus* namely They are *Tetranychus occultaspina* sp. nov on *Ipomoea aquatica* Forssk, (Convolvulaceae), *Tetranychus truncatissimus* sp. nov on *Bambusa multiplex* (Lour.) Raeusch. ex Schult (Poaceae) and *Schizotetranychus krungthepensis* sp. nov. on sugarcane (*Saccharum officinarum*L.) (Poaceae) were new to science.

Oligonychus sacchari McGregor, 1942 and *Schizotetranychus malayanus* Ehara, 1988 were treated as new records for Thailand. *Oligonychus Sacchari* was collected from lemongrass, *Cymbopogon citratus* (Poaceae) and *S. malayanus* from two host plants; wild grass and wild bean plant.

Guava, *Aegle marmelos* (L.) Corr. (Rutaceae) was recorded for the first time as a new host plant for *Eotetranychus celtis* Ehara, 1965. Similarly, passion fruit plant, *Passiflora foetida* (L.) Corr. (Passifloraceae) was also recorded as a new host plant for *Tetranychus marianae* McGregor, 1950.

These new findings indicated that Thailand may have more wide varieties of host plants and more diverse species of Tetranychid mites.

Student's signature

Thesis Advisor's signature

ACKNOWLEDGEMENTS

Firstly, I could not express in words my heart-felt thanks to my thesis advisor Professor Dr. Angsumarn Chandrapatya for her willingness to try to get my degree by all means, then for sharing her profound expertise, valuable time, continuous taking care, valuable advice and guidance in all aspects for the thesis. I believe with no doubt that my Ph.D. study would never have been successful without her constant and kind understanding and encouragement. My sincerely thanks with the same gratitude also extend to Associate Professor Dr. Arinthip Thamchaipanet for her encouragement, sharing valuable knowledge and kindly moral support on my study.

I gratefully acknowledge Dr. Maria NAVAJAS (Ph.D, Directrice de Recherches, INRA, Supagro, Montpellier, France) for her kind understanding and support and valuable guidance on my study. And I gratefully acknowledge to Philippe Auger, INRA supagro, Montpellier, France for his kind support, sharing wise knowledge, and constructive suggestions for thesis manuscript.

I am also greatly indebted to all staff members of Entomology department (Kasetsart University), as well as the family of my advisor, my Thai friends and Myanmar friends for their kind assistance and encouragement throughout the study. I am very grateful to TICA–TRF–FE (Thailand International Development Cooperative Agency–Thailand Research Fund under Royal Golden Jubilee (RGJ)–French Embassy in Bangkok) (Grant No. PHD/0088/2551) for the scholarship and TRF Senior Research Scholar # RTA 4880006 under TRF for the financial support to conduct this study.

I would like to dedicate my deep appreciation to my former Professor Dr. Myint Thuang, Yezin Agricultural University (YAU), Myanmar, for his suggestion to study on the taxonomy of spider mites. My special thanks go to Dr. Aung Kyi, Pro-Rector (Retd.), YAU, for his moral support and encouragement throughout my study. My deeply thanks extend to Dr. Tin Htut, Rector, YAU, for his kind understanding and continuous encouragement to finish this study. Finally, my affectionate family and loved ones who cared, treated well and supported every need are recognized and memorized with love.

Htar Htar Naing

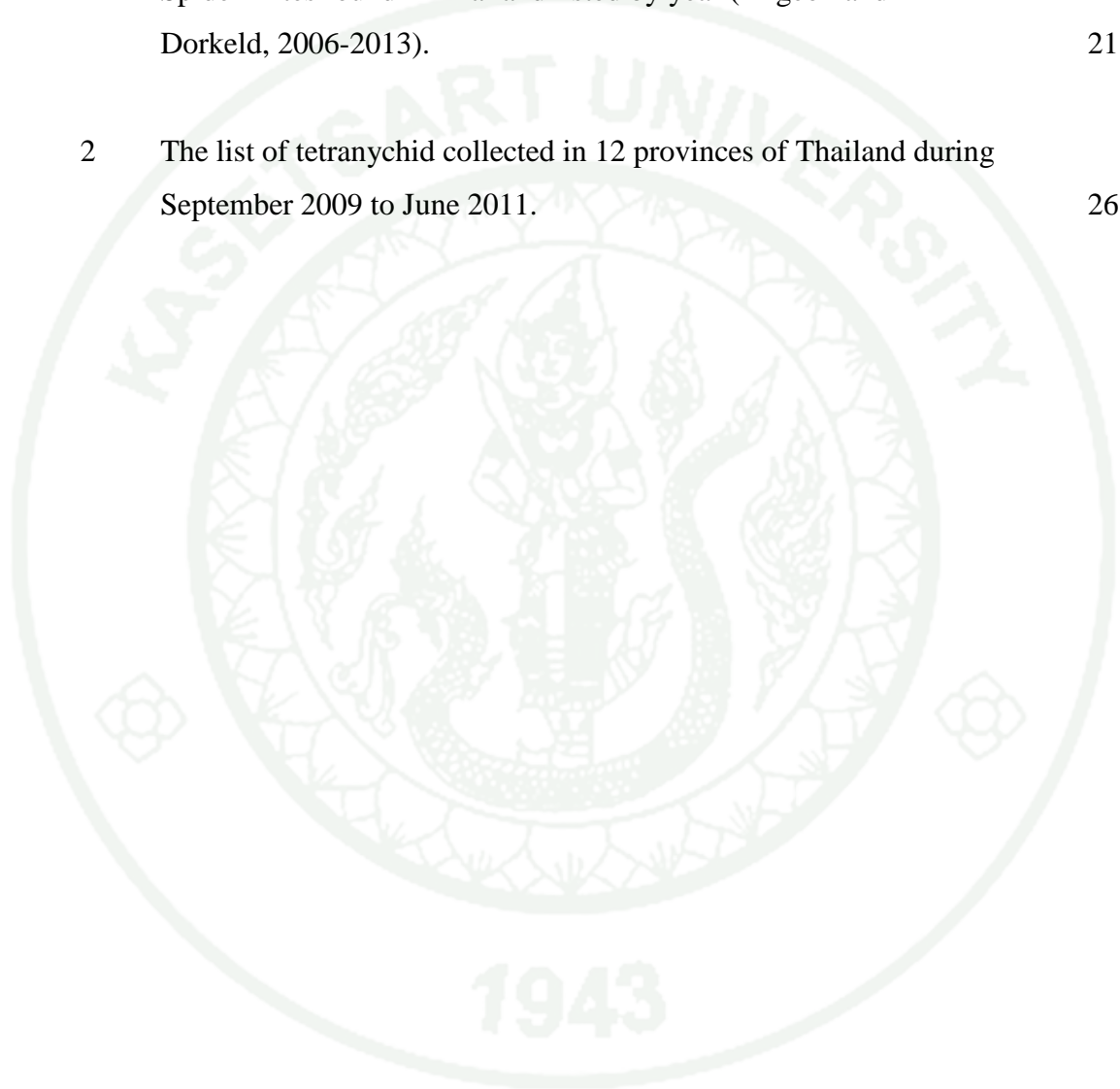
July 2014

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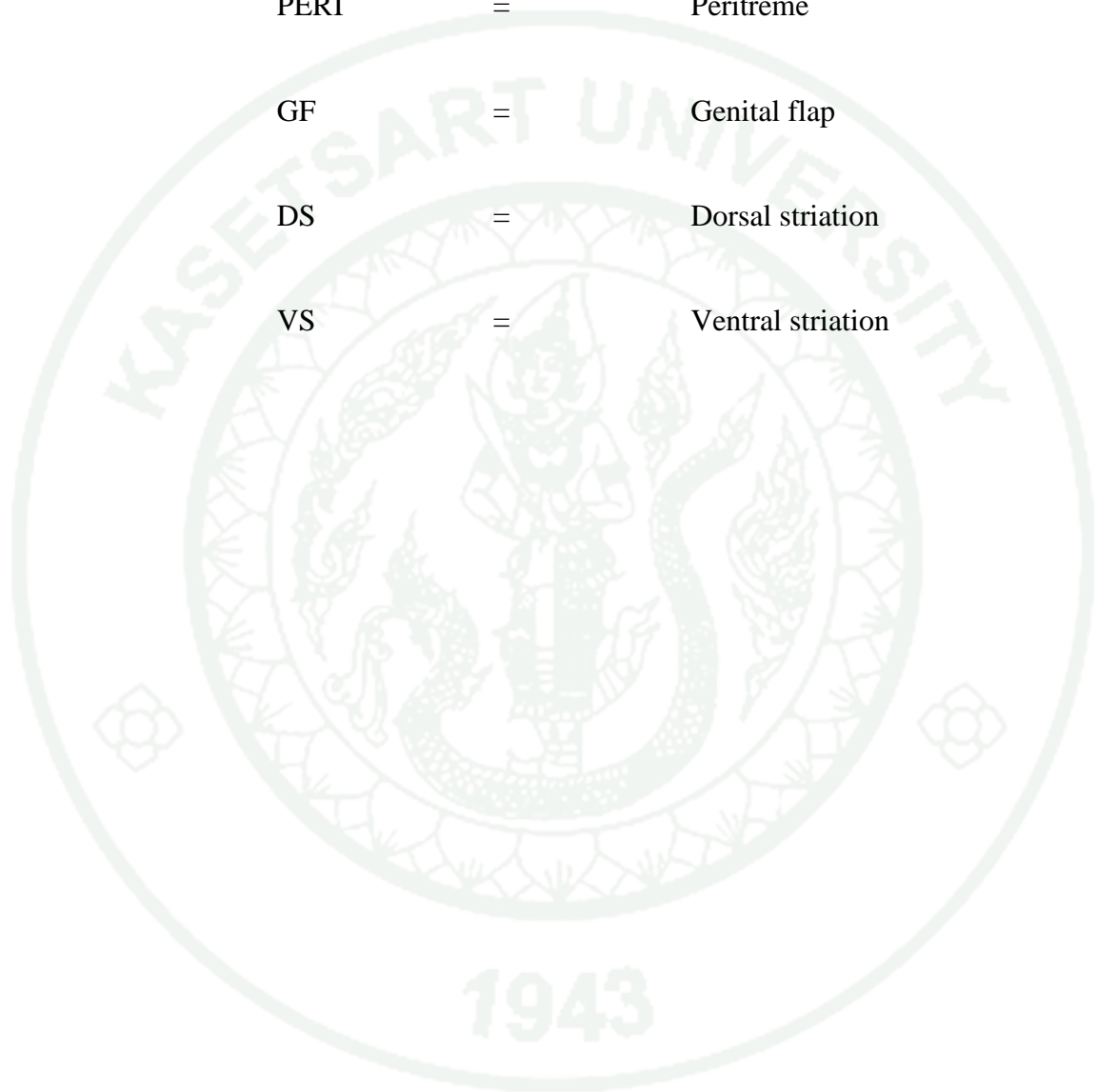
EMP = Empodium

PERI = Peritreme

GF = Genital flap

DS = Dorsal striation

VS = Ventral striation



MORPHOLOGICAL CHARACTERIZATIONS OF SOME TETRANYCHID MITES (ACARI: TETRANYCHIDAE) OF THAILAND WITH DESCRIPTION OF THREE NEW SPECIES

INTRODUCTION

Tetranychid or spider mite belongs to Suborder Actinedida, Family Tetranychidae. They are very small and microscopic in size, hence it is hard to see by the unaided eyes. These mites can be found infesting agricultural plants, horticultural plants, ornamental plants, medicinal plants, wild plants, perennial plants, fruit crops and weeds. Fortunately, out of 1,275 species known around the world, only few species are significantly important for the agricultural crops worldwide (Jeppson *et al.*, 1975; Helle and Sabelis, 1985; Seeman and Beard, 2011). Among these, two-spotted spider mite *Tetranychus urticae* Koch, 1836 also called web spinning spider mites, is a major agricultural pest worldwide according to their high fertility and short developmental time (Bounfour and Tanigoshi, 2001; Sabelis and Janssen, 1994). Over 200 plant species were reported as host plants for *T. urticae* (Bolland *et al.*, 1998, Batra and Stavely, 1994).

The tetranychid mites are no doubt the most important mites attacking plants worldwide. They destroy plants by inserting their cheliceral stylets into the plant cells and suck up cell contents (Helle and Sabelis, 1985; Jeppson *et al.*, 1975). Some tetranychid mites can transmit viral diseases, for example, *T. urticae* carried Potato Virus Y, (PVY also infected tomato, tobacco and other Solanaceae plants), tobacco ring spot virus, tobacco mosaic virus, southern bean mosaic virus and cotton curliness (Jeppson *et al.*, 1975).

Some tetranychid mites in the subfamily Tetranychinae produce silk from their spinnerets like the spiders. Zhang *et al.* (2002) reported that the silk produced from many of tetranychid mites is used only for the purpose of protection to their eggs. Moreover, Fernandez *et al.* (2012) predicted that *T. urticae* uses silk as a collective choice of path but not systematically under their tested conditions. Furthermore, there

are more functions of the silk web produced by some tetranychid mites. Penman *et al.* (1974) suggested that female deutonymph produces web to increase male attraction to quiescent female. In addition, web produced by parents can prevent predator from intruding into the nest and protect young offsprings (Mori *et al.*, 1998). Spider mite webbing also can reduce predation by adult predatory mites (Roda *et al.*, 2000).

The number of tetranychid species increases more than 10 folds for the past 50 years. In 1950, McGregor reported that members of the family Tetranychidae are classified into 102 species in 15 genera. Five years later, the number of species increased to 204 in 18 genera as reported by Pritchard and Baker (1955). In 1998, up to 1,189 species in 71 genera were listed in the World Catalogue of the Spider Mite Family (Bolland *et al.*, 1998). At present, approximately 1,275 species in 76 genera are currently known to science (Migeon and Dorkeld, 2006-2013).

In Thailand, taxonomy of tetranychid mites was mainly investigated by Baker (1975) and Ehara and Wongsiri (1975). Baker (1975) found 27 species and 9 undescribed species in 8 genera where Ehara and Wongsiri (1975) reported 26 species of tetranychid mites classified in 7 genera. The genera of tetranychid mites found in Thailand in the year 1975 include *Aponychus*, *Bakerina*, *Eotetranychus*, *Eutetranychus*, *Oligonychus*, *Panonychus*, *Schizotetranychus* and *Tetranychus* (Baker, 1975; Ehara and Wongsiri, 1975). The genus *Bakerina* is now replaced by *Mixonychus* and this genus is not appeared in the list of tetranychid mites in Thailand presented by Ehara and Wongsiri (1975).

At present, 42 species of Tetranychid mites are known in Thailand (Migeon and Dorkeld, 2006 - 2013). Among these 42 species, 9 species namely *Aponychus siamensis* Ehara and Wongsiri, 1975, *Eotetranychus thailandicus* Ehara and Wongsiri, 1975, *Mixonychus (Bakerina) thailandicus* Tangkanasing, 1988, *Neotetranychus lekFlechtmann*, 2013, *Oligonychus yasumatsui* Ehara and Wongsiri, 1975, *Schizotetranychus bhandhufalcki* Ehara and Wongsiri, 1975, *Schizotetranychus Chiangmaiensis* Ehara and Wongsiri, 1975, *Schizotetranychus vermiculatus* Ehara

and Wongsiri, 1975 and *Stylophoronychus nakaoui* (Ehara and Wongsiri, 1975), are native and only occurred in Thailand.

A study of taxonomy and nomenclature of tetranychids has been conducted around the world especially in Japan, France, China (Ehara, 1956a, 1956b, 1956c, 1957, 1959, 1960, 1962, 1963, 1964, 1969a, 1969b, 1971; Flechtmann *et al.*, 1999; Wang and Ma, 1993; Smiley and Baker, 1995). This issue is also gain interested by Thai researchers since Tetranychid mites are considered serious pest of agricultural plants in Thailand.

Intensive collection for plant feeding mites were performed by the mite division group, Department of Agriculture (DOA), Ministry of Agriculture and cooperatives over the past 30 years, but new species of tetranychid mites has never been found until *N. lek* was reported by Flechtmann in 2013.

OBJECTIVE

To study the morphology and explore the diversity of tetranychid mites in Thailand.



LITERATURE REVIEW

Tetranychid mites, or so-called spider mites, are plant feeders and the most important phytophagous mites attacking plants, causing economic damage in several countries around the world (Baker and Pritchard, 1960; Lindquist 1985a; Baker and Tuttle, 1994; Ehara, 1999; Zhang *et al.*, 2002; Krantz and Walter 2009; Seeman, 2012). Bolland *et al.* (1998) listed 3,600 species of plants worldwide as hosts of spider mites. The host plants include forest trees, agricultural plants, horticultural plants, ornamental plants, medicinal plants, vegetables, fruit trees, weeds, etc.

Among tetranychid mites, the two-spotted spider mite, *Tetranychus urticae* (Koch, 1836) attacks more than 1,000 plant species including many plants with economical importance. Some species of tetranychid mite is very host specific, feeding on only one plant species or monophagy for examples, *Schizotetranychus sacharum* Flechtmann and Baker, 1975; *Tetranychus bambusae* Wang and Ma, 1981; *Tetranychus ipomoeae* Ma and Gao, 1989; and *Tetranychus papayae* Nassar and Ghai, 1981 while several species are capable of feeding on 3 or more host plant species which are known as oligophagy and polyphagy, respectively. *T. urticae*, *Eutetranychus africanus* Tucker, 1926, *Oligonychus biharensis* Hirst, 1924, *Tetranychus truncatus* Ehara, 1956 etc. are known as polyphagous feeders. *Schizotetranychus approximatus* Ehara, 1988; *Schizotetranychus oryzae* Rossi de Simons, 1966; and *Eutetranychus citri* Attiah, 1967 are examples of oligophagous feeders, Migeon and Dorkeld (2006-2013).

Some species of tetranychid mite in the subfamily Tetranychinae produces silk or web, especially when the plants were heavily infested. The silks are released via spinneret on the pedipalp and use for many activities such as cover up their colonies in order to protect their eggs and offspring and aid in dispersion (Fernandez *et al.*, 2012; Zhang *et al.*, 2002). Silk produced by tetranychid mites also help reduce predation by predatory mites and prevent predator from intruding into the nest (Mori *et al.*, 1998; Roda *et al.*, 2000). In addition, Penman *et al.* (1974) mentioned that

female deutonymph produces silk to increase male attraction to quiescent female and to attract male for sexual reproduction.

1. Economic importance and damage

Spider mites are one of the most economically significant pests of economic crop worldwide. A record from China showed that the hawthorn spider mite, *Amphitetranychus viennensis* (Zacher, 1920) could cause 30-67% yield reduction in apple and *Schizotetranychus yoshimekii* Ehara and Wongsiri, 1975 could lead to a reduction in rice yield of up to 30% (Wang, 1981). A good example is *T. urticae* which is reported to feed on more than 1,000 host plants (Migeon and Dorkeld, 2006-2013). This particular mite severely damages several economic crops such as strawberry, rose, soybean and corn. Infestation of *T. urticae* occurred in late vegetative and early reproductive growth resulted in yield reductions of 40 – 60% on soybean in Wisconsin (Cullen and Schramm, 2009).

Tetranychid mites damage plants by inserting their chelicerae, which are modified into long, whip-like needles, into parenchyma cells to suck up the cell contents. Normally, most tetranychid mites prefer to live and feed on under leaf surfaces while only few species such as *E. africanus* on durian and papaya in Thailand feeds on the upper surface of the leaves. Hence, the symptoms of mite feeding appears as small yellowish-white spots on the upper side of the leaf due to chlorophyll depletion, which may develop into irregular shaped of white or greyish-white spots, resulting in the yellowing and bronzing of leaves (Zhang, 2003). Necrosis may occur in young leaves and tender stems. In addition, heavy infestation may lead to leaves turning brown, defoliation, or even death of the plant (Zhang, 2003).

Beside direct damage, some tetranychid mites can act as vector transmitting plant viral diseases. Jeppson *et al.* (1975) states that the Potato Virus Y which occurred on potato, tomato, tobacco and other plants in family Solanaceae were carried by *T. urticae*. Moreover, this mite can also transmit tobacco ring spot virus, tobacco mosaic virus, southern bean mosaic virus and cotton curliness viruses as well.

2. Morphology of tetranychid mite

Tetranychid mites are soft-bodied and medium in size, with an average of adult female about 400-500 μm (Zhang *et al.*, 2002) (Figure 1). Male is slightly smaller than female. The body of tetranychid mite, as in other mites, is divided into gnathosoma and idiosoma (Figure 2).

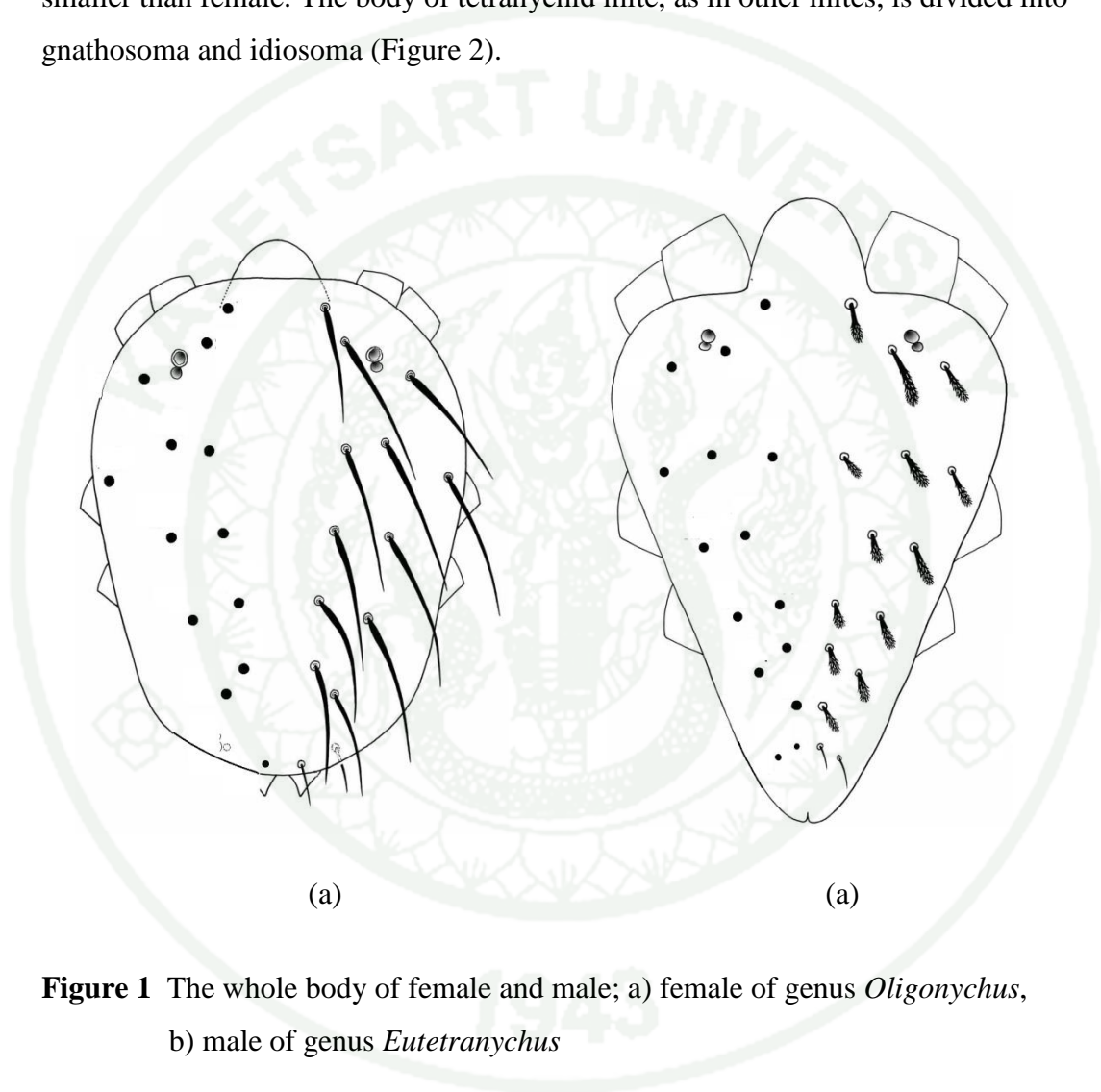


Figure 1 The whole body of female and male; a) female of genus *Oligonychus*,
b) male of genus *Eutetranychus*

Source: Seeman and Beard, 2011

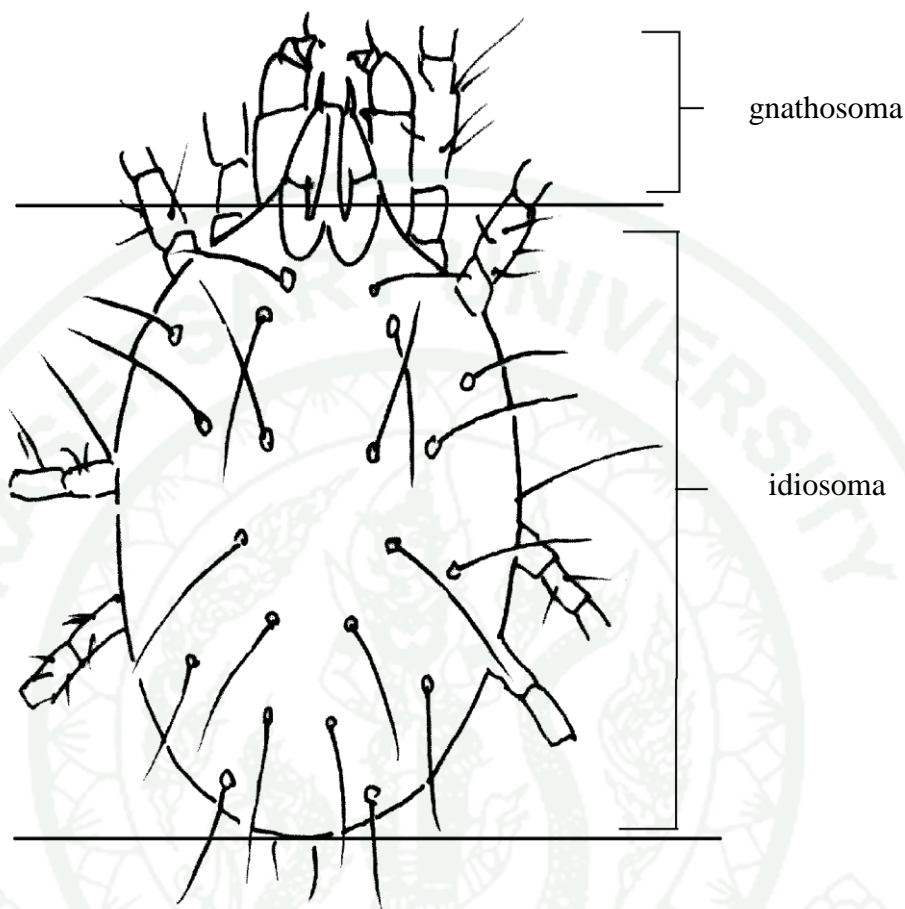


Figure 2 Body division of a tetranychid mite showing gnathosoma and idiosoma.

2.1 Gnathosoma

Gnathosoma of tetranychid mite composes of chelicerae and pedipalp, forming the mouthparts of the mite (Figures 3 and 4). The movable digits of the chelicerae have been highly modified to form elongate whip-like or needle-like stylets for piercing plant tissues (Reck 1952; Baker and Pritchard 1953; Krantz 1978; Walter *et al.*, 2009). Each stylet is recurved proximally, forming J-shaped which is used to distinguish tetranychoid from other mites (Walter *et al.*, 2009).

The whip-like stylets of tetranychid mites arise on a capsule-like structure known as the stylophore, formed by the fusion of the cheliceral body. This structure is deeply retractable and helping the mites to pierce their stylets into the plant tissues.

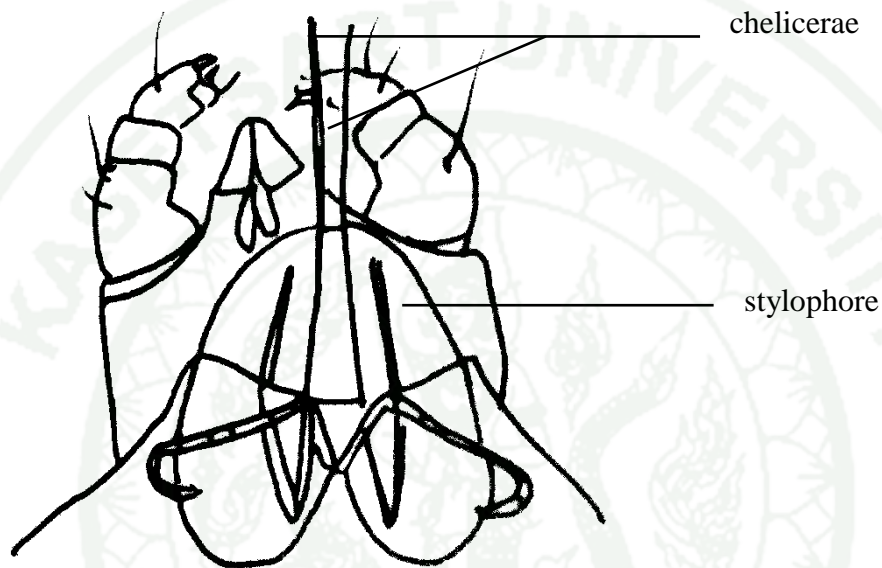


Figure 3 Gnathosoma of tetranychid mite showing chelicerae on stylophore.

Source:Pritchard and Baker, 1955

The pedipalps of tetranychid mites compose of five-segments. The palpal tarsus and tibia, including a distal claw-like seta known as the tibial claw, often form a thumb-claw complex. The tarsus bears three tactile setae, three eupathidia and one solenidion. One distal eupathidion or spinneret is enlarged and used to spin webs or silk in many species. The size and shape of the spinneret is of taxonomic significance.

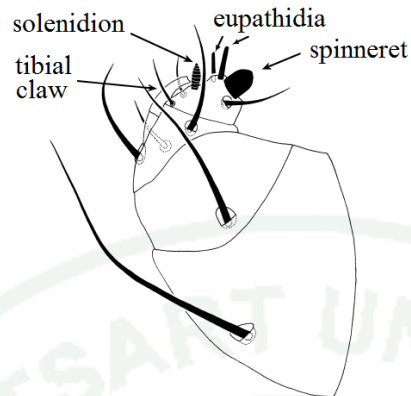


Figure 4 Pedipalp of tetranychid mite showing thumb-claw complex.

Source: Seeman and Beard, 2011

A pair of stigmata is located near the base of the chelicerae where the peritremes or tracheae arise. Trägårdh(1915) found that the peritreme can be used for species differentiation. This organ is V-shaped with both arms of equal caliber in some species, or appeared as V-shaped but with one arm much thicker than the other in some species while the trachea of some tetranychid species is straight with a bladder-like enlargement at its end. Shape of peritreme is used for species identification (Figure 5).

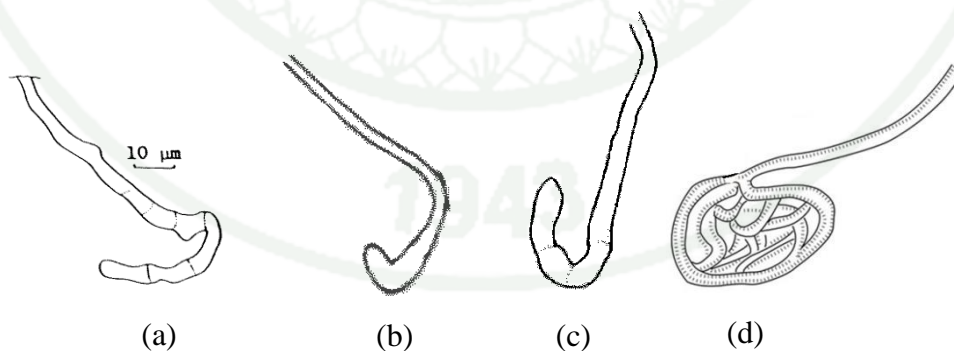


Figure 5 Different shapes of peritreme found in Tetranychidae; a) *Tetranychus*, b) *Schizotetranychus*, c) *Eotetranychus* and d) *Bryobia*.

Source:Ehara, 1999

2.2 Idiosoma

Idiosoma of tetranychid mite is often covered with a striae cuticle. It is divided into propodosoma and opisthosoma. In general, female idiosoma is oval-shaped and round posteriorly while those of male are smaller, with a wedge-shaped and tapering posteriorly.

2.2.1 Propodosoma

The anterior part of idiosoma is called propodosoma. Three or four pairs of setae known as v_1 (vertical internal), v_2 (vertical external), sc_1 (scapular internal) and sc_2 (scapular external) are presented on propodosoma (Figure 6). The size and shape of lobes at the bases of setae v_1 and v_2 can be used for species identification in some genera. In addition, two pairs of eyes also present on the dorsal propodosoma. These eyes are easily observed in live mite where they are normally red in color.

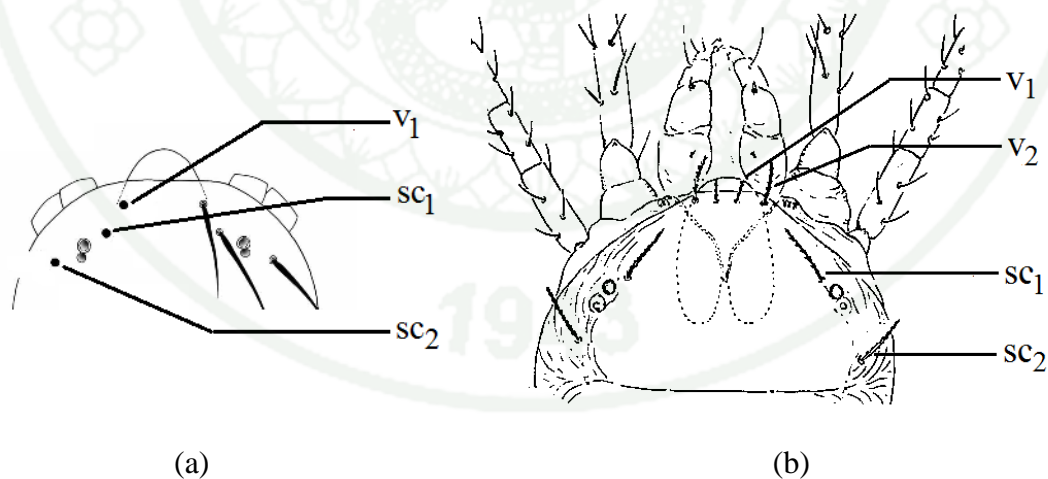


Figure 6 Propodosoma bearing different setae in tetranychid: a) 3 pairs of setae in *Oligonychus*; b) 4 pairs of setae in *Bryobia*.

Source: a) Prichard and Baker, 1955 and b) Seeman and Beard, 2011.

2.2.2 Opisthosoma

Chaetotaxy on dorsal opisthosoma is very useful characters for tetranychid identification. There are five rows of dorsal setae present on dorsal opisthosoma namely c_{1-3} , d_{1-2} , e_{1-2} , f_{1-2} and h_{1-3} (Figure 7). The number, location, length and shape of dorsal setae are required for taxonomic purpose. Setae h_{2-3} may appear ventral in position in some species, depending on the way the slides are mounted (Zhang *et al.*, 2002).

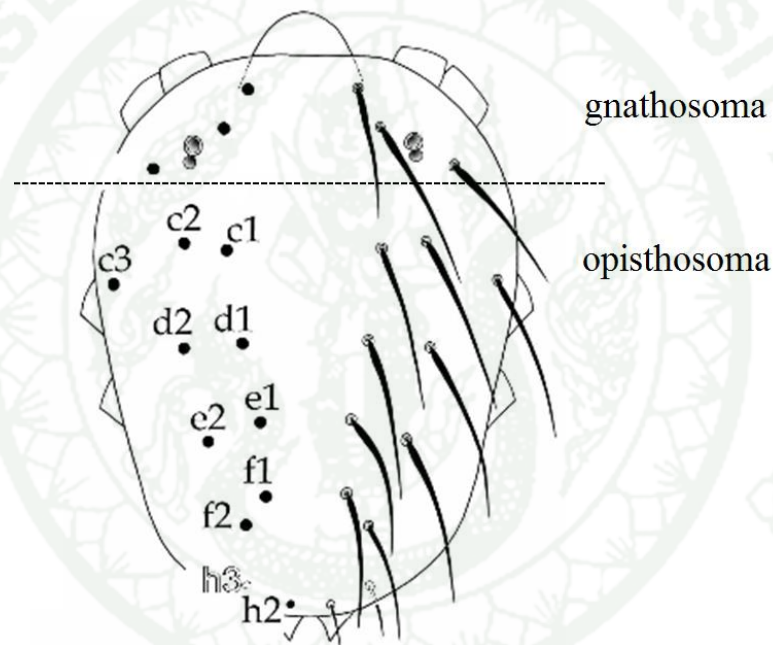


Figure 7 Opisthosomal setae in *Oligonychus*.

Source: Seeman and Beard, 2011

The pattern of the striation between dorsal setae and the shape/density of lobes distributed on the striae of female are also useful diagnostic characters. In general, there are three main patterns of dorsal striation between setae e_1 and f_1 namely transverse, hourglass pattern and diamond shape pattern (Seeman and Beard, 2011) (Figure 8).

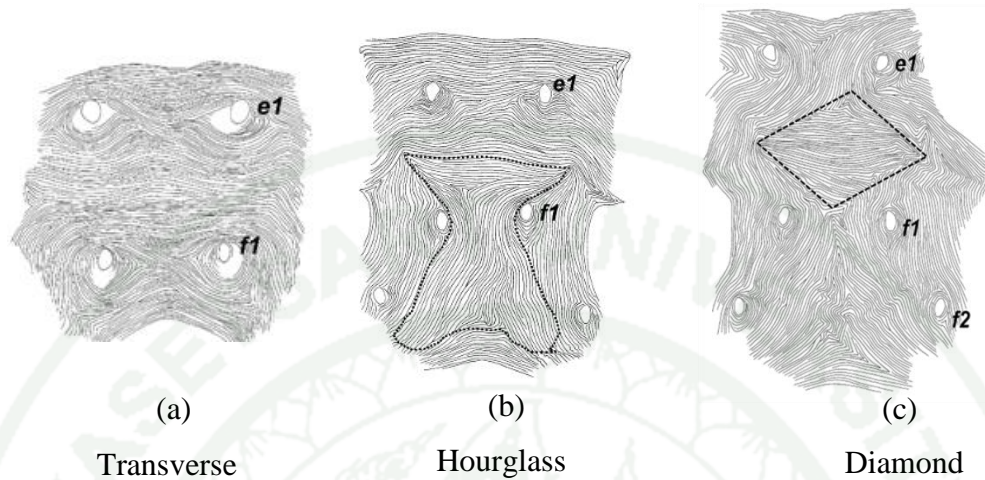


Figure 8 Three main dorsal striation patterns between setae e_1 and f_1 in *Tetranychus* spp.: a) Transverse striation in *Tetranychus mcdanieli*, b) Hourglass pattern in *Tetranychus lambi*, and c) Diamond shape pattern in *Tetranychus gloveri*

On the venter of opisthosoma, two pairs of legs, leg 3 and leg 4, are located on the ventral surface of opisthosoma. In addition, genitalia and anus are located posteriorly on the ventral opisthosoma.

The genital pore of adult female comprises of tightly folded cuticle appearing as wavy striae around the posterior margin of an ovoid genital flap. Two pairs of genital setae, g_1 and g_2 , are located on each side of the genital pore. The striation pattern on and anterior to the female genital flap is also of significance for species identification in some groups (Zhang *et al.*, 2002). The number of anal setae (a) and para-anal setae (ps) on the anal area is also used for species identification. Two or three pairs of ps setae (ps_1 - ps_3) are found on each of the anal region in subfamilies Tetranychinae and Bryobiinae, respectively (Figure 9).

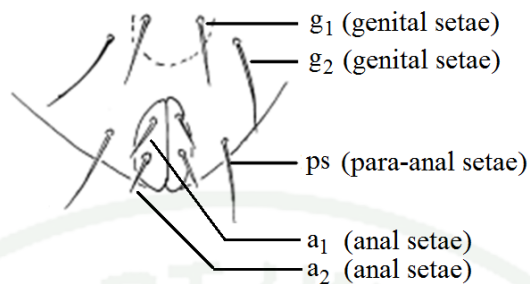


Figure 9 Genito-anal region of tetranychid female showing anal setae and para-anal setae.

Source: Ehara, 1999

2.3 Male aedeagus

In adult male, the striation pattern on the body surface and the shape of aedeagus in the lateral profile are required for species identification in some genera. The aedeagus of tetranychid mites is of high taxonomic value. Zacher (1910) is the first one who introduced the male aedeagus for mite identification (Figure 10). Ewing also employed the aedeagus as taxonomic character in the year 1913. Later, Trägårdh (1915) followed the use of variation in male aedeagus for taxonomic identification of such mite.

The male aedeagus is very small and required good slide preparation in order to observe all detail needed. Hence, poor slide preparation or minor differences in aedeagus differentiation could lead to species mis-identification. For example, *Tetranychus hydrangeae* Pritchard and Baker, 1955 and *Tetranychus kanzawai* Kishida, 1927 were distinguished by the aedeagal knob as being 0.6 μm larger in *T. hydrangeae* prior to their synonymy by Navajas *et al.* in 2001. A similar over-splitting of species based on trivial aedeagal differences is probable amongst the species close to *Oligonychus punicae* (Hirst, 1926) which are *Oligonychus coffeae* (Nietner, 1861), *Oligonychus mangiferus* (Rahman and Saprà, 1940) and *Oligonychus vitis* Zaher and Shehata, 1965 and perhaps even *Oligonychus ununguis* (Jacobi, 1905).

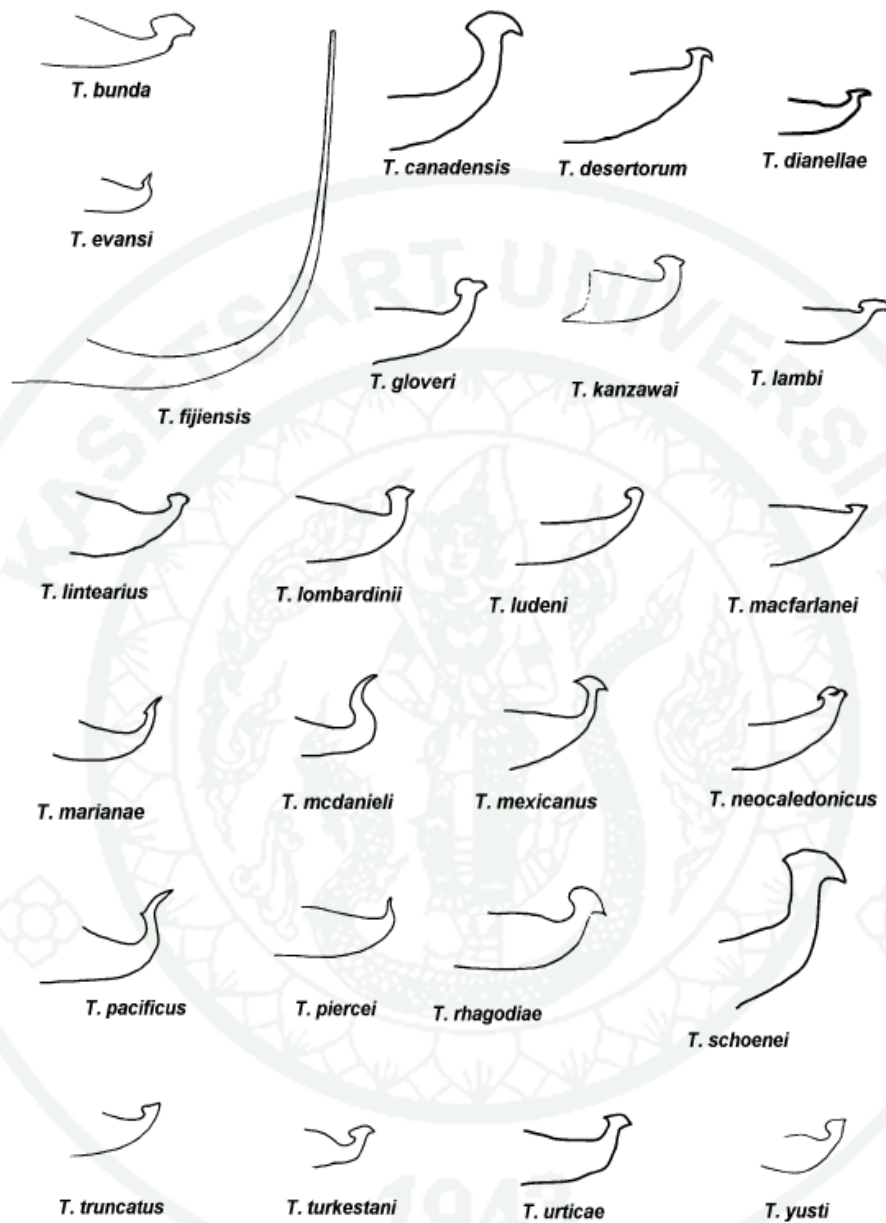


Figure 10 Different shapes of aedeagus in the genus *Tetranychus*.

Source: Ehara, 1999

The aedeagus comprises a shaft that may curve, either dorsally or ventrally, and may terminate in a knob. Most species in *Tetranychus* have a short shaft that curves abruptly upwards and often terminates in a knob. However, the knob can be absent, or nearly so, giving the aedeagus a sigmoid form, such as in *Tetranychus mcdanieli* McGregor, 1931. The orientation of the knob with the axis of the shaft is another useful feature, as it varies from being parallel (most species), to acute (e.g., *Tetranychus marianae* McGregor, 1950) or obtuse (e.g., *Tetranychus mexicanus* McGregor, 1950). When the knob is present, the region where the shaft curves upwards towards the knob is referred to as the neck of the aedeagus.

2.4 Leg chaetotaxy

Leg chaetotaxy, especially on tarsus, is one of the important characters used for identification of tetranychid mite (Figure 11). Tarsi normally bear 3 types of setae which are normal or tactile setae, solenidia and eupathidia. Both solenidia and eupathidia are sensory setae and present in a fewer number comparing to the tactile setae (Seeman and Beard, 2011). Tactile setae are solid, hair-like with a tapered end. These setae can be lightly or heavily barbed. In contrast, solenidia and eupathidia have a hollow transparent appearance and a blunt tip. Solenidia can be distinguished easily from eupathidia by the annulate texture along their entire length (Zhang *et al.*, 2002).

Duplex setae are located on tarsi I and II of tetranychid mites. These are group of two setae, a long solenidion or companion seta (ω) and a short tactile seta (ft), with their hair sockets are coalesced with each other. Number and position of duplex setae are important taxonomic characters for spider mite diagnoses. In the genus *Tetranychus*, tarsus I has two pairs of duplex setae and tarsus II has only one pair. The number of tactile setae proximal to the proximal duplex setae (ω' and ft') is also an important character used in keys (e.g., Meyer, 1974, 1987) and to form species groups (e.g., Flechtmann and Knihinicki, 2002).

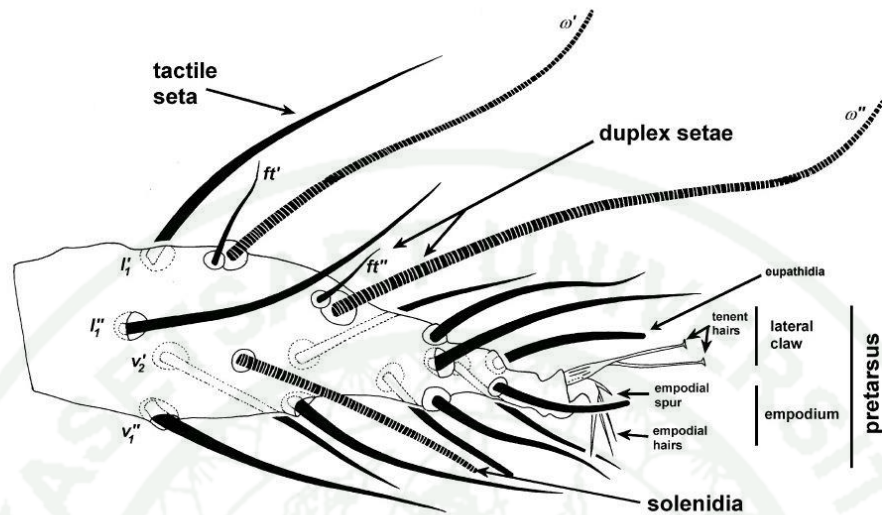


Figure 11 Tarsus I of genus *Tetranychus* (female) shows different types of setae.

Source: Flechtmann and Knihinicki, 2002

Pretarsus of tetranychid mite composes of claw and empodium. Both claw and empodium can be claw-like or pad-like, with or without tenent hairs which are located on either dorsal or ventral surfaces. The structure of the pretarsus is also being used for mite identification. The empodium may have an empodial spur, which arises dorsally to the proximoventral hairs. The empodium can be present or absent, if present, it may be obvious or tiny etc. (Figure 11 and 12).

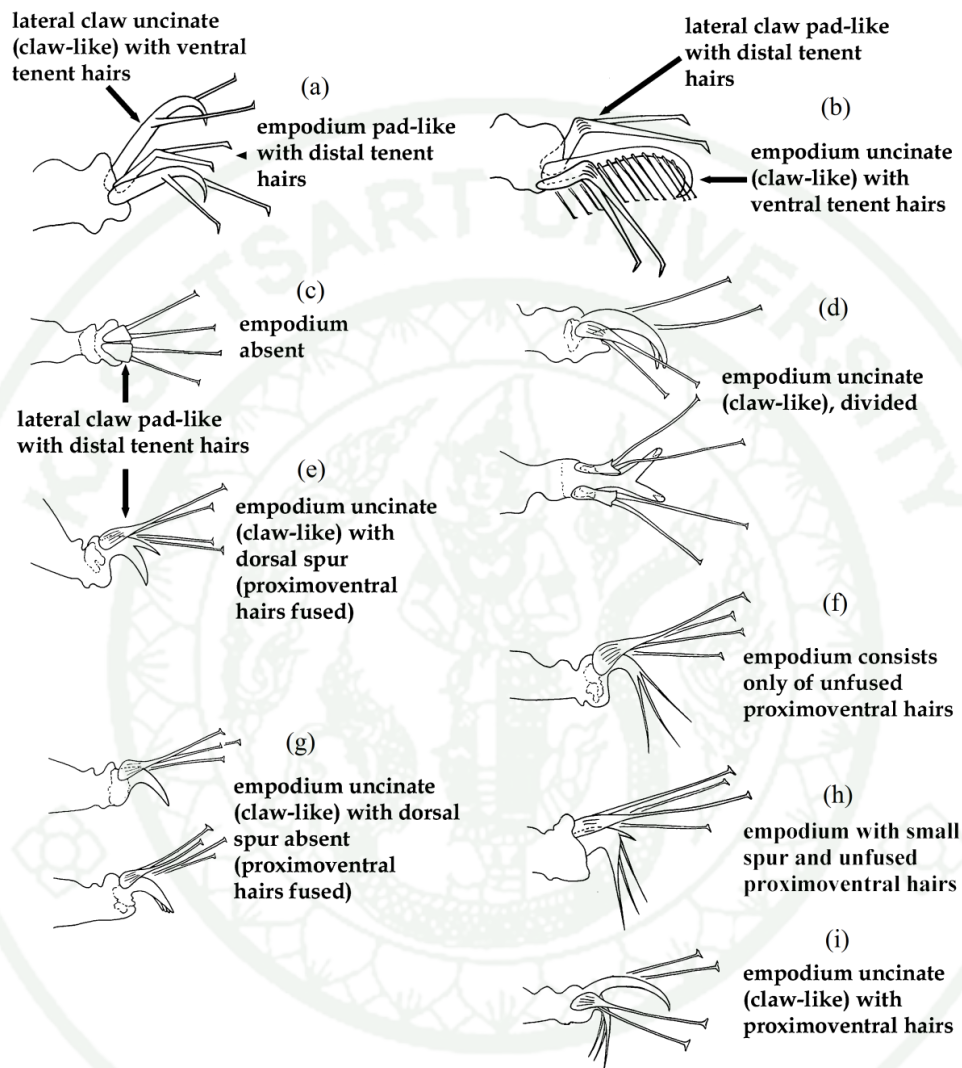


Figure 12 Different types of empodium in Bryobiini and Tetranychini.

Source: Seeman and Beard, 2011

3. Systematic position of tetranychid mite

The tetranychid mite belongs to family Tetranychidae, superfamily Tetranychoida, a group distinguished by the morphology of the mouthparts where movable digits of the chelicerae are modified to form elongate stylets for piercing plant tissue (Reck 1952; Baker and Pritchard 1953; Krantz 1978; Walter *et al.* 2009). The basal part of each stylet are recurved, forming a J-shaped chelicerae which is used to separate the tetranychoids from all other mites. A deeply retractable stylophore are formed at the base of chelicerae where this structure is present only in the Tetranychoida and some Raphignathoidea (Walter *et al.*, 2009). The Tetranychidae can be distinguished from other tetranychoid families by the combination of a palp thumb-claw structure, lateral prodorsal eyes and the absence of long filamentous setae on the posterior region of the mite (Donnadieu, 1875; Baker and Pritchard, 1953; Pritchard and Baker, 1955).

The family Tetranychidae consists of two subfamilies namely Bryobiinae and Tetranychinae. The subfamilies are distinguished by the form of the empodia in the female mite. In tribe Bryobiini of subfamily Bryoniinae, true claws are uncinata and empodia are pad-like. In tribe Hystrichonychini, claws and empodia are pad-like and in tribe Petrobiini, claws are pad-like and empodia are uncinata.

In tribe Eurytetranychini of subfamily Tetranychinae, empodia are claw like or rudimentary. In Tenuipalpoidini, empodia are uncinata and without ventral hairs. In tribe Tetranychini, empodia are either claw-like or with several pairs of ventrally directed hairs.

Tenent hairs are normally present on the empodium in Bryobiinae. But in the Tetranychinae, the empodium may be absent, claw-like, comprising of fine hairs only, with basal fine hairs attach to a claw or with a dorsal spur. In addition, tenent hairs are absent on the empodium in Tetranychinae (Baker and Tuttle, 1994).

4. Taxonomy of tetranychid mite

The tetranychid mites are member of the family Tetranychidae which was erected by Donnadieu in 1875. The first description of tetranychid mite, *Acarus telarius* (Bryobiidae) was performed by Scopoli in 1763. Taxonomic study of tetranychid mite was performed in many countries in the 19th century. For examples, Pritchard and Baker (1955) made a great effort in revising all the information of tetranychid mites. Ehara (1956a, 1956b, 1956c, 1957, 1959, 1960, 1962, 1963, 1964, 1969a, 1969b, 1971) worked on tetranychidae and published a series of paper on spider mites in Japan (Ehara, 1999; Baker and Tuttle, 1994).

Meyer (1974) revised the family tetranychidae and provided a comprehensive key for 59 world genera and reported that the family Tetranychidae composes of two subfamilies; Bryobiinae and Tetrachinae. Subfamily Bryobiinae has 35 genera and 24 genera are in Tetranychinae.

At present, 1,275 described species in 6 tribes (Bryobiini, Hystrichonychini, Petrobiini, Eurytetranychini, Tenuipalpoidini and Tetranychini) and 85 genera are recorded (Bolland *et al.* 1998; Migeon & Flechtmann 2004; Migeon & Dorkeld 2006–2013). Among these, in each major 5 genera were represented by more than 100 known species. These include *Schizotetranychus* Trägårdh, 1915 (116 spp.), *Bryobia* Koch, 1836 (129 spp.), *Tetranychus* Dufour, 1832 (143 spp.) *Eotetranychus* Oudemans, 1931 (184 spp.) and *Oligonychus* Berlese, 1886 (200 spp.).

5. Taxonomic study of tetranychid mite in Thailand

The Thailand spider mite fauna was mainly investigated by Baker (1975) and Ehara and Wongsiri (1975). Baker recorded 36 species of 8 genera while Ehara and Wongsiri found 26 species under 7 genera. The spider mite species in Thailand by many authors are listed by year in Table 1. In 2013, Flechtmann discovered the new species of tetranychidae, *Neotetranychus lek* and this was almost 15 years far from the last species described in 1988 by Ehara and Tangkanasing.

Table 1 Spider mites found in Thailand listed by year (Source: Migeon and Dorkeld, 2006-2013).

No.	Spider mites	Author	Year
1	<i>Tetranychus urticae</i>	Koch	1836
2	<i>Oligonychus coffeae</i>	Nietner	1861
3	<i>Oligonychus modestus</i>	Banks	1900
4	<i>Oligonychus pratensis</i>	Banks	1912
5	<i>Tetranychus ludeni</i>	Zacher	1913
6	<i>Oligonychus biharensis</i>	Hirst	1924
7	<i>Tetranychus fijiensis</i>	Hirst	1924
8	<i>Oligonychus oryzae</i>	Hirst	1926
9	<i>Schizotetranychus andropogoni</i>	Hirst	1926
10	<i>Tetranychus kanzawai</i>	Kishida	1927
11	<i>Tetranychus neocaledonicus</i>	McGregor	1933
12	<i>Eutetranychus orientalis</i>	Klein	1936
13	<i>Oligonychus mangiferus</i>	Rahman and Sapra	1940
14	<i>Tetranychus marianae</i>	McGregor	1950
15	<i>Tetranychus piercei</i>	McGregor	1950
16	<i>Tetranychus tumidellus</i>	Pritchard and Baker	1955
17	<i>Tetranychus yusti</i>	McGregor	1955
18	<i>Tetranychus truncatus</i>	Ehara	1956
19	<i>Eotetranychus cendanai</i>	Rimando	1962
20	<i>Oligonychus orthius</i>	Rimando	1962
21	<i>Oligonychus velascoi</i>	Rimando	1962
22	<i>Schizotetranychus baltazarae</i>	Rimando	1962
23	<i>Panonychus elongatus</i>	Manson	1963
24	<i>Eotetranychus celtis</i>	Ehara	1965
25	<i>Aponychus corpusae</i>	Rimando	1966
26	<i>Stylophoronychus vannus</i>	Rimando	1968

Table 1 (Continued).

No.	Spider mites	Author	Year
28	<i>Aponychus siamensis</i>	Ehara and Wongsiri	1975
29	<i>Eotetranychus thailandicus</i>	Ehara and Wongsiri	1975
30	<i>Eotetranychus suvipakiti</i>	Ehara and Wongsiri	1975
31	<i>Oligonychus yasumatsui</i>	Ehara and Wongsiri	1975
32	<i>Schizotetranychus bhandhufalcki</i>	Ehara and Wongsiri	1975
33	<i>Schizotetranychus Chiangmaiensis</i>	Ehara and Wongsiri	1975
34	<i>Schizotetranychus vermiculatus</i>	Ehara and Wongsiri	1975
35	<i>Schizotetranychus yoshimekii</i>	Ehara and Wongsiri	1975
36	<i>Stylophoronychus nakaoi</i>	Ehara and Wongsiri	1975
37	<i>Mixonychus (Bakerina) thailandicus</i>	Tangkanasing	1988
38	<i>Schizotetranychus approximatus</i>	Ehara	1988
39	<i>Schizotetranychus laevidorsatus</i>	Ehara	1988
40	<i>Schizotetranychus saitoi</i>	Ehara	1988
41	<i>Tetranychus malaysiensis</i>	Ehara	1988
42	<i>Neotetranychus lek</i>	Flechtmann	2013

MATERIALS AND METHODS

1. Stock culture

Mites were collected from infested leaves from 12 provinces in Thailand by using hand lens. Collected mites were then reared on mulberry leaves (*Morus alba* L.), (if the mites are specific to the host plants, they were reared on those specific host plants' leaves) for several generations to provide a laboratory colony using the method by Khodayari *et al.* (2008) with some modifications (Figure 13). Water saturated sponge was placed in a plastic box and a layer of water saturated cotton was placed over the sponge. Then fresh and clean leaves were placed on the top of cotton layer with the upper surface facing down. Each leaf petiole was covered with a saturated cotton strip. The leaf arenas were loaded with several stages of mites by placing infested pieces onto the new leaf arenas. New leaf was provided when the old leaf became wilted or showed the signs of deterioration.



Figure 13 Mass rearing for tetranychid mites.

Each female adult of every species was picked up and placed separately on the specific leaf arenas to provide the same species for the purpose of the identification based on the morphological characteristics (Figure 14). Both male and female newly

emerged adults were picked up and then kept in 70 % ethanol before mounting on microscopic slides for further morphological identification.



Figure 14 Rearing specific specimens for identification.

2. Slide preparation

Modified Hoyer's mounting medium was used in the preparation of permanent slides. The medium was prepared at room temperature in the laboratory with following formula;

Distilled water	-	50 ml
Gum Arabic	-	30 gm
Chloral hydrate	-	200 gm
Glycerin	-	20 ml
Glacial Acetic acid	-	1-2 ml

The medium was kept in the oven for thickening for more than 10 days. The medium to be used for the preparation of the male spider mites was separately kept in oven until the medium gets sticky enough to make a slide mounting.

Female mites were picked up from each colony and positioned dorso-ventrally while male spider mites were mounted in lateral position since the aedeagus of males are distinguished characters to identify, and lateral view is necessary in this case. The permanent slides were kept in slide box for further identification.

3. Slide identification

The specimens were examined using a Leica DM LB 2 phase contrast microscope and illustrated with the aid of a drawing tube attachment (camera lucida). Measurements were taken using the imaging software Perfect Image® (Clara Vision) coupled with Progres® Capture Pro 2.6 software for image acquisition.

Morphological identification was performed by examining relevant taxonomic characters for Tetranychidae systematics. The shape of the aedeagus (male genitalia) was used to confirm for the species. Discriminative characters were examined under phase contrast and interference microscopes using 40x and 100x objectives (Leitz Wetzlar and Nikon Eclipse 80i).

RESULTS AND DISCUSSION

Morphology of Thailand tetranychid mites

Adult tetranychid mites collected from 12 provinces in Thailand were described into 25 species in 8 genera (Table 2).

Table 2 The list of tetranychid species collected in 12 provinces of Thailand during September 2009 to June 2011.

No.	Mite species
1	<i>Aponychus</i> <i>siamensis</i> Ehara and Wongsiri, 1975
2	<i>Eutetranychus</i> <i>africanus</i> Tucker, 1926
3	<i>Eotetranychus</i> <i>celtis</i> Ehara, 1965 <i>cendanai</i> Rimando, 1962 <i>thailandicus</i> Ehara and Wongsiri, 1975
4	<i>Neotetranychellus</i> <i>lekFlechtmann</i> , 2013
5	<i>Oligonychus</i> <i>biharensis</i> McGregor, 1950 <i>mangiferus</i> (Rahman and Sapra), 1940 <i>modestus</i> Banks, 1900 <i>orthius</i> Rimando, 1962 <i>punicae</i> Hirst, 1926 <i>sacchari</i> McGregor, 1942 <i>velascoi</i> Rimando, 1962
6	<i>Panonychus</i> <i>elongatus</i> Manson, 1963

Table 2 (Continued)

No.	Mite species
7	<i>Schizotetranychus</i>
	<i>colocasiae</i> Ehara and Tho, 1988
	<i>krungthepensis</i> Naing and Auger, 2014*
	<i>malayanus</i> Ehara, 1988
8	<i>Tetranychus</i>
	<i>fijiensis</i> Hirst, 1924
	<i>kanzawai</i> Kishida, 1927
	<i>marianae</i> McGregor, 1950
	<i>occultaspina</i> Naing and Auger, 2014*
	<i>piercei</i> McGregor, 1950
	<i>truncatissimus</i> Naing and Auger, 2014*
	<i>truncatus</i> Ehara, 1956
	<i>urticae</i> Koch, 1836

Remark: * new species found in this study and published in *Zootaxa* 3802 (2): 257–275 in 2014.

Genus *Aponychus*, Rimando

Type specie *Aponychus corpuzae*, Rimando

General characteristics:

Opisthosoma with 10 pairs of dorsal setae, 1 pair of anal setae; tarsus I dorsally with loosely associated duplex setae or without duplex setae, empodium usually rudimentary or absent.

In this study, only one species of genus *Aponychus*, *Aponychus siamensis* Ehara and Wongsiri, 1975 was found (Figure 15). This mite only occurs on the lower surface of the bamboo leaves (Baker, 1975; Ehara and Wongsiri, 1975).



Female

Male

Figure 15 Female and male of *Aponychus siamensis*.

Morphology of *Aponychus siamensis* Ehara and Wongsiri, 1975

Gnathosoma:

Stylophore with deeply cleft mediolaterally in both male and female (Figure 16). Palptarsus with . Spinneret slender and more or less 3 times as long as broad, 5.1-5.5 μm long, 1.5-1.9 μm wide. Peritreme very narrow in both sexes (Figure 17).

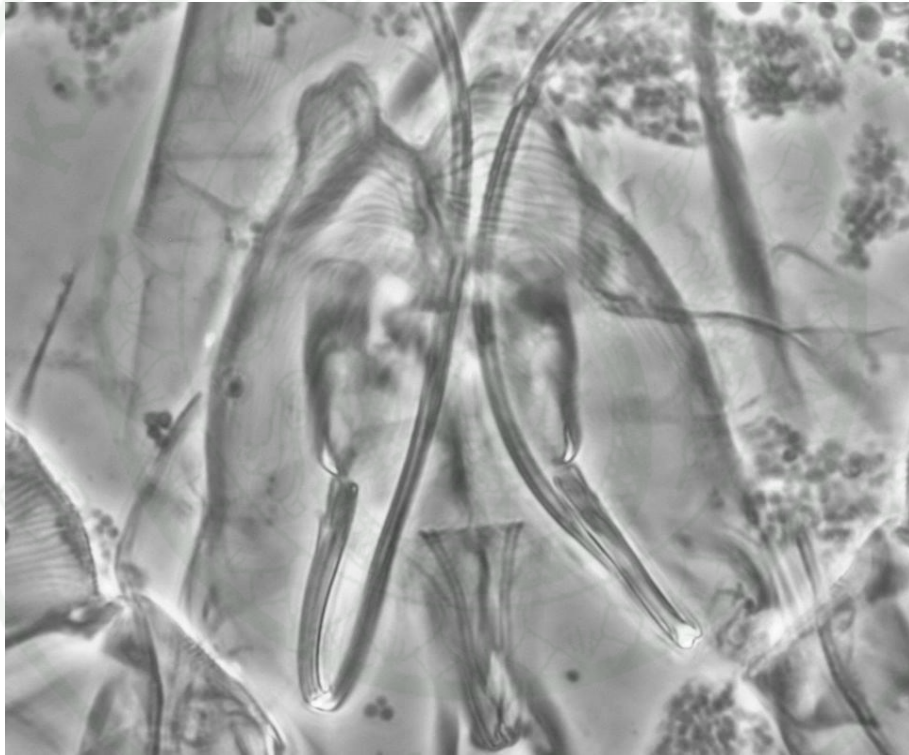


Figure 16 Stylophore with deeply cleft.



Figure 17 Narrow peritreme of female.

Idiosoma:

Dorsal integument wrinkled in both sexes as shown in Figure 18; dorsal setae spatulate, serrate; dosoventral setae (c_1 , d_1 and e_1) not set on tubercles (Figure 18) where as other dorsocentral and dorsolateral setae are more stronger, long, serrate and set on tubercles (Figure 19).

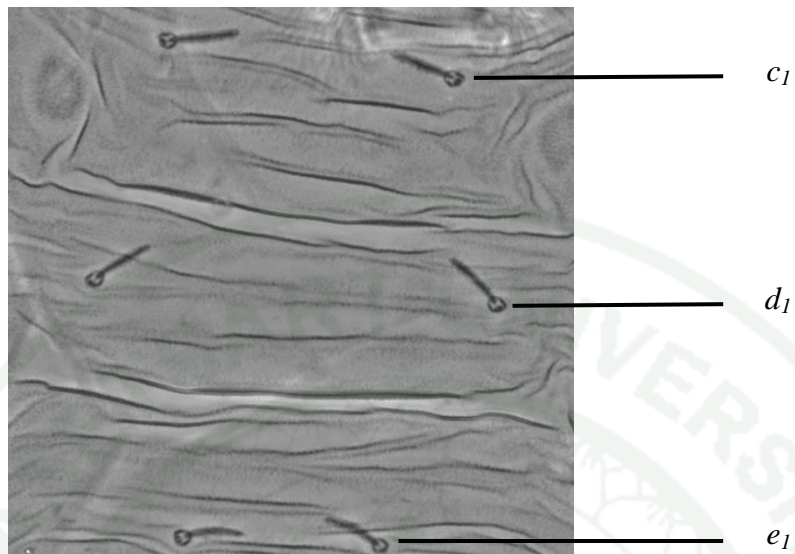


Figure 18 Wrinkled dorsum showing dorsocentral setae (c_1 , d_1 and e_1) not set on tubercles.

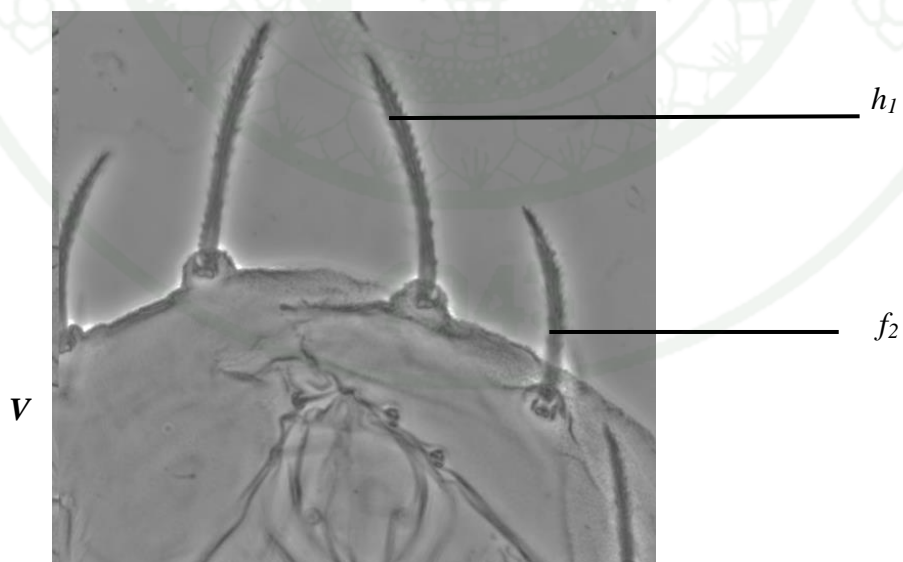


Figure 19 Long, strong and serrate dorsal setae set on tubercles.

Venter:

Ventral striation without lobes; in female two pairs of para-anal setae and a pair of anal setae are present;(Figure 20), genital flap and area immediately anterior to it bearing transverse striation (Figure 21); 4 pairs of genito-anal setae in the male.

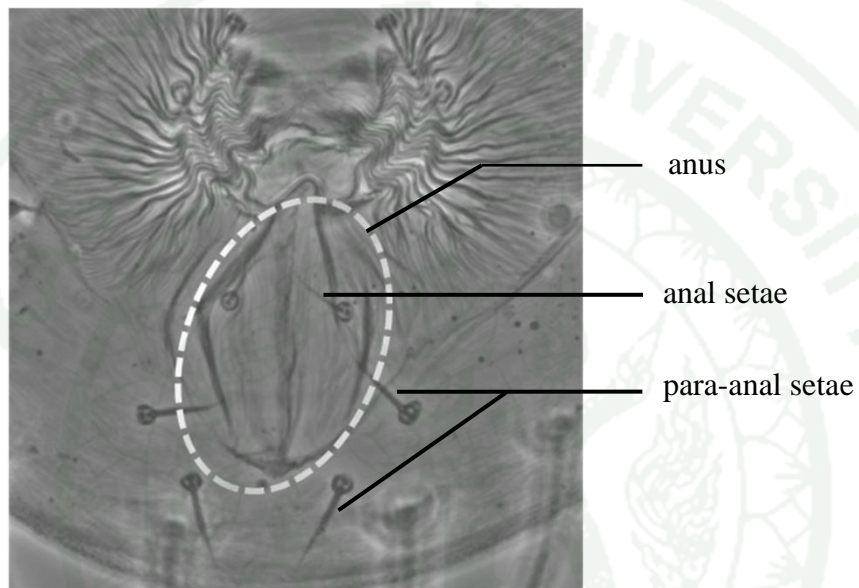


Figure 20 Anal region showing anal and para-anal setae.

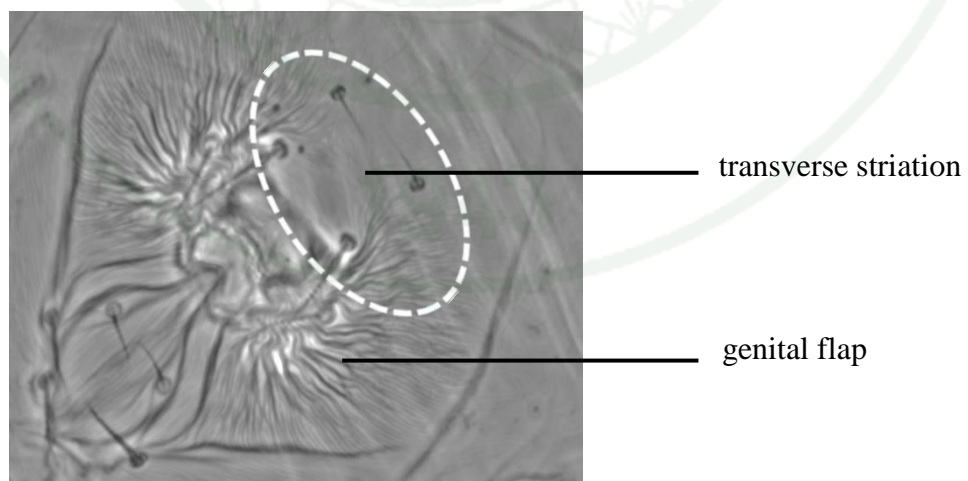


Figure 21 Genital flap and area immediately anterior with transverse striation.

Legs:

Empodium rudimentary, with a small round knob (Figure 22); tarsus I and II without characteristic duplex setae, tarsus I with a pair of loosely associated setae probably homologous with one of the pair of duplex setae (Figure 23), however, the alveoli not coalesce; legs of male relatively longer than those of female.

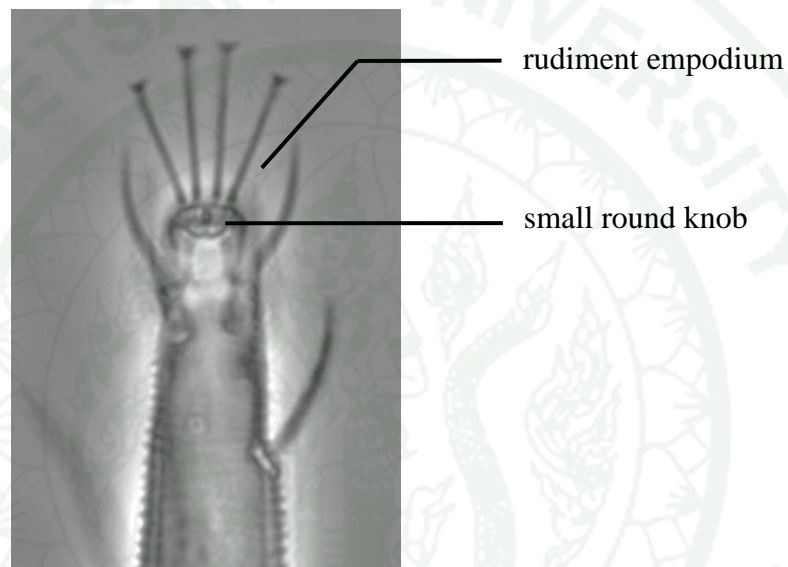


Figure 22 Rudiment empodium with small round knob.

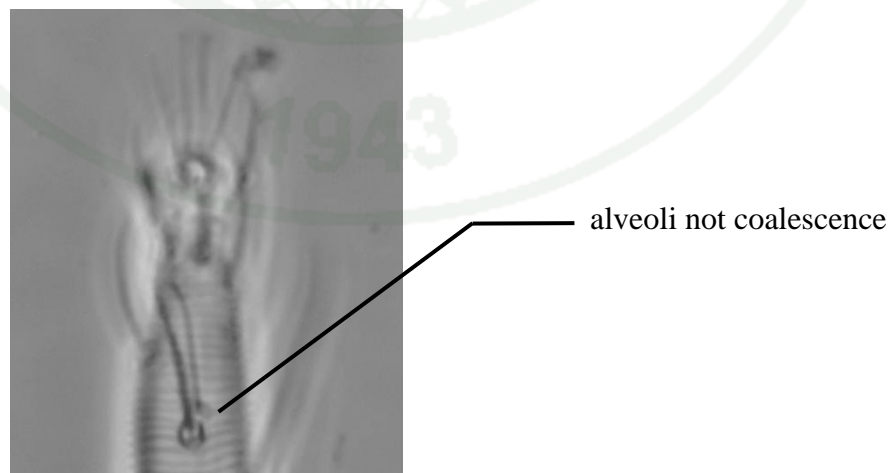


Figure 23 Tarsus I with setae looks like a pair of duplex setae.

Male aedeagus:

Aedeagus bent dorsad at a right angle with dorsal margin of the shaft, abruptly tapering, with acute tip pointing caudad (Figure 24).

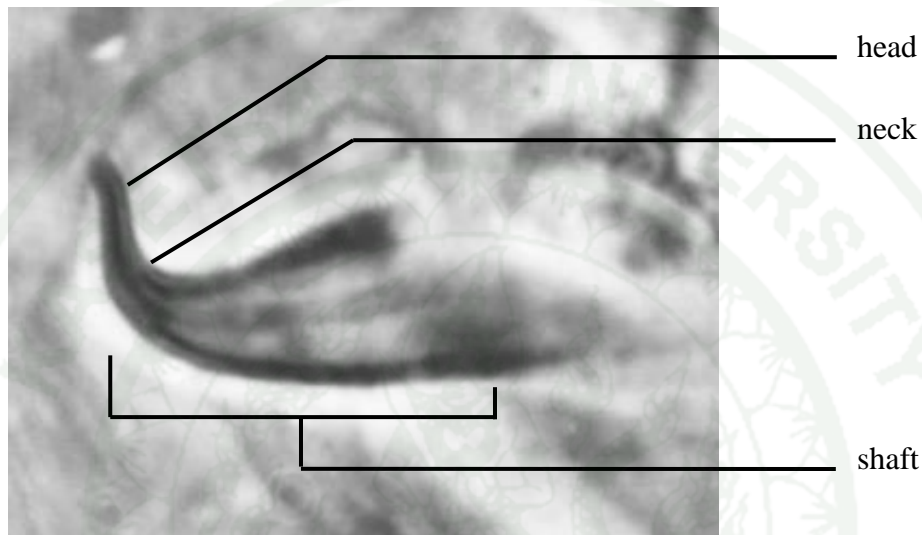


Figure 24 Aedeagus of *Aponychus siamensis*.

Genus *Eutetranychus*, Banks

Type genus: *Tetranychus banksi* McGregor

General characteristics:

Opisthosoma with 10 pairs of dorsal setae, 2 pairs of anal setae; tarsus I and II without characteristic duplex setae, tarsus I with a pair of loosely associated setae probably homologous with one of the pair of duplex setae, however, the alveoli not coalesce, empodium rudimentary, with a small round knob. Legs of male relatively longer than those of female.

In this study, only one species of genus *Eutetranychus*, *Eutetranychus africanus* Tucker, 1926 was found (Figure 25).



Figure 25 Female and male of *Eutetranychus africanus*.

This mite normally occurs on the upper surface of the leaves of their host plants. The mite is very common and has a wide variety of host plants. It is recorded as a serious pest of several commercial crops in Thailand such as papaya, durian, jack fruit, castor bean, cotton, cassava, yard long bean and citrus plants from forty provinces of Thailand (Chandrapatya, 2011).

Morphology of *Eutetranychus africanus* Tucker, 1926

Gnathosoma:

Stylophore without cleft (Figure 26). Palptarsus with spinneret about 3 times as long as broad, 6.8-7.0 μm long, 2.0-2.5 μm wide. Peritreme ends with simple bulb (Figure 27).

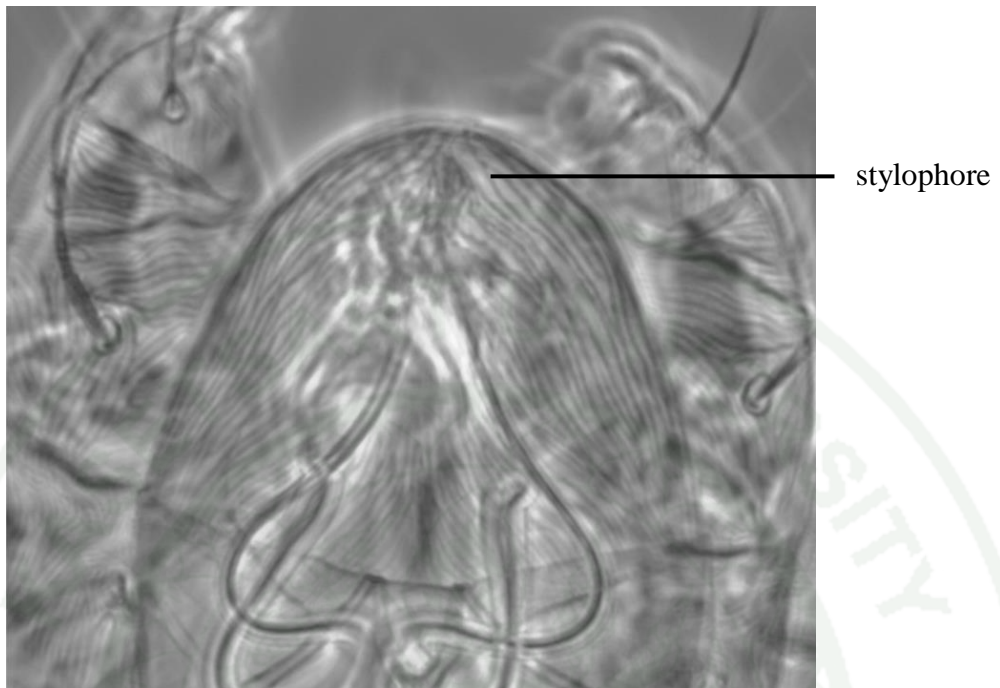


Figure 26 Stylophore of *Eutetranychus africanus*.

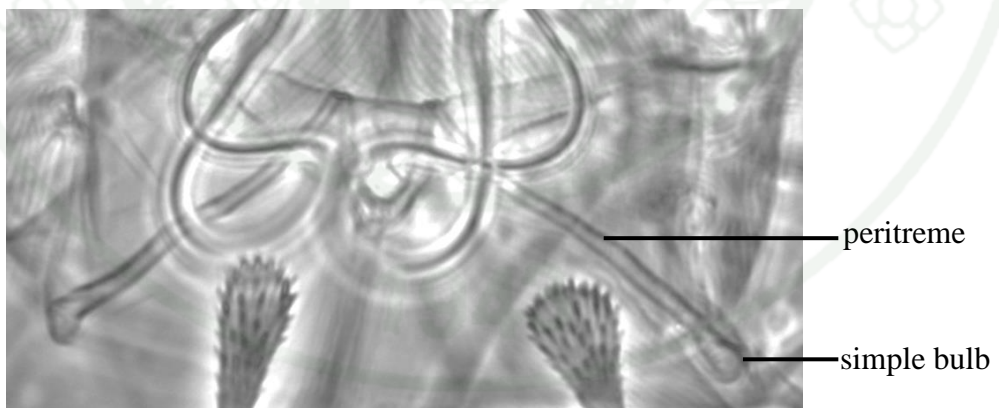


Figure 27 Peritreme of *Eutetranychus africanus* ending with simple bulb.

Idiosoma:

Dorsal integument with transverse striae; dorsal setae serrate, sub-spatulate borne on tubercles (Figure 28). The length of dorsocentral setae (c_1 , d_1 , e_1 and f_1) are half of the length of corresponding dorsolaterals c_2 , d_2 , e_2 and f_2 which are long and slender.

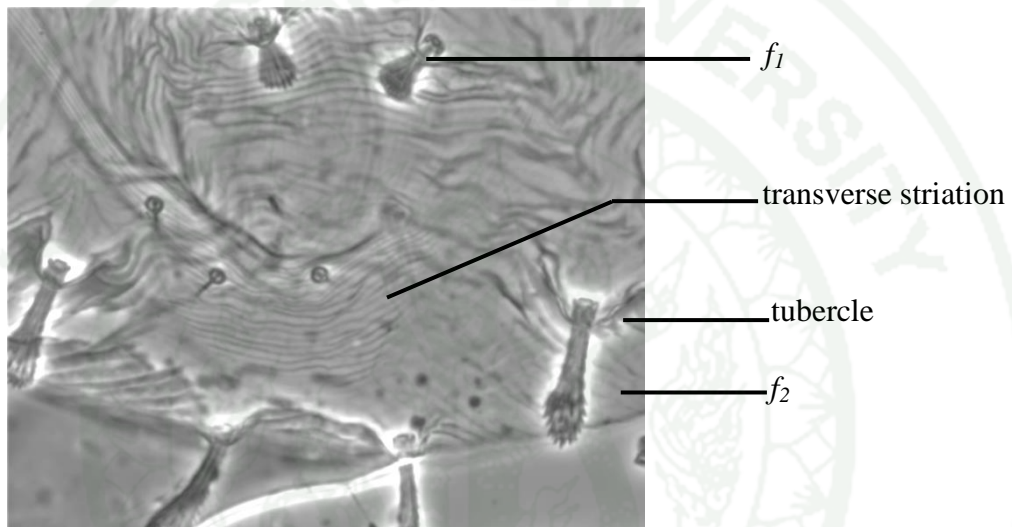


Figure 28 Dorsal idiosoma of *Eutetranychus africanus* showing transverse striae, setae f_1 and f_2 set on tubercles, f_1 is half the length of f_2 .

Venter:

Ventral striation without lobes, genital flap and area immediately anterior to it bearing wavy transverse striation (Figure 29). Two pairs of para-anal and two pairs of anal setae are present (Figure 30).

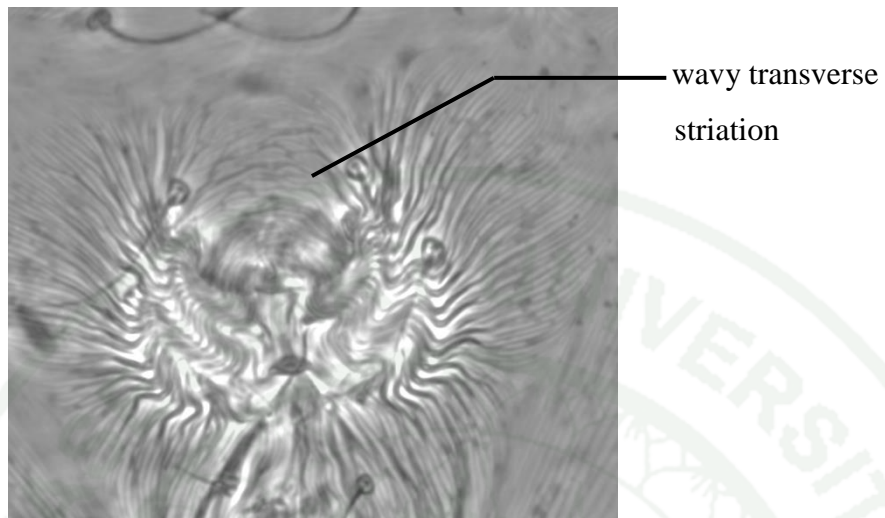


Figure 29 Genital flap and area immediately anterior with wavy transverse striation.

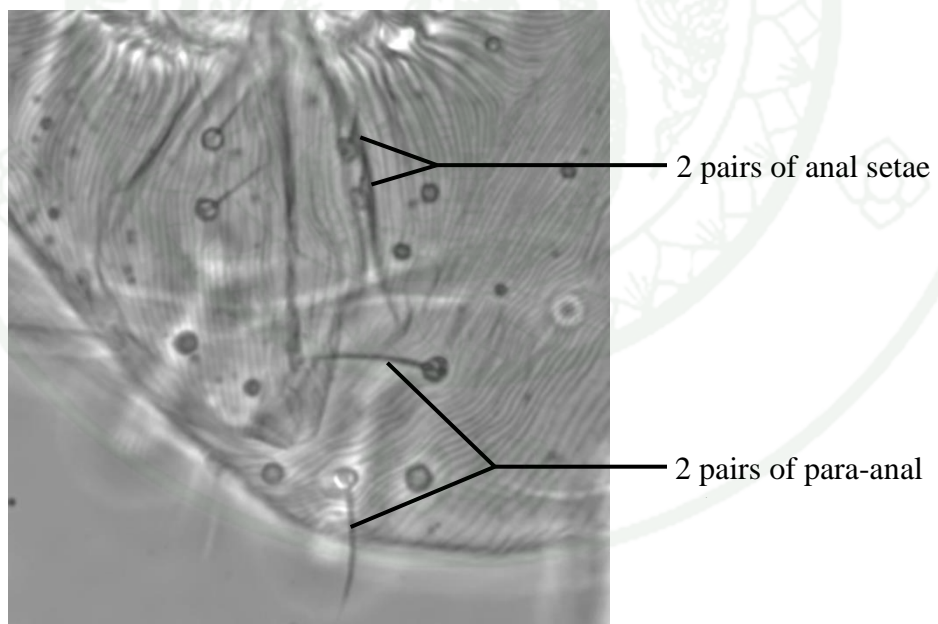


Figure 30 Anal region of *Eutetranychus africanus* showing anal and para-anal setae.

Legs:

The characters of the leg of *E. africanus* are the same as in *A. siamensis*; empodium rudimentary, with a small round knob; tarsus I and II without characteristic duplex setae, tarsus I with a pair of loosely associated setae probably homologous with one of the pairs of duplex setae, however, the alveoli not coalesce; legs of male relatively longer than those of female.

Male aedeagus:

Bent portion is no longer than the dorsal margin of the shaft. The tip of the head is blunt (Figure 31).

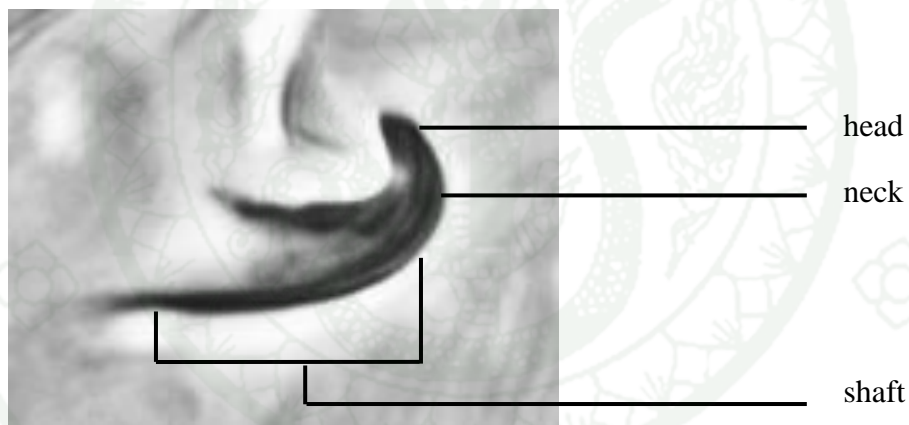


Figure 31 Aedeagus of *Eutetranychus africanus*.

Genus *Eotetranychus* Oudemans, 1931

General characteristics:

Opisthosoma with transverse striae with lobes on dorsocentral area, dorsal body setae as long as or longer than the intervals between their bases, genital area with various striation patterns, 2 pairs of para-anal setae; tarsus I with 2 sets of duplex

setae distal and adjacent to each other (Figure 32), Empodium split into 3 pairs of ventrally directed hairs or ending in a tuft of hairs (Figure 33).

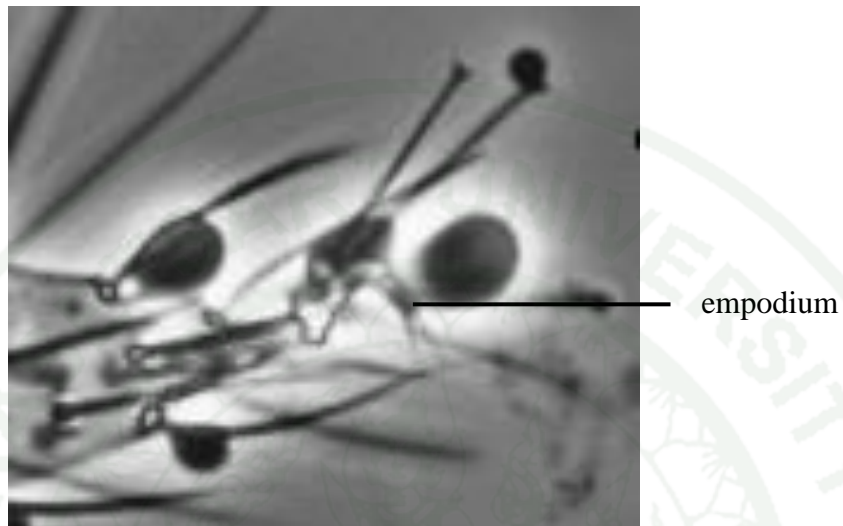


Figure 32 Empodium ending in a tuft of hairs.

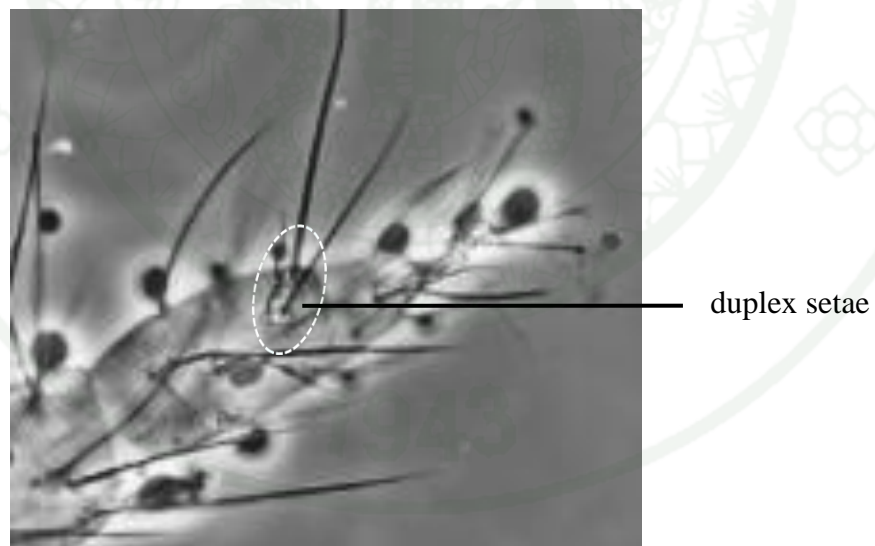


Figure 33 Tarsus I with duplex setae distal and adjacent.

In this study, three species of this genus; *Eotetranychus celtis* Ehara, 1965 (Figure 34); *Eotetranychus cendanai* Rimando, 1962 (Figure 35) and *Eotetranychus thailandicus* Ehara and Wongsiri, 1975 (Figure 36) were recorded.

E. celtis was found on 4 host plants from 12 provinces of Thailand (Chandrapatya, 2011), Ehara and Wongsiri, 1975; and Kongchuensin *et al.*, 2005. This is the new record of host plant for this mite. The mite was collected on Guava, *Aegle marmelos* (L.) Corr. (Rutaceae) from Nakhom Pathom province, Thailand.

E. cendanai was also recorded from 17 provinces on 11 host plants. This mite normally occurs on the family Rutaceae in Thailand Thailand (Chandrapatya, 2011), Baker, 1975; Ehara and Wongsiri, 1975; and Kongchuensin *et al.*, 2005.

E. thailandicus is an oligophagous species and it was recorded on 2 host plants; *Ficus* sp. and *Morus alba* L. from 4 provinces of Thailand (Chandrapatya, 2011), Ehara and Wongsiri, 1975; and Kongchuensin *et al.*, 2005.

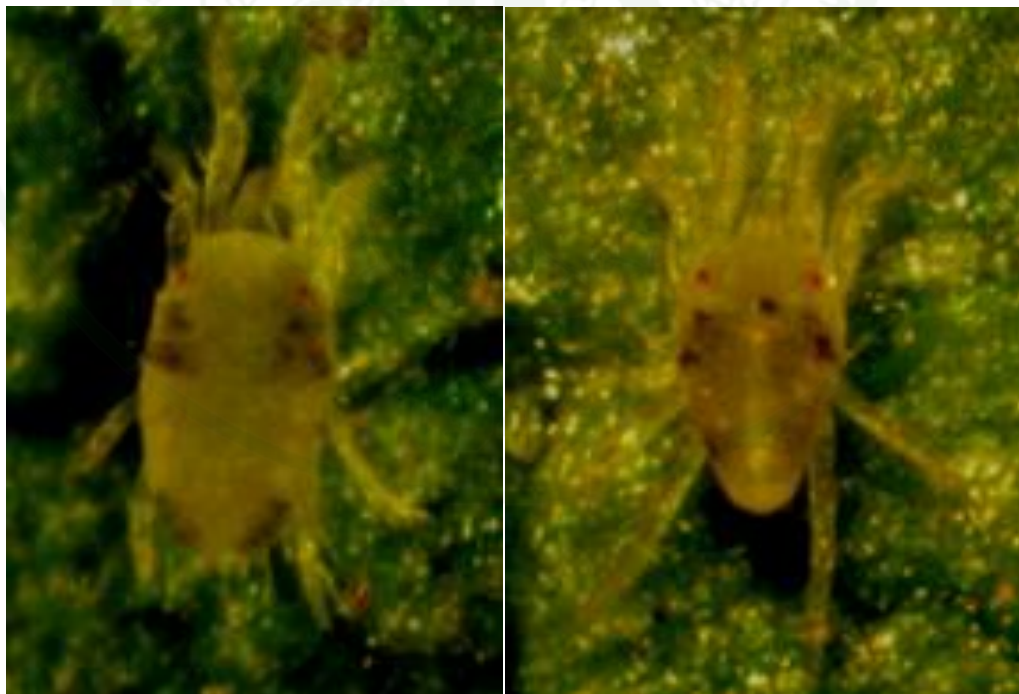


Figure 34 Female of *Eotetranychus celtis*.



Female

Male

Figure 35 Female and male of *Eotetranychus cendanai*.

Female

Male

Figure 36 Female and male of *Eotetranychus thailandicus*.

Morphology of three species of genus *Eotetranychus*

Gnathosoma:

Stylophore with shallow concave mediolaterally in *E. cendanai* (Figure 37) whereas rounded stylophore in *E. celtis* and *E. thailandicus*. Spinneret of palpus about twice as long as broad; dorsal sensillum slender. Spinneret absent in males of both *E. celtis* and *E. cendanai*.

Peritreme straight distally dilated at distal end in *E. cendanai* (Figure 37) and hooked distally forming as U-shaped to L-shaped in *E. celtis* and *E. thailandicus*(Figure 38).

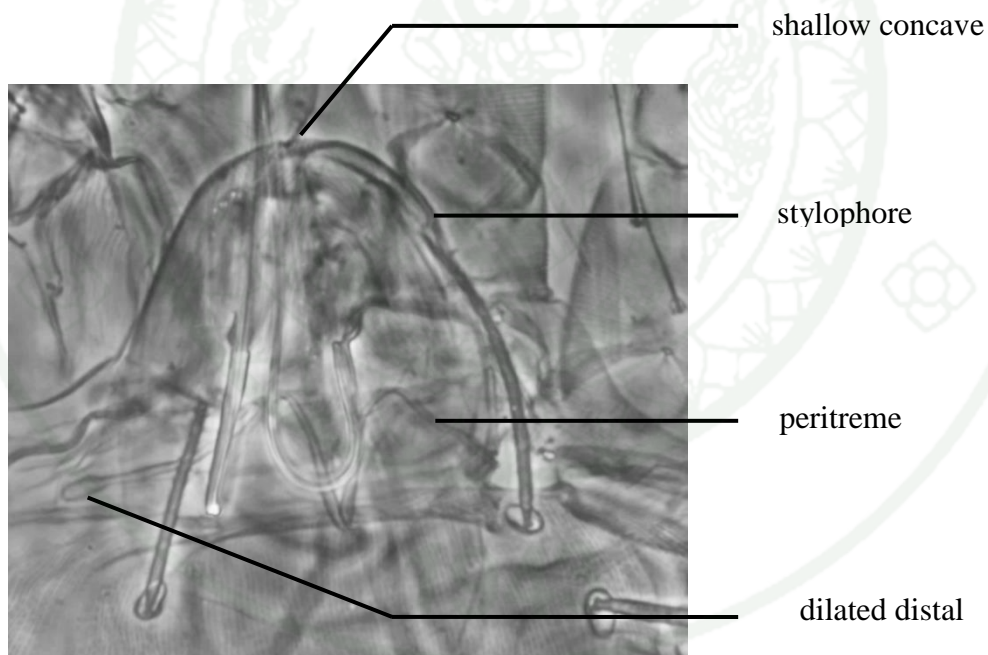


Figure 37 Stylophore and peritreme of *Eotetranychus cendanai*.

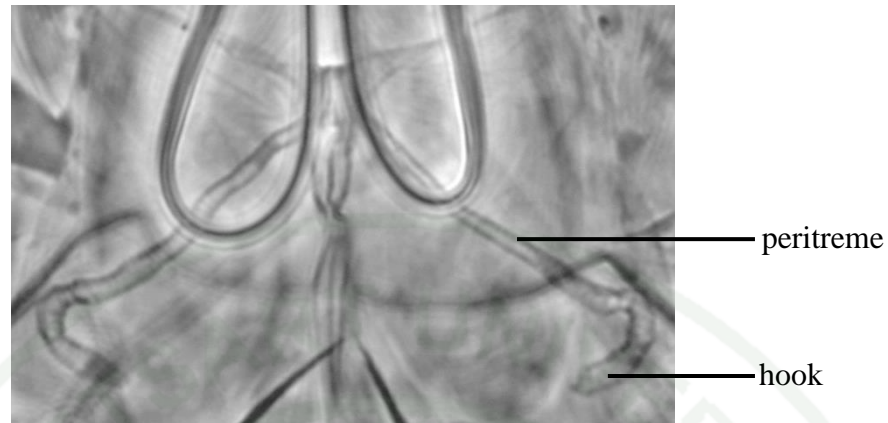


Figure 38 Hooked peritreme of *Eotetranychus celtis* and *Eotetranychus thailandicus*.

Idiosoma:

Mostly the same morphological characteristics appear in both *E. celtis* and *E. thailandicus* in idiosoma. Dorsal setae of idiosoma slender, tapering, pubescent, longer than distances between their bases, inner sacral setae longer than outer sacral setae.

Venter:

Genital flap with transverse striae; area immediately anterior to flap with irregular, usually oblique striae in both *E. celtis* and *E. thailandicus*.

Legs:

Leg chaetotaxy of females in *E. celtis* and *E. thailandicus* are the same, tarsus I with 5 tactile and 1 solenidion proximal to duplex setae; tibia I with 9 tactile and solenidion, tarsus II with 3 tactile and 1 solenidion proximal to duplex setae, one tactile seta near duplex setae; tibia II with 8 tactile setae, tarsi III and IV each with 10 tactile and 1 solenidion; tibia III with 6 tactile setae; tibia IV with 7 tactile setae.

In female *E. cendanai*, tarsus I with 4 tactile and 1 solenidion proximal to duplex setae; tibia I with 8 tactile and solenidion, tarsus II with 1 tactile and 1 solenidion proximal to duplex setae, one tactile seta near duplex setae; tibia II with 5 tactile setae, tarsi III and IV each with 9 tactile and 1 solenidion; tibia III and IV with 5 tactile setae.

Male aedeagus:

In *E. celtis*, aedeagus abruptly narrowing to the middle, nearly perpendicularly bent ventrad there; the bent distal part tapering posteriorly, it nearly perpendicularly bent caudad near its middle (Figure 39) (Ehara, 1965).

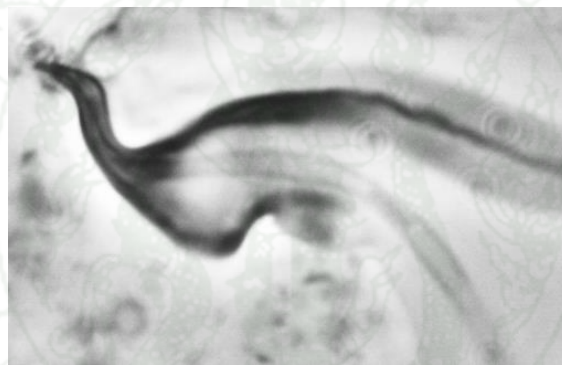


Figure 39 Aedeagus of *Eotetranychus celtis*.



Figure 40 Aedeagus of *Eotetranychus cendanai*.

Aedeagus of *E. thailandicus* with short shaft, curved dorsad from its base, and then bent ventrad to form a narrower distal part, the tip slightly dilated (Figure 41) (Ehara and Wongsiri, 1975).

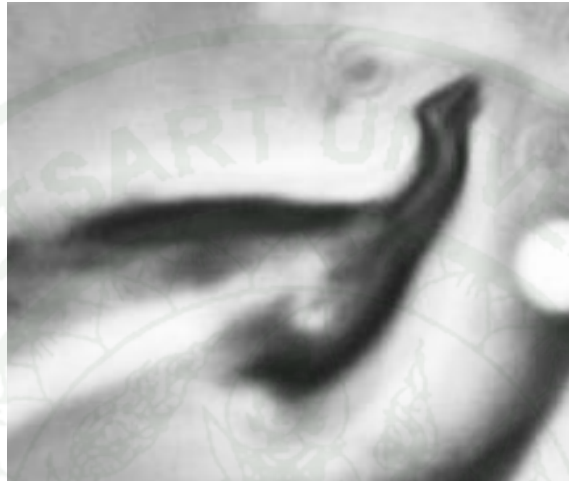


Figure 41 Aedeagus of *Eotetranychus thailandicus*.

Genus *Neotetranychus* Trägårdh, 1915

Type-species: *Neotetranychus rubi* Trägårdh (1915)

General characteristics:

Dorsal body setae long and set on tubercles; female opsithosoma bearing mostly transverse striae which may form a basket-wave patterns or grouped into reticulated clusters; 2 pairs of para-anal (h_{2-1}) and 2 pairs of anal setae (ps_{1-2}) present on venter; empodia split distally (Meyer, 1987).

In this study, only one species of genus *Neotetranychus*, *Neotetranychus lek* Flechtmann, 2013 was found (Figure 42).



Female

Male

Figure 42 Female and male of *Neotetranychus lek*.

Morphology of *Neotetranychus lek* Flechtmann, 2013

Gnathosoma:

Stylophore rounded anteriorly, longitudinally striated, terminal sensillum of palp (spinneret) as long as broad (Figure 43). Peritreme straight ending in a slightly expanded bulb (Figure 44).

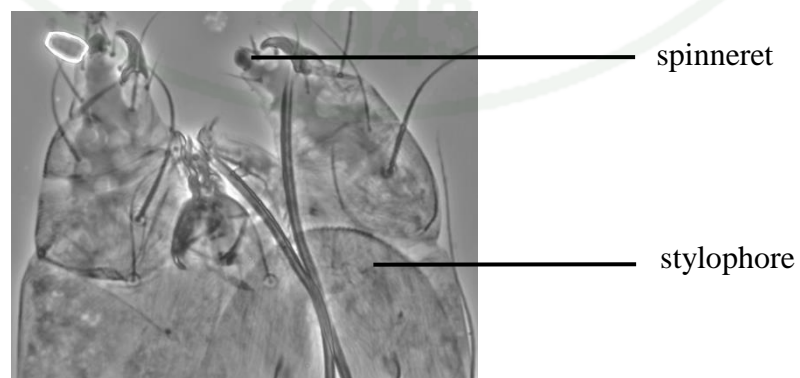


Figure 43 Gnathosoma of *Neotetranychus lek* showing stylophore and spinneret.

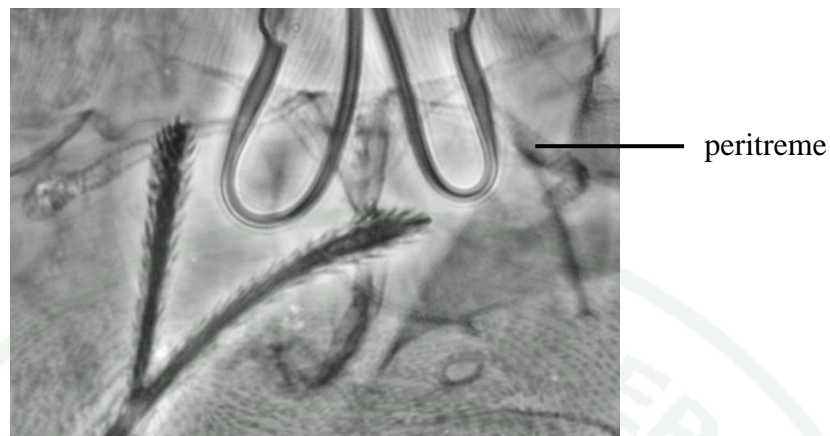


Figure 44 Gnathosoma of *Neotetranychus lek* showing peritreme.

Idiosoma:

Dorsal setae cylindrical, slightly expanded distally, thickly pubescent, inserted on strong tubercles (Figure 45). Dorsal integument entirely striated, striae with small irregular lobes, irregularly transverse between setae c_1 - c_1 , d_1 - d_1 , f_1 - f_1 and caudally, but longitudinal between setae e_1 , and striae longitudinal around bases of tubercles of setae d_1 and e_1 , forming a near diamond shaped pattern (Figure 46).

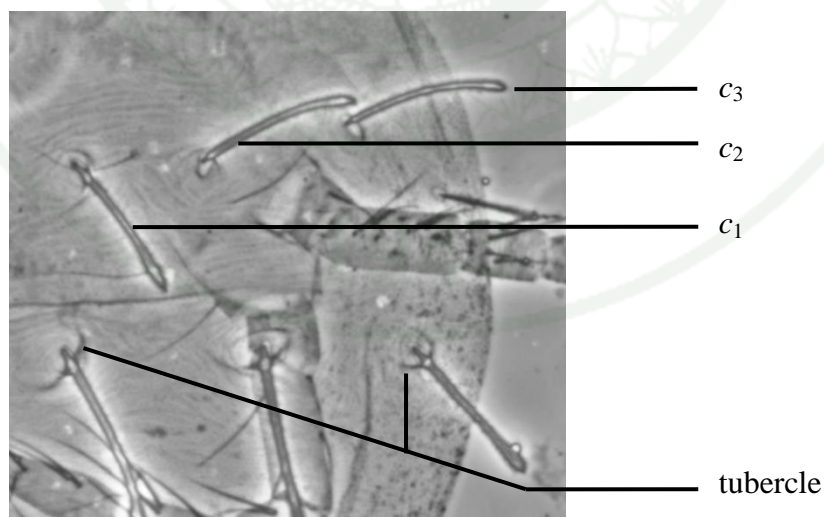


Figure 45 Dorsal setae of *Neotetranychus lek* showing setae set on tubercles.

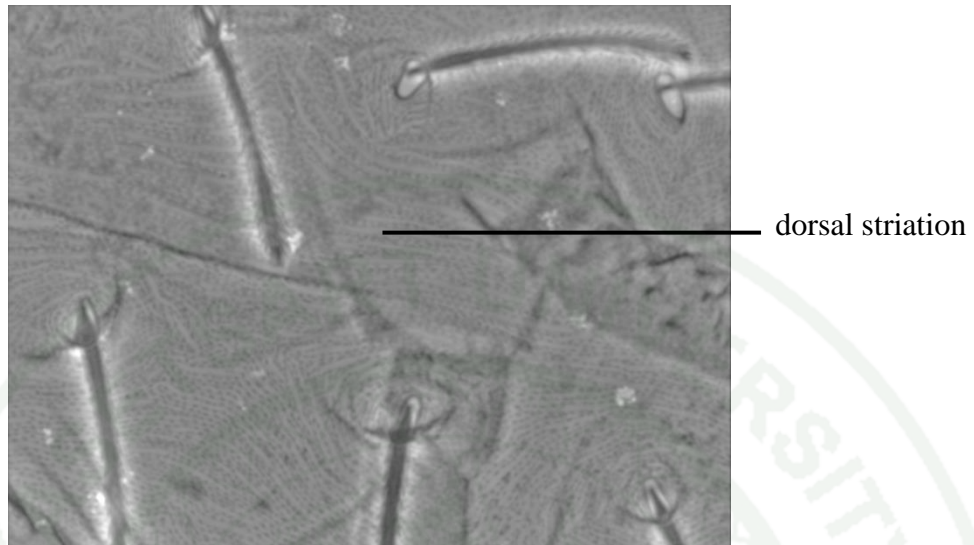


Figure 46 Dorsal striation of *Neotetranychus lek* showing irregular transverse pattern.

Venter:

Genital flap with arched striae; area immediately anterior to it with transverse striae. Medioventral striae without lobes.

Legs:

Tarsus I with 2 sets of duplex setae distal and adjacent to each other. Empodium claw like with proximoventral hairs (Figure 47).\

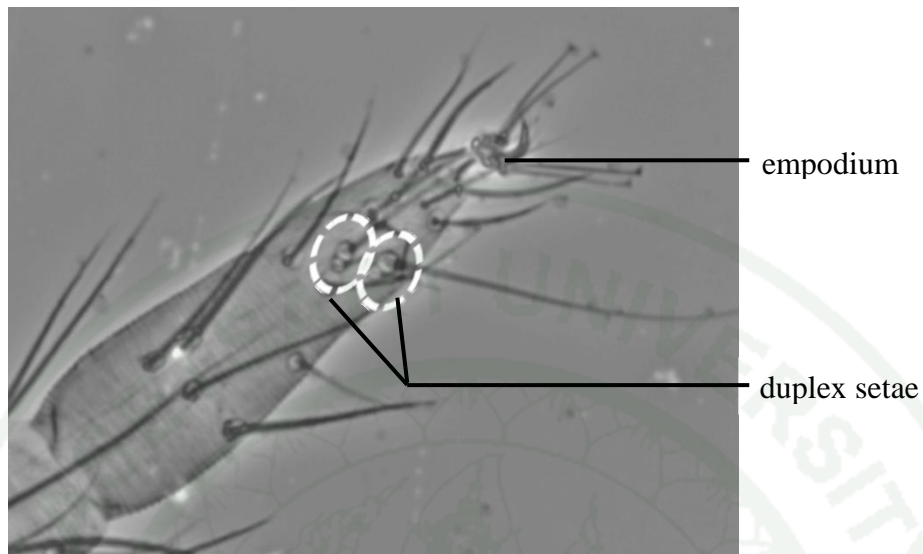


Figure 47 Tarsus I of *Neotetranychus lek* showing duplex setae and empodium.

Male aedeagus:

The aedeagus of this species has long shaft and upturned. The anterior projection of aedeagal knob rounded and posterior projection acute pointed. The dorsal margin of the knob slightly convex rather than flattened (Figure 48).

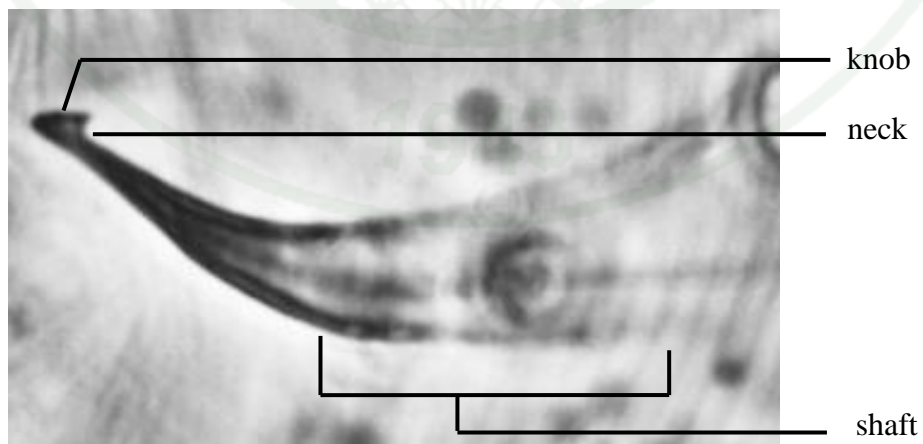


Figure 48 Tarsus I of *Neotetranychus lek* showing duplex setae and empodium.

Genus *Oligonychus* Berlese, 1886

General characteristics:

Opisthosomal striae transverse on anterior portion of dorsocentral area and various in patterns on posterior portion, 1 pair of para-anal setae, dorsal body setae usually not set on tubercles; tarsus I with 2 sets of duplex setae distal and adjacent to each other, empodium claw-like, with pairs of proximoventral setae (Figure 49).

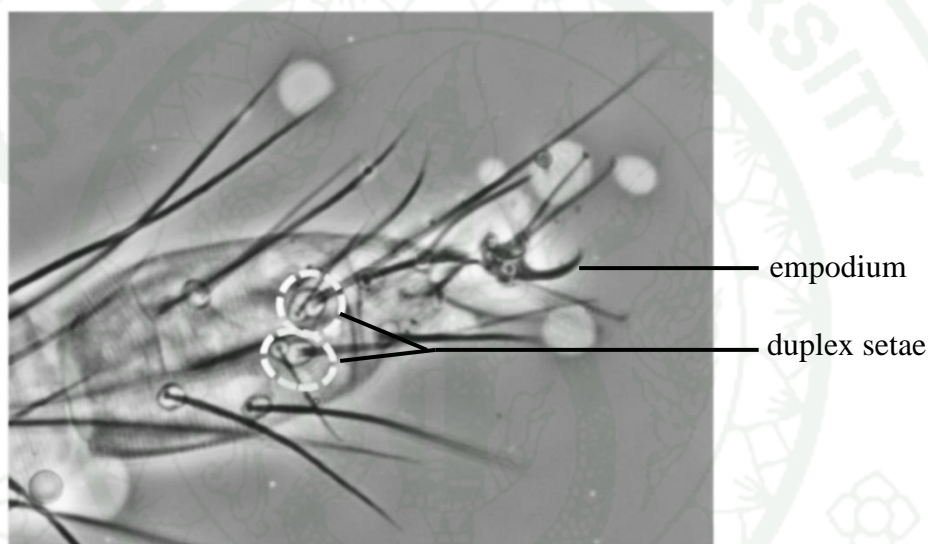


Figure 49 Tarsus I of *Oligonychus* showing duplex setae and empodium.

Seven species of this genus were found in this study. They are *Oligonychus biharensis* (Figure, 50), *O. mangiferus* (Figure, 51), *O. modestus* (Figure, 52), *O. orthius* (Figure, 53), *O. punicae* (Figure, 54), *O. Sacchari* (Figure, 55), and *O. velascoi*. Since the genus composes of a very large group of species, the size and shapes of the members of this genus are variable.

Oligonychus biharensis has been recorded from 42 host plants in 36 provinces of Thailand (Baker, 1975a; Ehara and Wongsiri, 1975; Charanasri *et al.*, 1977; Wongsiri, 1991; Charanasri and Kongchuensin, 1994; Kongchuensin *et al.*, 2005; Chandrapatya, 2011).

Oligonychus mangiferus was recorded from 14 host plants in 21 provinces of Thailand (Baker, 1975a; Kongchuensin *et al.*, 2005; Chandrapatya, 2011).

Oligonychus modestus was recorded from 3 host plants in 3 provinces of Thailand (Baker, 1975a; Wongsiri, 1991; Kongchuensin *et al.*, 2005; Chandrapatya, 2011).

Oligonychus orthius was also recorded on 5 host plants from only 1 province of Thailand (Baker, 1975b; Wongsiri, 1991; Kongchuensin *et al.*, 2005; Chandrapatya, 2011).

Oligonychus punicae was recorded on 2 host plants; *Harrisonia perforate* (Blanco) and *Punica granatum* from 2 provinces of Thailand (Charanasriet *al.*, 1977; Chandrapatya, 2011).

Oligonychus Sacchari was found as a new record on *Cymbopogon citratus* (DC.) Stapf (Poaceae), Phetchaburi Province in Thailand.

Oligonychus velascoi was found on 4 host plants (*Musa sapientum* L., *Zea mays* L., *Cocos nucifera* L. var. *nucifera* and *Digitaria* sp.) from 3 provinces of Thailand (Baker, 1975a; Ehara and Wongsiri, 1975; Wongsiri, 1991).



Figure 50 Female and male of *Oligonychus biharensis*.

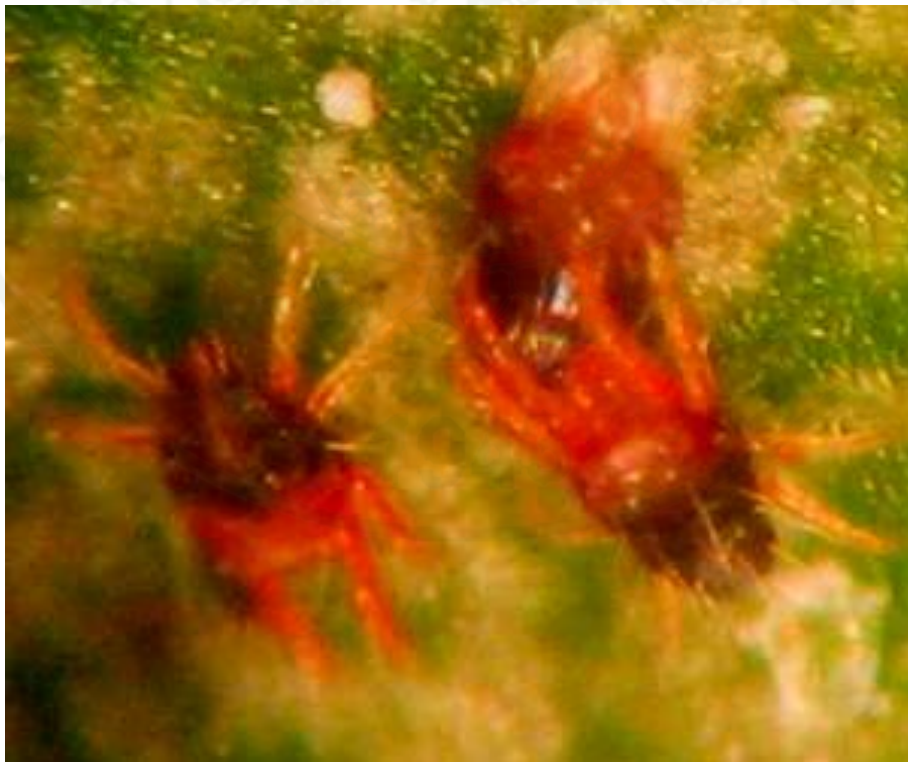


Figure 51 Female and male of *Oligonychus mangiferus*.



Female

Male

Figure 52 Female and male of *Oligonychus modestus*.



Figure 53 Female of *Oligonychus punicae*.



Figure 54 Female of *Oligonychus sacchari*.

Morphology of *Oligonychus biharensis* Hirst, 1924

Gnathosoma:

Stylophore rounded, palp tarsus with spinneret twice as long as broad (Figure 55), peritreme hooked terminally (Figure 56).

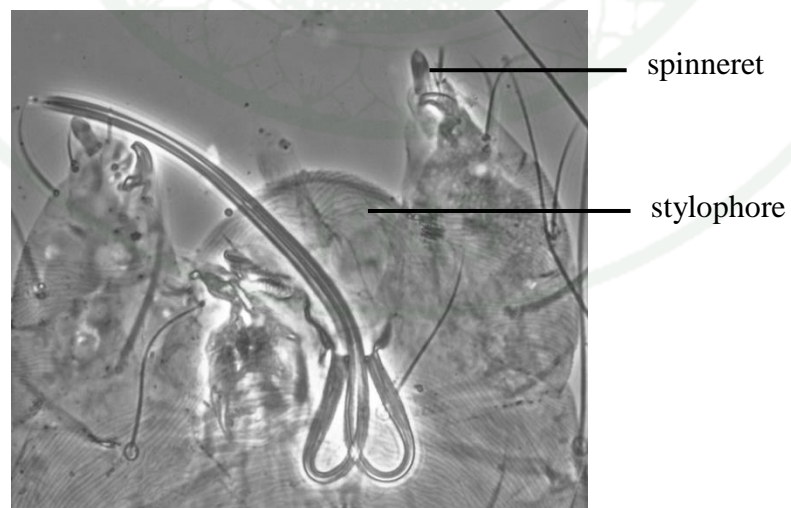


Figure 55 Gnathosoma of *Oligonychus biharensis* showing stylophore and spinneret.

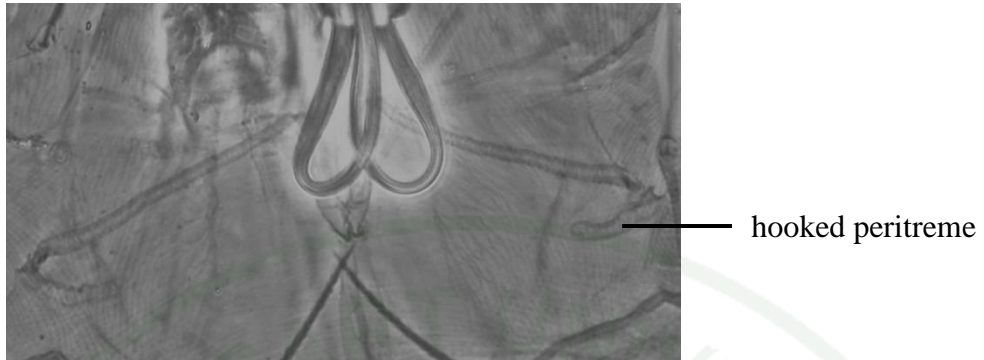


Figure 56 Peritreme of *Oligonychus biharensis*.

Idiosoma:

Longitudinal striae between e_1 setae, dorsocentral area between setae d_1 and e_1 transverse striation with small lobes (Figure 57).

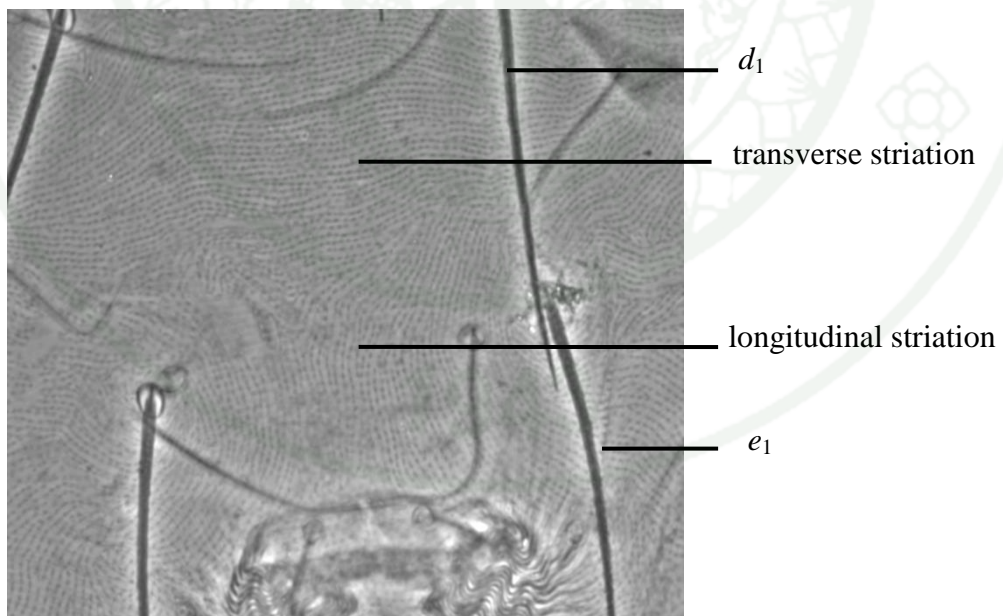


Figure 57 Dorsal striation of *Oligonychus biharensis*.

Venter:

Ventral striation without lobes; in female two pairs of anal setae and a pair of para-anal setae are present; genital flap with area immediately anterior to it bearing broken longitudinal striation (Figure 58).

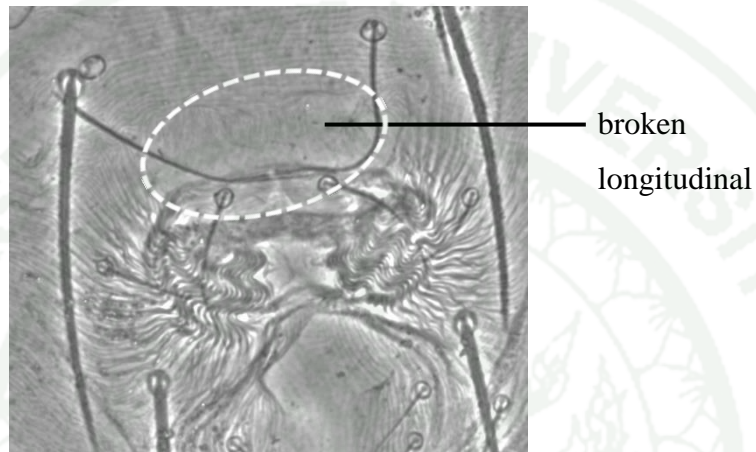


Figure 58 Pregenital area with broken longitudinal striation.

Legs:

Tarsus I with 2 sets of duplex setae adjacent to each other (Figure 59); empodium claw like, with proximoventral hairs (Figure 60).

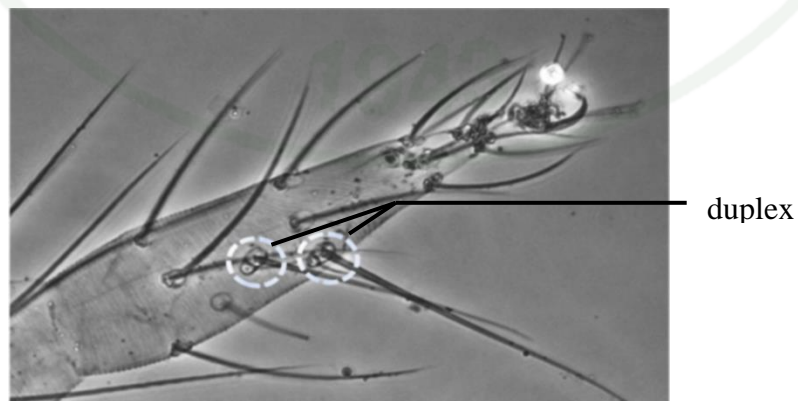


Figure 59 Tarsus I of *Oligonychus biharensis* showing 2 sets of duplex setae.

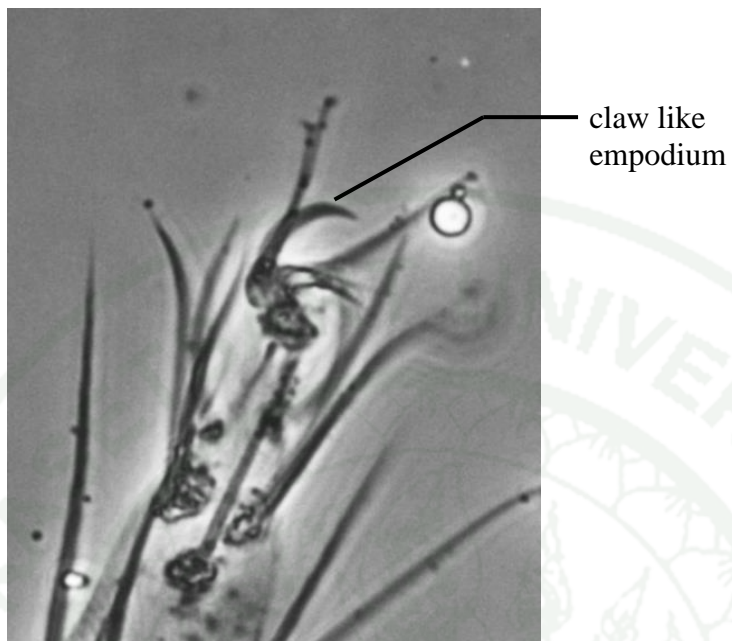


Figure 60 Empodium of *Oligonychus biharensis*.

Male aedeagus:

The aedeagus of *O. biharensis* is distinct in having the terminal knob convex dorsally, with a very long, downward-bending posterior projection (Figure 61).

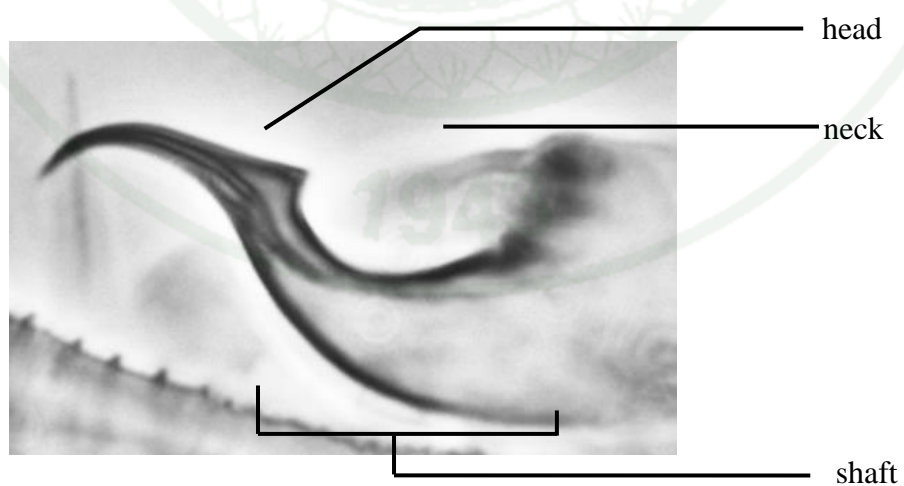


Figure 61 Aedeagus of *Oligonychus biharensis*.

Morphology of *Oligonychus mangiferus*

Gnathosoma:

Stylophore rounded (Figure 62), palp tarsus with spinneret about as long as wide, 3.6-3.8 μ m long and 3.6-3.7 μ m wide (Figure 63). Peritreme curved terminally (Figure 64).

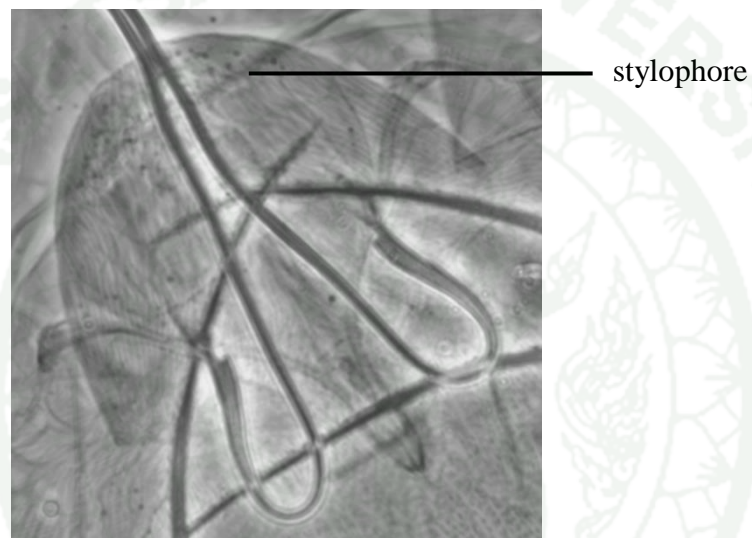


Figure 62 Stylophore of *Oligonychus mangiferus*.

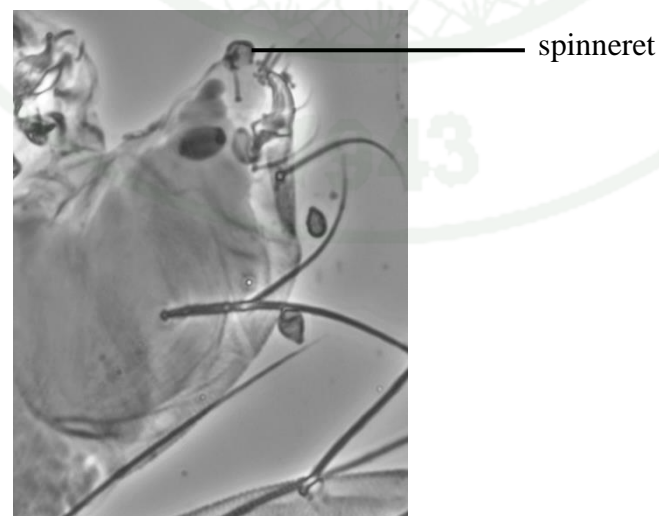


Figure 63 Palp tarsus of *Oligonychus mangiferus*.

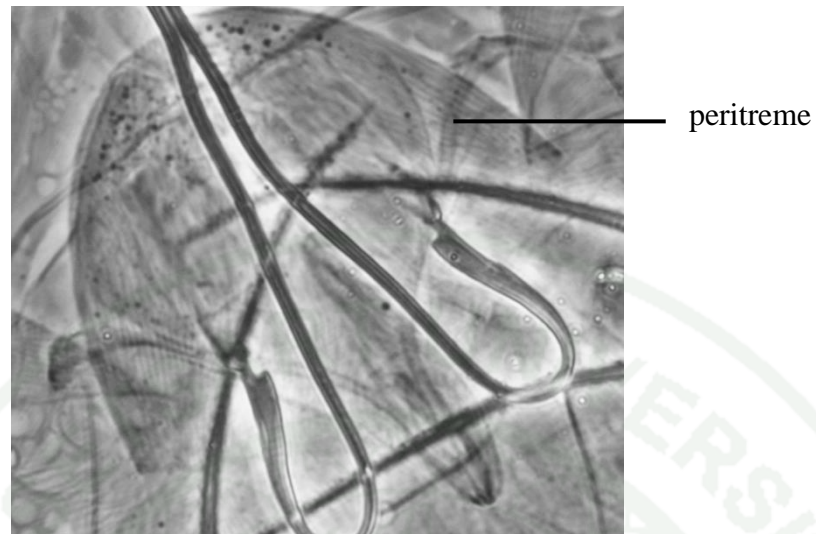


Figure 64 Peritreme of *Oligonychus mangiferus*.

Idiosoma:

Dorsal striation transverse with small lobes, more prominent lobes in area between setae d_1 and e_1 (Figure 65).

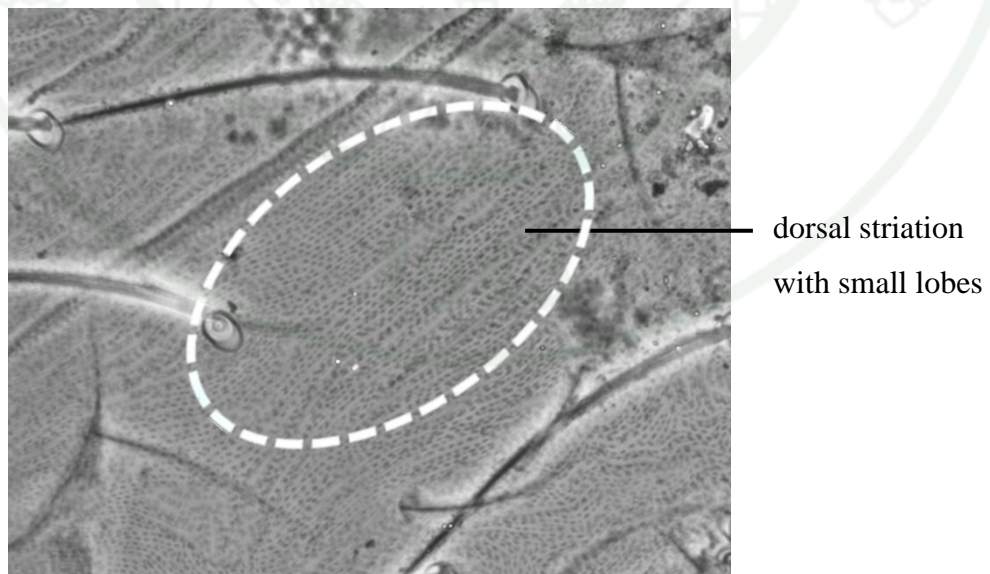


Figure 65 Dorsal striation of *Oligonychus mangiferus*.

Venter:

Ventral striation transverse, no lobes; genital flap with area immediately anterior irregular (Figure 66).

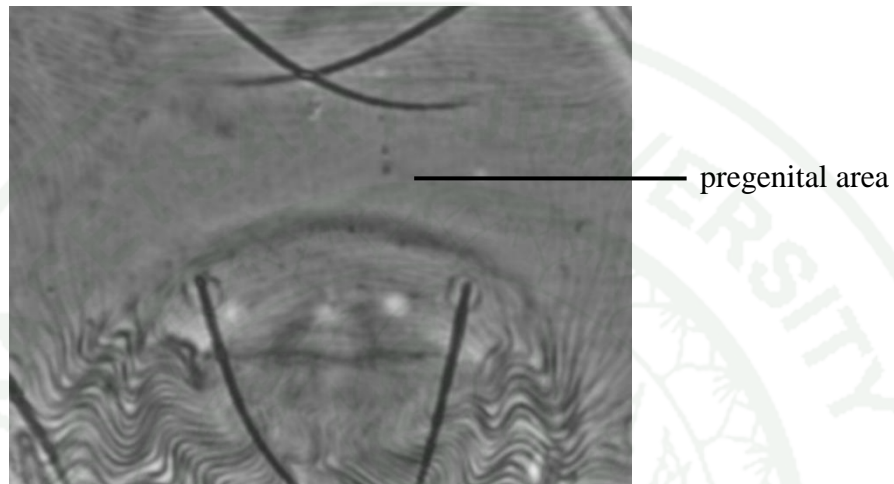


Figure 66 Pregenital area with irregular pattern of *Oligonychus mangiferus*.

Legs:

Empodium claw like, with proximoventral hairs; tarsus I with 2 sets of duplex setae distal adjacent to each other (Figure 67).

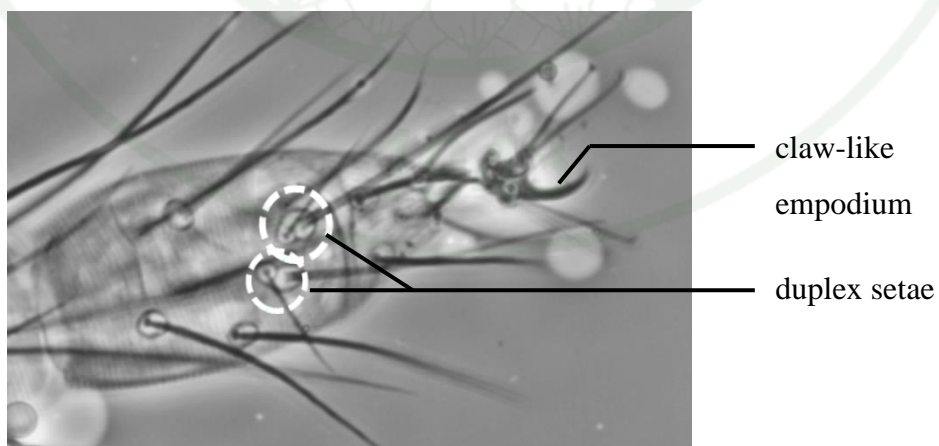


Figure 67 Tarsus I of *Oligonychus mangiferus* showing duplex setae and empodium.

Morphology of *Oligonychus modestus* Banks, 1900

Gnathosoma:

Rounded stylophore (Figure 68), spinneret with 3.03-3.45 μm long and 2.41-2.63 μm wide. Peritreme ending with simple bulb (Figure 69).

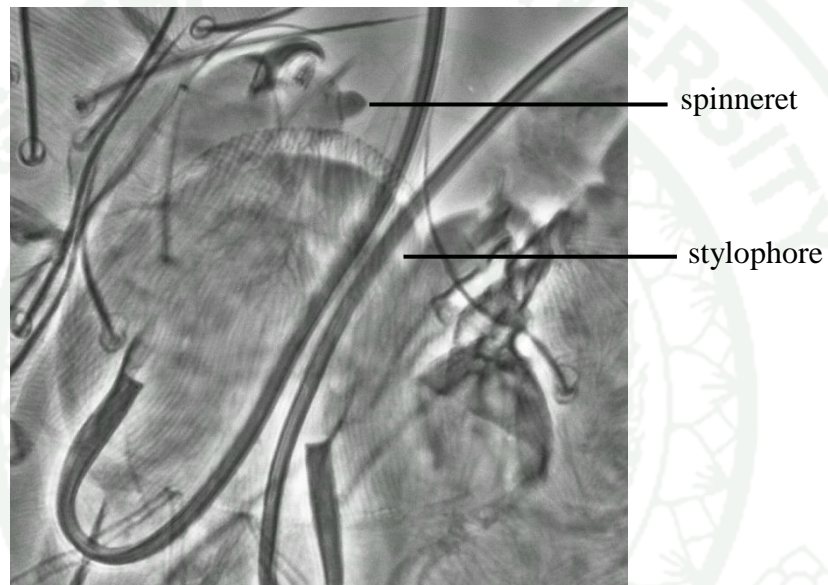


Figure 68 Gnathosoma of *Oligonychus mangiferus* showing stylophore and spinneret.

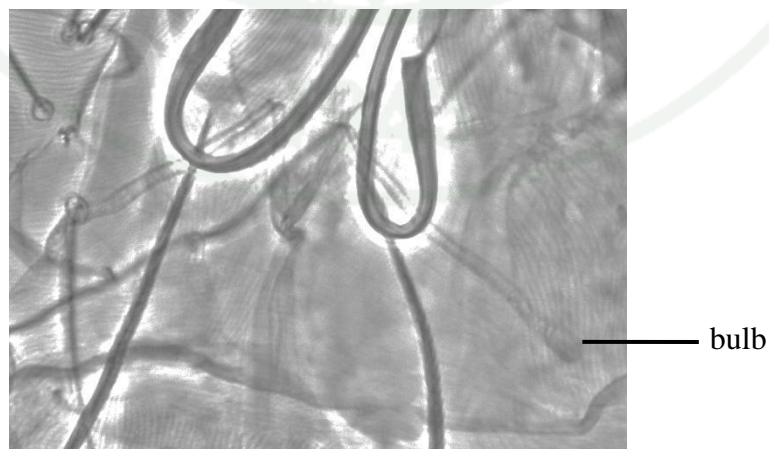


Figure 69 Peritreme of *Oligonychus mangiferus*.

Idiosoma:

Prodorsal striate longitudinal, opisthosomal striae transverse except for longitudinal pattern between f_1 setae; lobes small, broader than tall.

Venter:

Ventral striae transverse, lobed, becoming longitudinal anterior to genital flap, flap pattern longitudinal on anterior margin and then becoming transversely arched.

Legs:

Tarsus I with 2 sets of duplex setae not so close to each other, 2 proximal tactile setae inline with 1 solenidion, empodium claw like with proximoventral hairs (Figure 70).

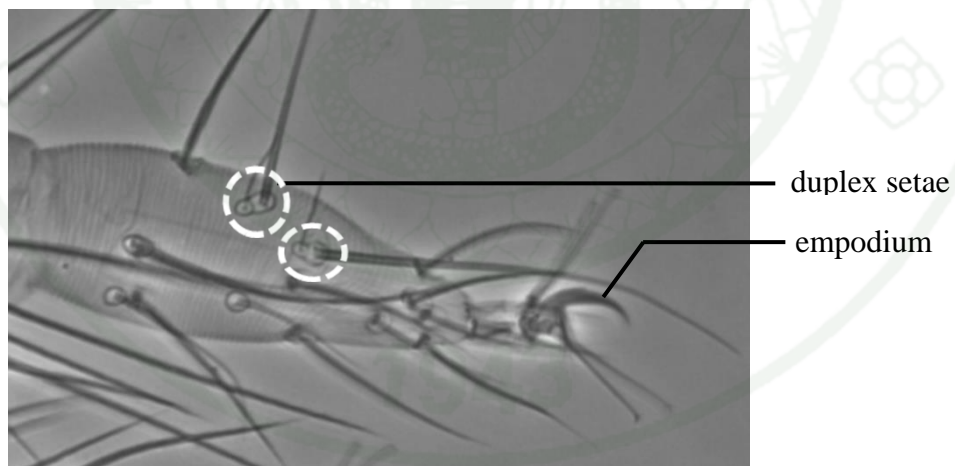


Figure 70 Tarsus I of *Oligonychus mangiferus* showing duplex setae and empodium.

Male aedeagus:

Aedeagus abruptly upturned at right angle to shaft, neck short, head narrow and flap dorsally (Figure 71).



Figure 71 Aedeagus of *Oligonychus mangiferus*.

Morphology of *Oligonychus orthius* Rimando, 1962

Gnathosoma:

Rounded stylophore, spinneret about 1.5 times as long as broad; 5.19-5.34 μ m long and 3.11-3.28 μ m wide. Peritreme is more or less bent at the distal end (Figure 72).

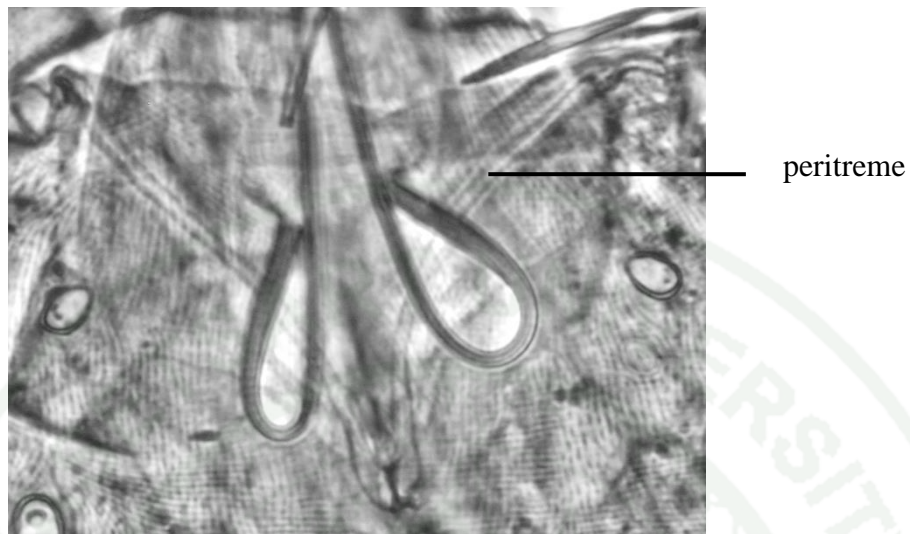


Figure 72 Peritreme of *Oligonychus orthius*.

Male aedeagus:

The aedeagus is distinctive in having the upturned distal portion slender and sigmoid (Figure 73).

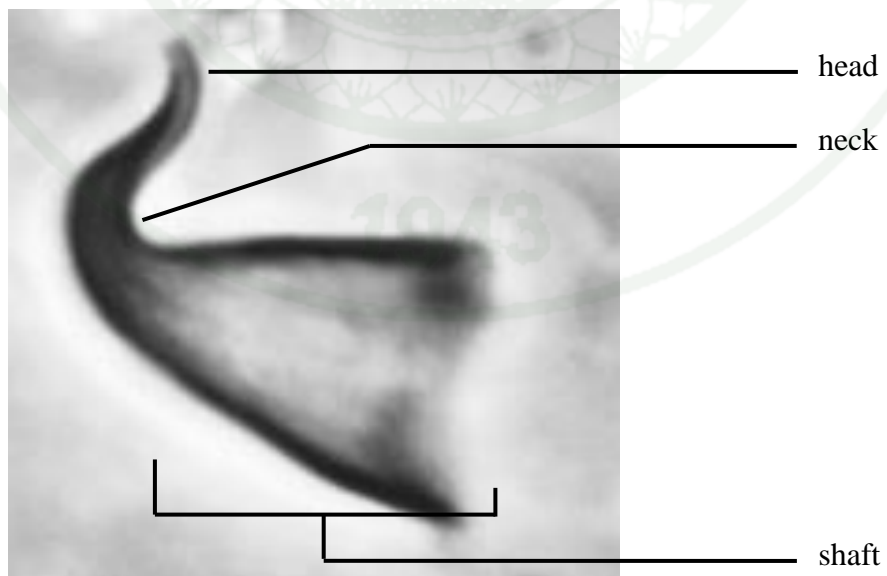


Figure 73 Aedeagus of *Oligonychus orthius*.

Morphology of *Oligonychus velascoi* Rimando, 1962

Gnathosoma:

Rounded stylophore, spinneret less than twice as long as broad, 5.24-5.41 μm long and 3.04-3.39 μm wide. Peritreme straight distally, ending in a simple bulb (Figure 74).

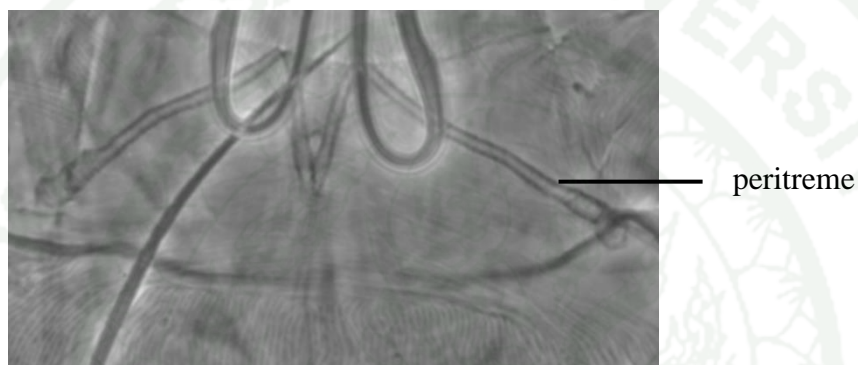


Figure 74 Peritreme of *Oligonychus velascoi*.

Idiosoma:

Prodorsal striate longitudinal (Figure 75), opisthosomal striae transverse except for longitudinal pattern between f_1 setae (Figure 76); lobes small, broader than tall.

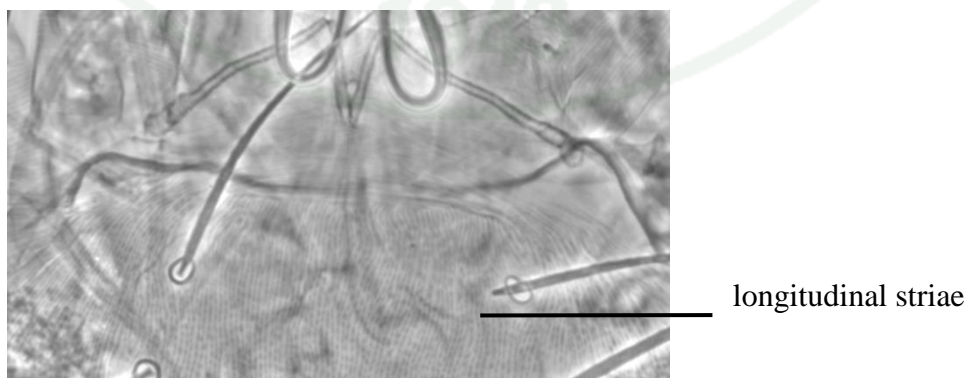


Figure 75 Prodorsum of *Oligonychus velascoi* showing longitudinal striae.

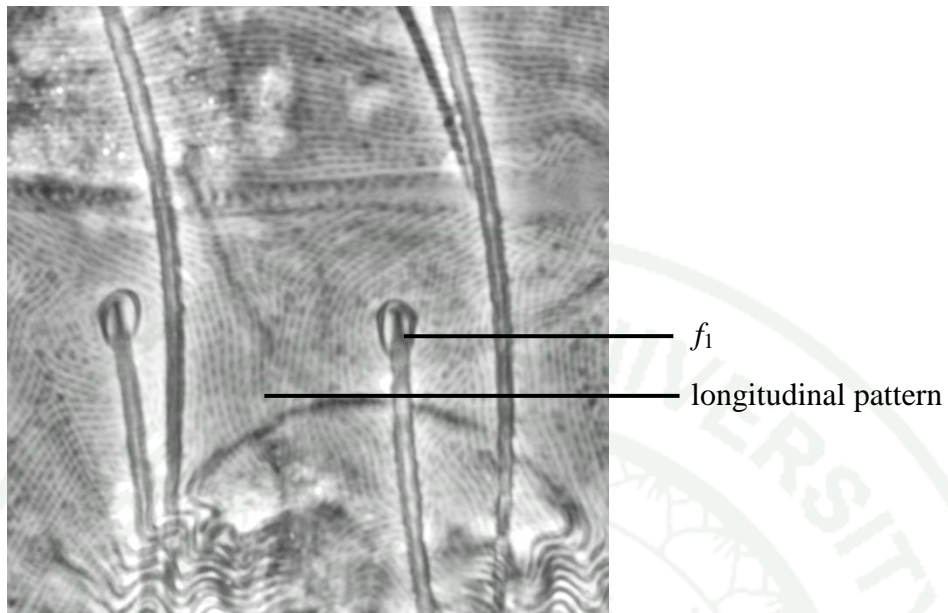


Figure 76 Opisthosomal striae showing longitudinal pattern between f_1 setae.

Venter:

Ventral striae transverse, lobed, genital flap with area immediately anterior to it bears longitudinal and then becoming transversely arched (Figure 77).

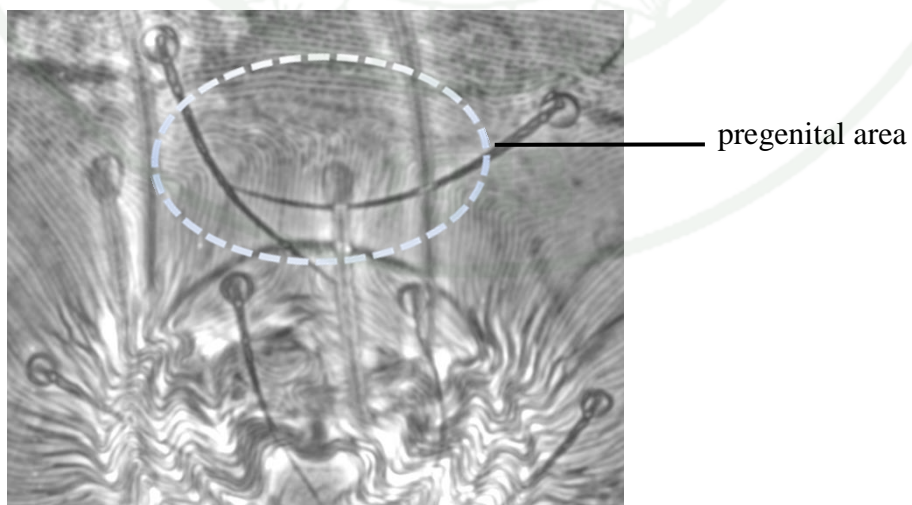


Figure 77 Longitudinal and transversely arched striae on pregenital area.

~8~

Tarsus I with 2 sets of duplex setae not so closed (Figure 78). Empodium well developed curved claw and each with 3 pairs of proximoventral hairs (Figure 79).

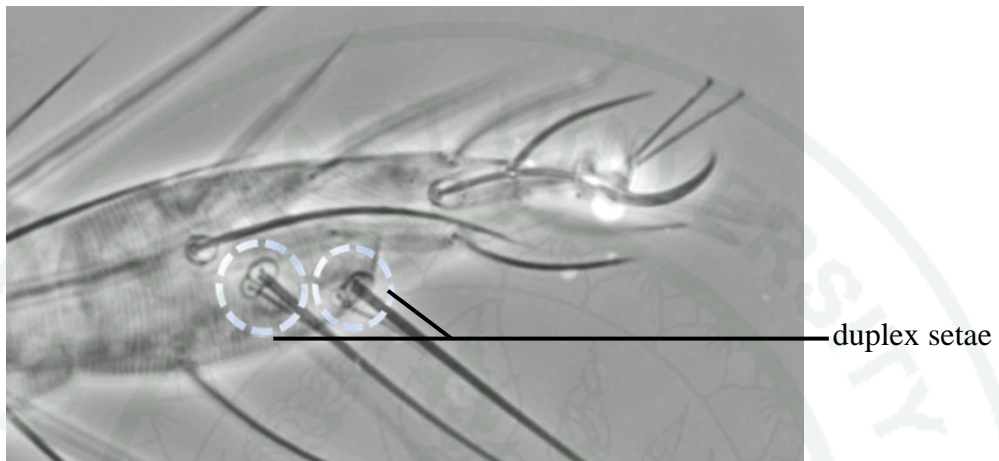


Figure 78 Tarsus I with 2 sets of duplex setae.

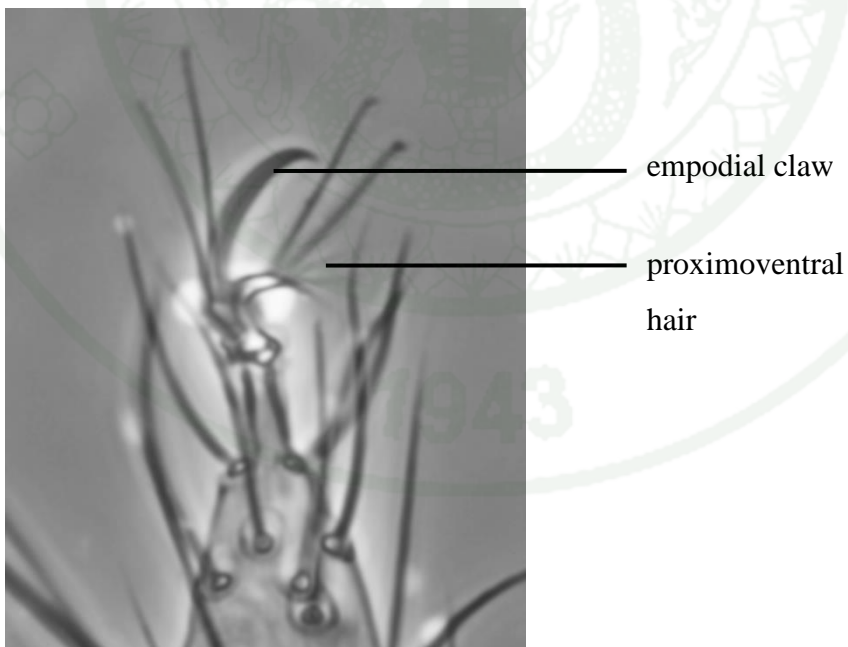


Figure 79 Empodium of *Oligonychus velascoi* showing claw and proximoventral hair.

Male aedeagus:

Aedeagus bent dorsad with distal end slightly sigmoidal, tapering to a tiny dorsocauded tip (Figure 80).

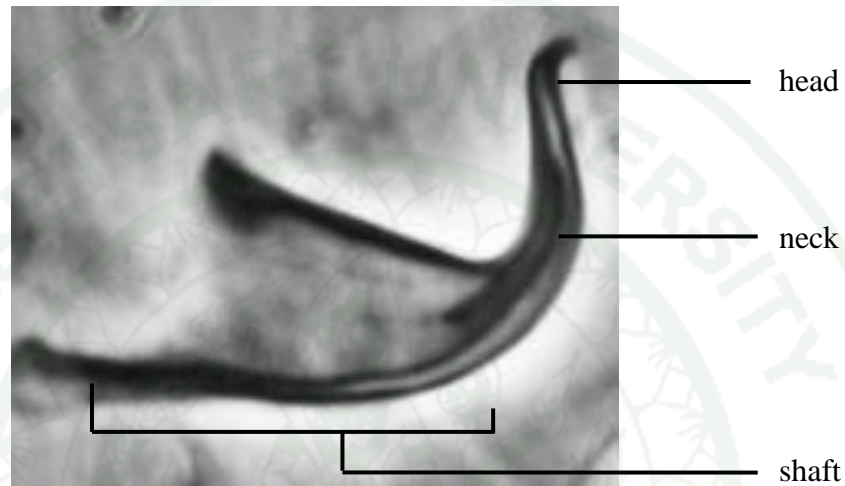


Figure 80 Aedeagus of *Oligonychus velascoi*.

Genus *Panonychus* Yokoyama, 1929

Type species: *Panonychus mori* Yokoyama, 1929

General characteristics:

Body globular, dorsal idiosomal setae set on prominent tubercles, opisthosoma with dorsocentral setae₂ in normal position, with 2 pairs of para-anal setae, tarsus I with 2 pairs of duplex setae; empodium claw-like or split distally, empodium with proximoventral hairs.

In this study, there is only one species of this genus, *Panonychus elongatus* Manson, 1963 was recorded (Figure 81).



Female

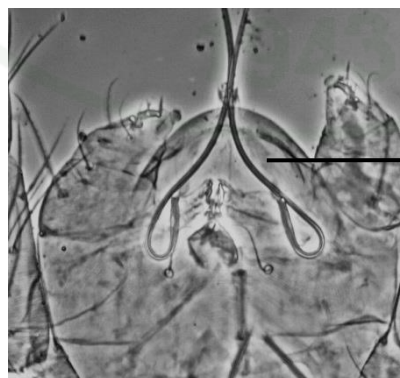
Male

Figure 81 Female and male of *Panonychus elongatus*.

Morphology of *Panonychus elongatus* Manson, 1963

Gnathosoma:

Rounded stylophore (Figure 82), spinneret about twice as long as broad, peritreme ending as a simple bulb.



stylophore

Figure 82 Gnathosoma of *Panonychus elongatus* showing stylophore.

Idiosoma:

Dorsal body setae set on prominent tubercles (Figure 83).

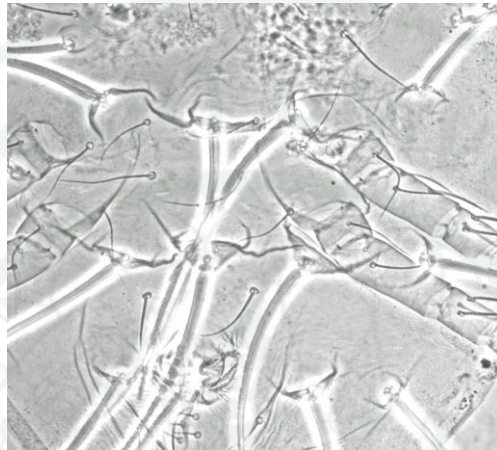


Figure 83 Dorsal setae set on tubercles.

Venter:

Opisthosoma with 2 pairs of anal setae and 2 pairs of para-anal setae (Figure 84).



Figure 84 Anal region with two pairs of anal setae and two pairs of para-anal setae.

Genus *Schizotetranychus* Trägårdh, 1915

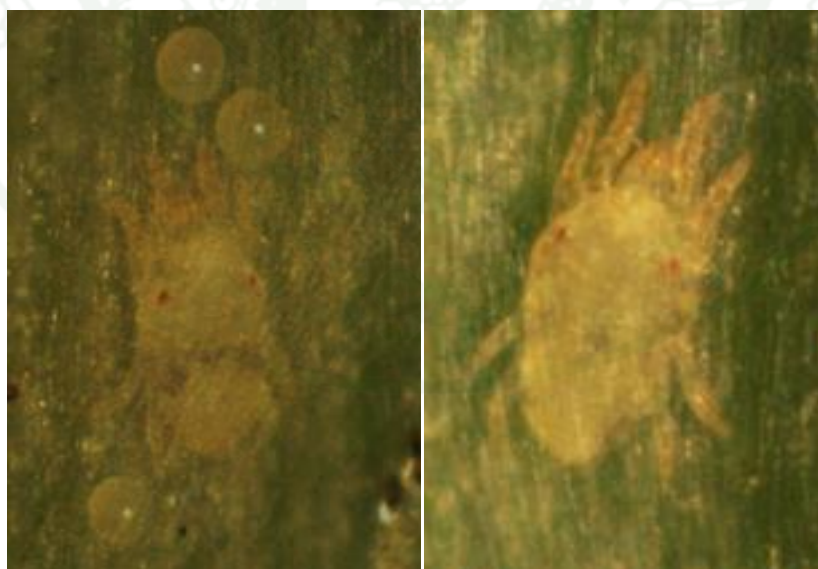
General characteristics:

Opisthosoma with transverse or longitudinal striae on anterior portion of dorsocentral area, transverse striae on posterior portion; 2 pairs of para-anal setae; tarsus I with 2 sets of duplex setae distal and adjacent to each other, empodium claw-like, bifurcate, all 3 pairs of empodial hairs may be present or absent.

There are 3 species of *Schizotetranychus* recorded in this study.

Schizotetranychus krungthepensis is a new species found on sugarcane, *S. malayanus* is a new record for Thailand feeding on wild grass and wild bean plant and *S. colocasiae* is commonly found on taro and distributed in many areas.

Schizotetranychus colocasiae Ehara and Tho, 1988; *Schizotetranychus krungthepensis* sp. nov. Naing and Auger, 2014 (Figure 85) and *Schizotetranychus malayanus* Ehara, 1988 (Figure 86) were discovered. *S. malayanus* was treated as a new record in Thailand.



Female with eggs under

Male

Figure 85 Female and male of *Schizotetranychus krungthepensis* Naing and Auger.



Female

Male

Figure 86 Female and male of *Schizotetranychus malayanus*.

Morphology of three species of genus *Schizotetranychus*

Gnathosoma:

Tip of stylophore of these three species are different. There is a rounded shape in *S. colocasiae* (Figure 87) whereas a mediodorsally shallow concave in *S. krungthepensis* and *S. malayanus* (Figure 88).

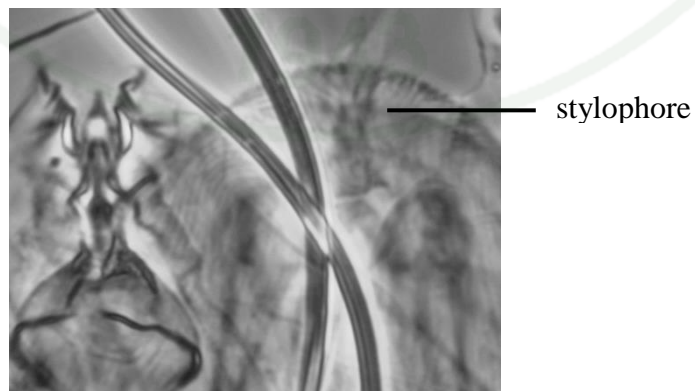


Figure 87 Stylophore in gnathosoma of *Schizotetranychus colocasiae*.

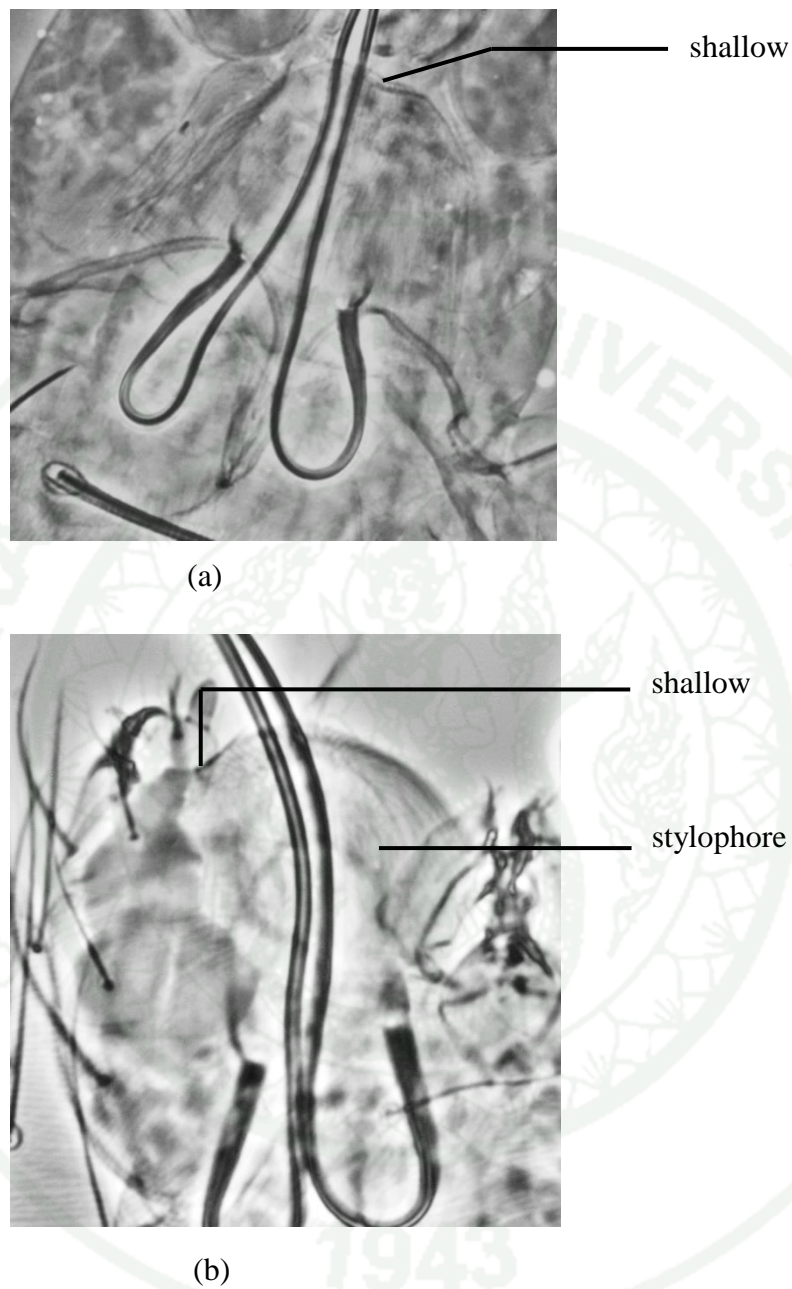


Figure 88 Stylophore in gnathosoma with mediodorsally shallow in a) *Schizotetranychus krungthepensis* and b) *Schizotetranychus malayanus*.

The shapes of peritreme are also different among these three species. Tobacco-pipe-shaped (distal end curved and dilated) is found in *S. colocasiae* and *S. malayanus* while hooked distally in *S. krungthepensis* (Figure 89).

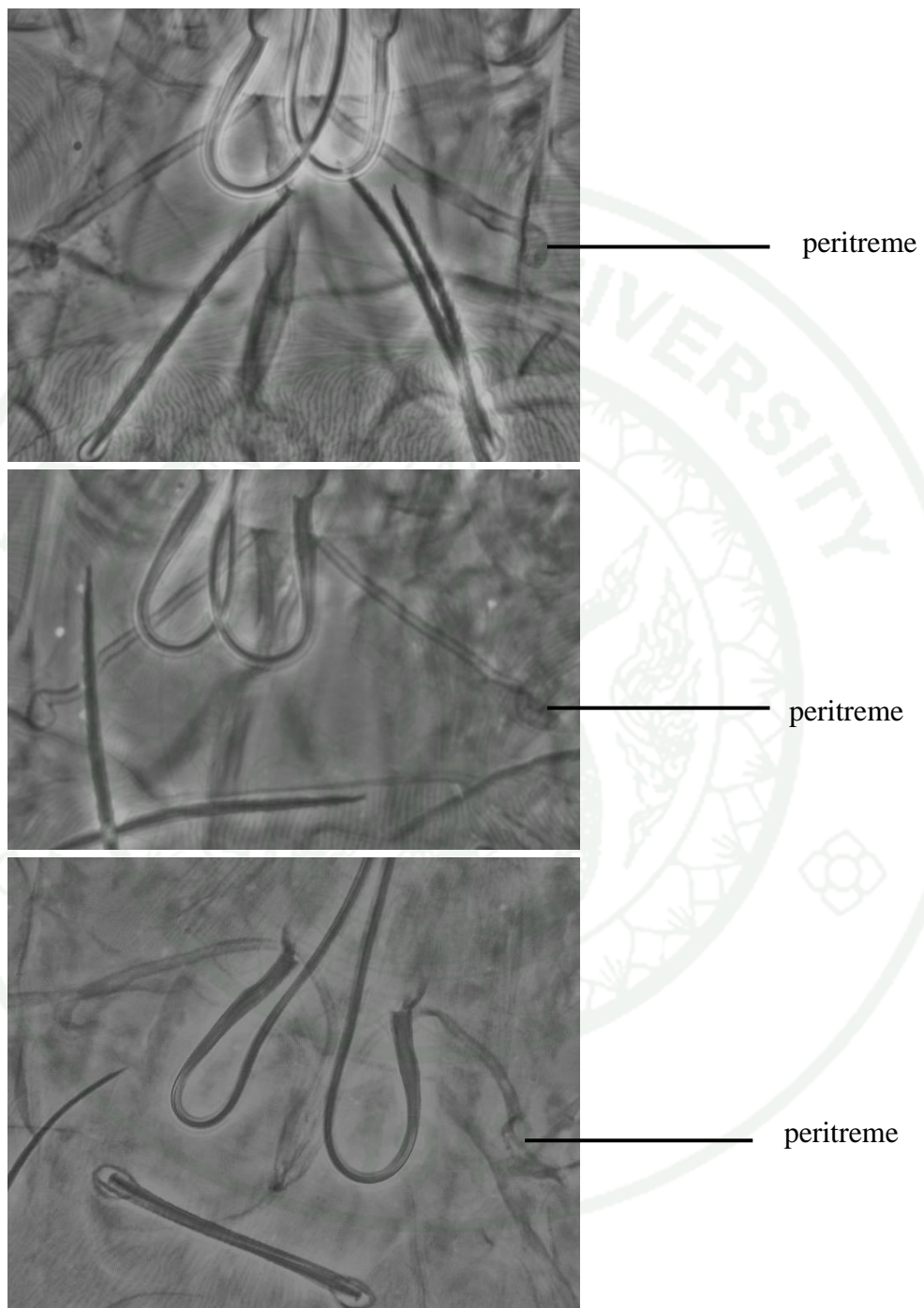


Figure 89 Different shapes of peritreme: a) *Schizotetranychus colocasiae*, b) *Schizotetranychus malayanus* and c) *Schizotetranychus krungthepensis*.

Idiosoma:

In all three species, female opisthosoma with longitudinal striae on anterior portion of dorsocentral area (prodorsum) (Figure 90) and with transverse striae on posterior portion. Two pairs of para-anal setae also observed.

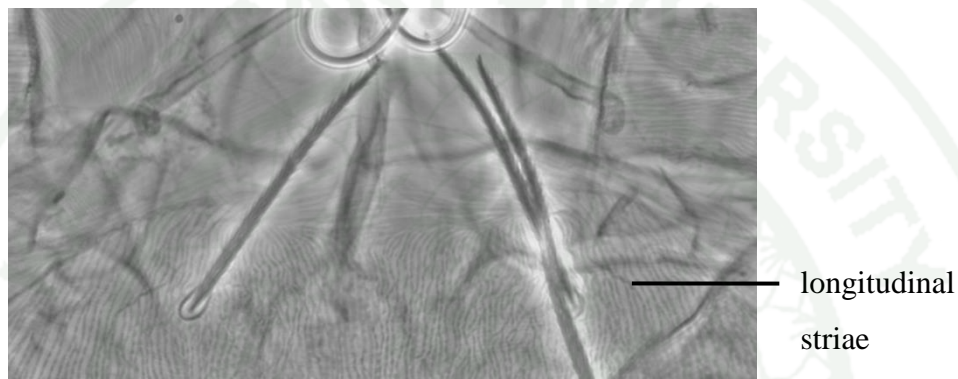


Figure 90 Prodorsum showing longitudinal striae.

Venter:

Ventral striae transverse with lobes in *S. colocasiae* and *S. krungthepensis* whereas without lobes in *S. malayanus*, genital flap and area immediately anterior to it bearing transverse striation.

Legs:

Two sets of duplex setae on tarsus I distal and adjacent to each other in all species. Empodium with bifurcate in *S. colocasiae* and claw-like in both *S. krungthepensis* and *S. malayanus* (Figure 91).

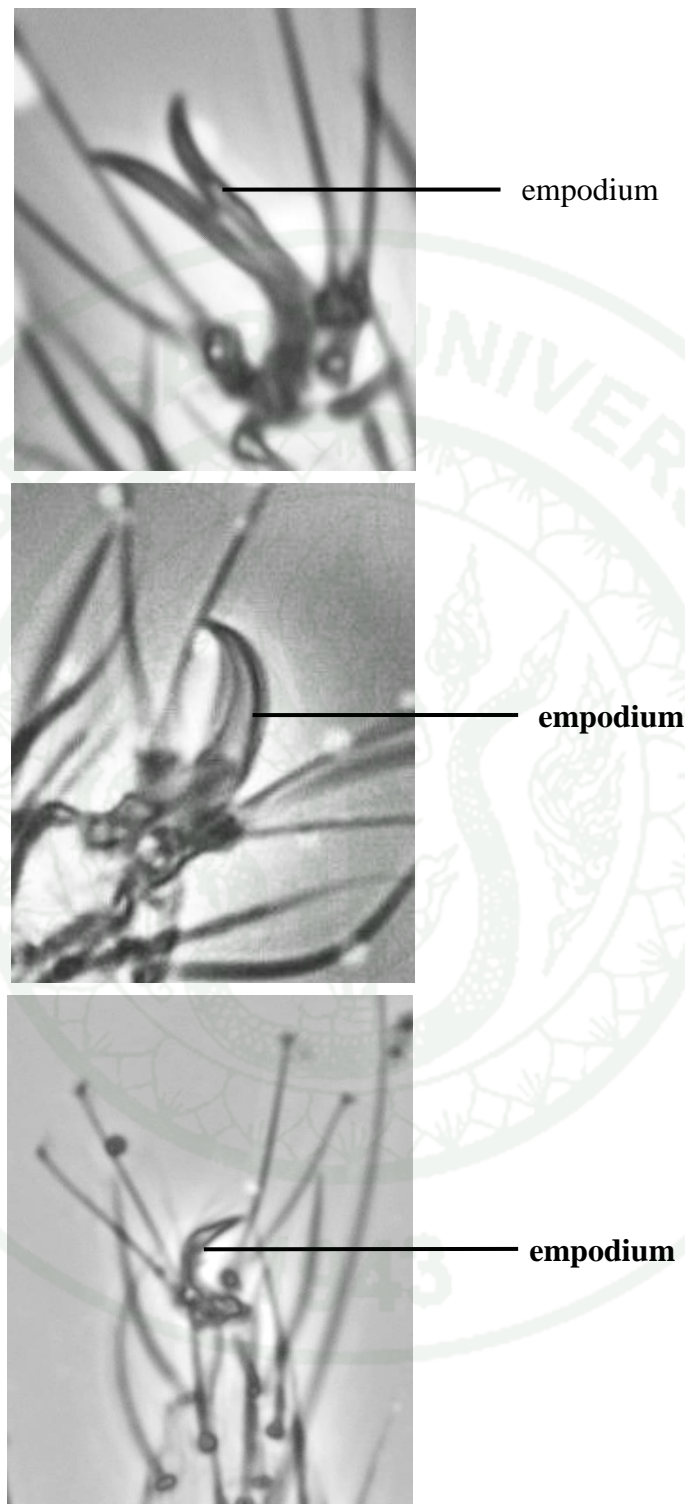


Figure 91 Empodium on tarsus I; a) *Schizotetranychus colocasiae*,
b) *Schizotetranychus krungthepensis* and c) *Schizotetranychus malayanus*.

Genus *Tetranychus*

General characteristics:

The morphological characters of all *Tetranychus* sp. has peritreme distal portion hooked; dorsocentral area of opisthosoma with striae entirely or mostly transverse; one pairs of para-anal setae. Tarsus I with duplex setae widely separated, dividing it into more or less three equal parts; tibia II with tactile setae. Empodia usually consisting of 3 pairs of ventrally directed hairs, mediodorsal spur present or absent; male empodium I usually composed of pair of short, tridigitate, claw-like divisions with or without mediodorsal spur. Aedeagus bent dorsad (Baker and Tuttle, 1994, Ehara, 1999, Pritchard and Baker, 1955).

In this study, eight species of genus *Tetranychus* have been found and two of those are recorded as new species in Thailand namely; *Tetranychus occultaspina* Naing and Auger, 2014 and *Tetranychus truncatissimus* Naing and Auger, 2014.

Among eight species found in this study, 6 species [*T. Kanzawai* (Figure 92), *T. marianae*, *T. occultaspina* **sp. nov.** (Figure 93), *T. Piercei* (Figure 94), *T. truncatus* (Figure 95) and *T. urticae* (Figure 96)] belong to the *Tetranychus* of the ninth group defined by Flechtmann and Knihinicki (2002). The morphological characters of this group are as followed; empodium with 3 pairs of proximoventral hairs; peritremes hooked; tarsus I with 3-4 tactile and sensory setae proximal to or in line with proximal pair of duplex setae; dorsohysterosomal striae longitudinal between *e1* setae and setae *f1*, forming a diamond shaped pattern; tarsus I with proximal pair of duplex setae not so close to proximal tactile setae; empodium with dorsomedian spur tiny or absent.

T. truncatissimus **sp. nov.** belongs to the *Tetranychus* group 6 defined by Flechtmann and Knihinicki (2002).

T. fijiensis is only one member of Fijiensis group of the genus *Tetranychus* (Rimando, 1962).



Female

Male

Figure 92 Female and male of *Tetranychus kanzawai*.



Female

Male

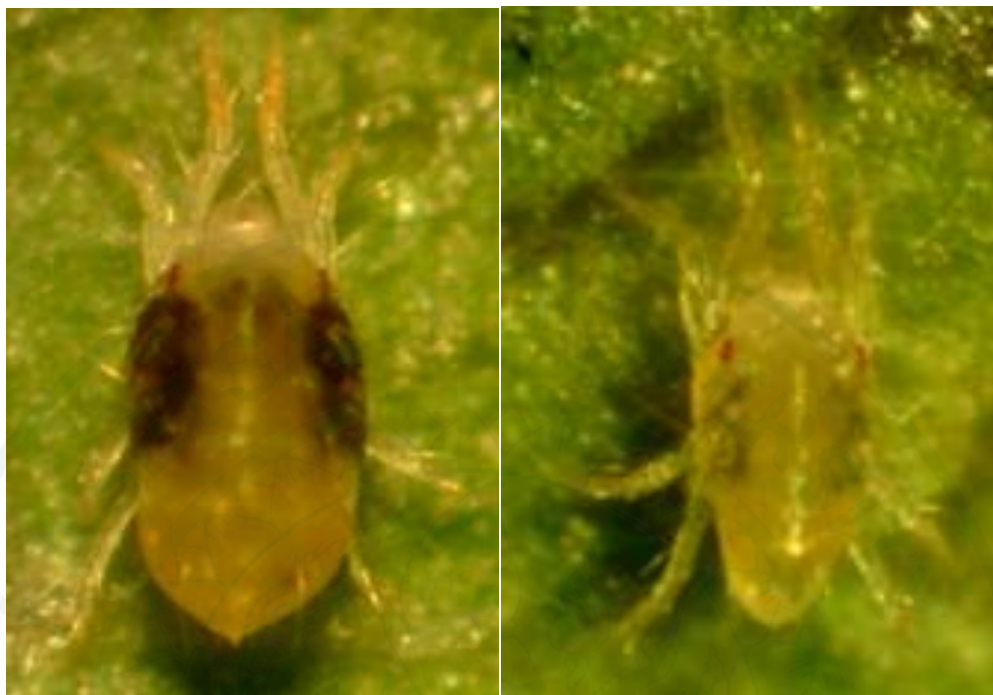
Figure 93 Female and male of *Tetranychus occultaspina* sp. nov.



Female

Male

Figure 94 Female and male of *Tetranychus piercei*.**Figure 95** Female of *Tetranychus truncatus*.



Female

Male

Figure 96 Female and male of *Tetranychus urticae*.

Morphology of six species of *Tetranychus* in *Tetranychus* group9

Gnathosoma:

Rounded stylophore, peritremes hooked in all six species (Figure 97).

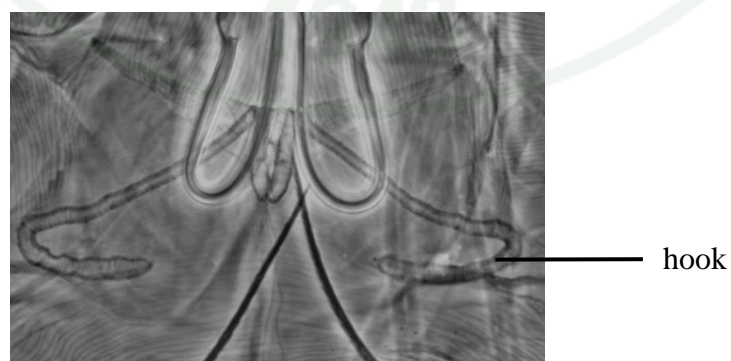


Figure 97 Hooked peritreme in *Tetranychus truncatus*.

The size of spinnerts in palp tarsus are different depended on the species, 2.9 μm long and 1.8 μm wide in *T. kanzawai*; 6 μm long and 3.2 μm wide in *T. marianae*; 6.5 μm long and 3.3 μm wide in *T. occultaspina* **sp. nov.**; 6.6 μm long and 4.1 μm wide in *T. truncatus*; and 2.8 μm long and 1.8 μm wide in *T. urticae* respectively.

Idiosoma:

Dorsohysterosomal striae longitudinal between *e1* setae and setae *f1*, forming a diamond shaped pattern (Figure 98) in this group.

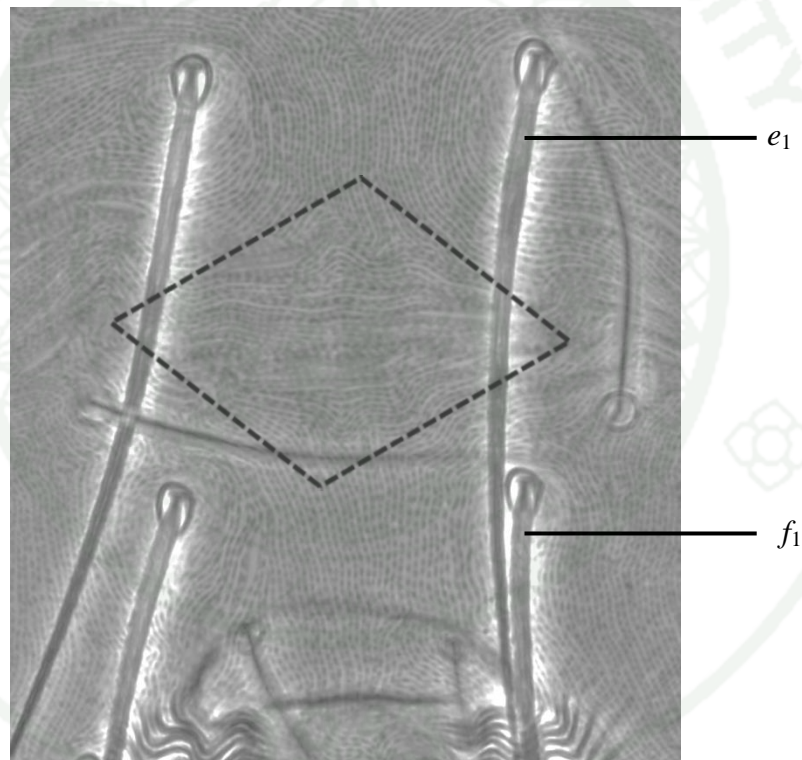


Figure 98 Diamond-shaped pattern on dorsal striation of *Tetranychus marianae*.

Legs:

Tarsus I proximal pair of duplex setae not so close to proximal tactile setae; with 3-4 tactile and sensory setae proximal to or in line with proximal pair of duplex setae (Fig. 99).

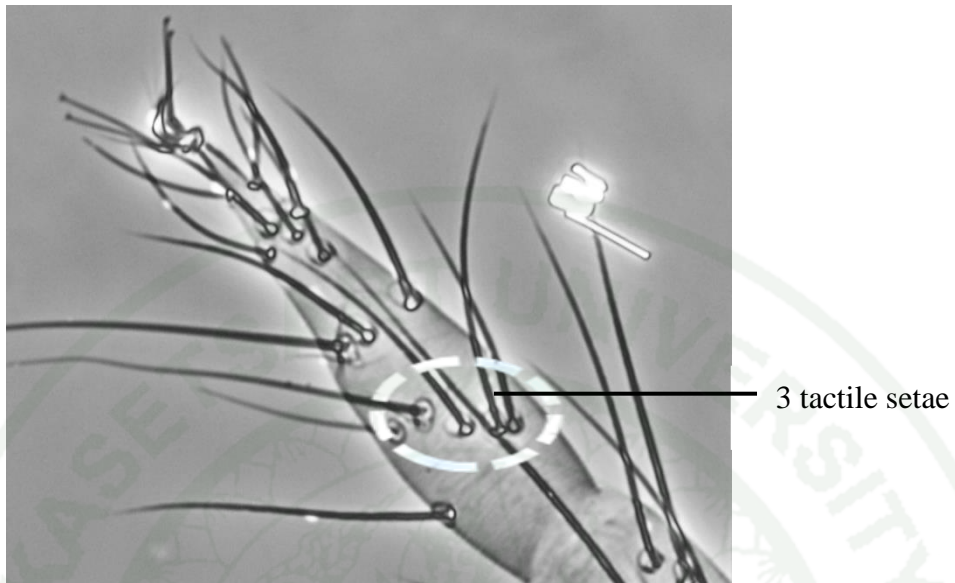


Figure 99 Tarsus I of *Tetranychus truncatus* showing tactile setae in line with proximal duplex setae.

Male aedeagus:

Shape and size of male aedeagus are variable and used to identify within the group.

Aedeagus of *T. Kanzawai* with large knob (knob twice as long as neck), with blunt anterior projection and pointed posterior projection, dorsal surface convex (Figure 100).



Figure 100 Aedeagus of *Tetranychus kanzawai*.

Aedeagus of *T. marianae* with small knob, anterior projection tiny and rounded, posterior projection pointed and directed at 45° angle to shaft, dorsal margin of knob may have small lump (Figure 101).

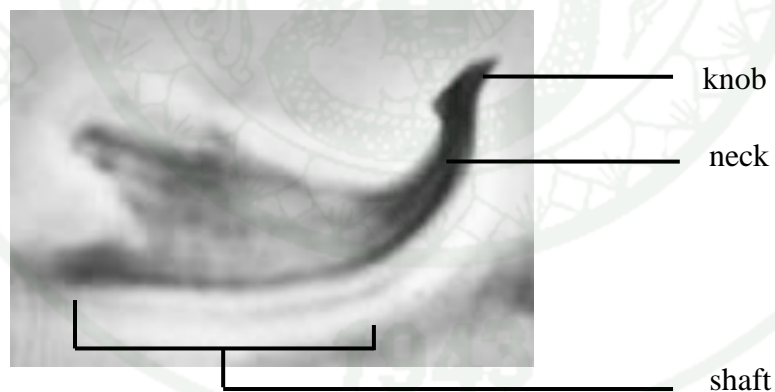


Figure 101 Aedeagus of *Tetranychus marianae*.

Aedeagus of *T. occultaspina* **sp. nov.** with shaft of the aedeagus gradually narrow distally, slightly upturned, knob large asymmetrical with a poorly developed posterior rounded projection and a well-developed anterior rounded projection anterodorsally directed. Dorsal margin of the knob undulate (Figure 102).

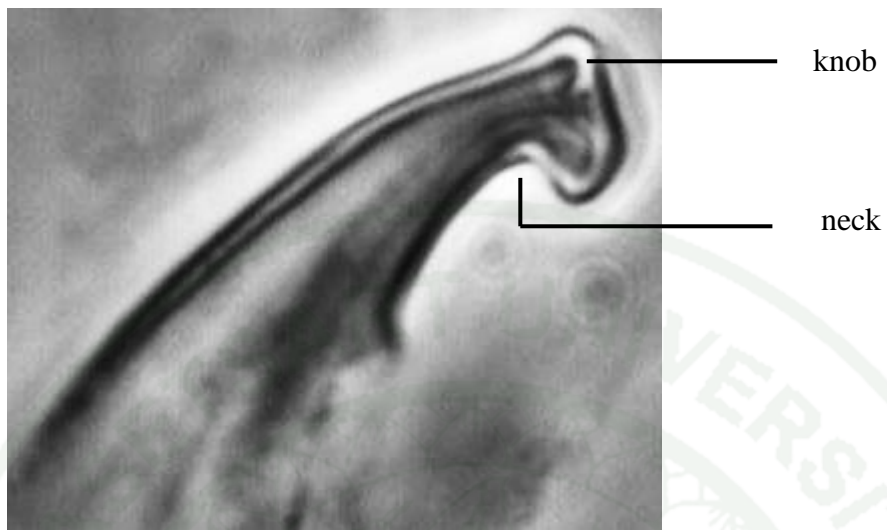


Figure 102 Aedeagus of *Tetranychus occultaspina* sp. nov.

Aedeagus of *T. piercei* without distinct knob, tip sigmoid, much narrower than shaft, short finger-like tip directed posteriorly (Figure 103).

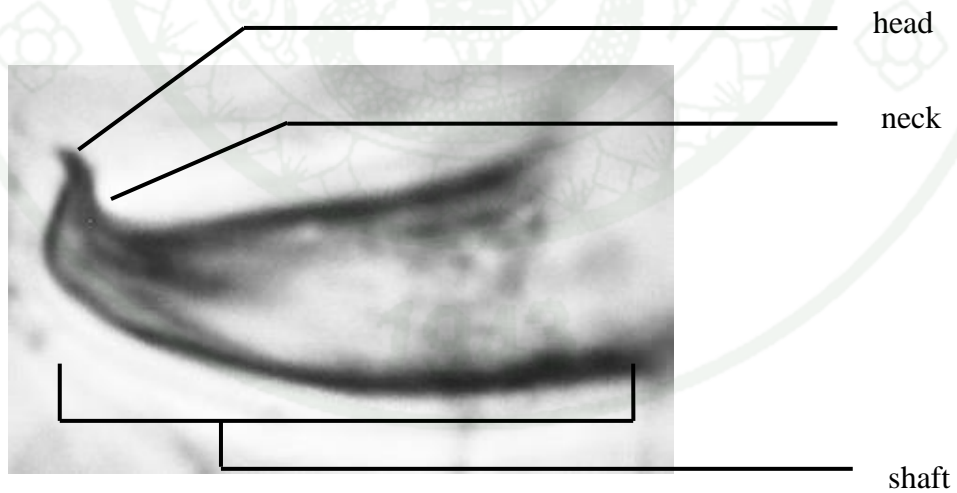


Figure 103 Aedeagus of *Tetranychus piercei*.

Aedeagus of *T.truncatus* with small knob, anterior projection rounded, short, posterior projection pointed, short, dorsal surface flat to slightly convex, with medial indentation (Figure 104).

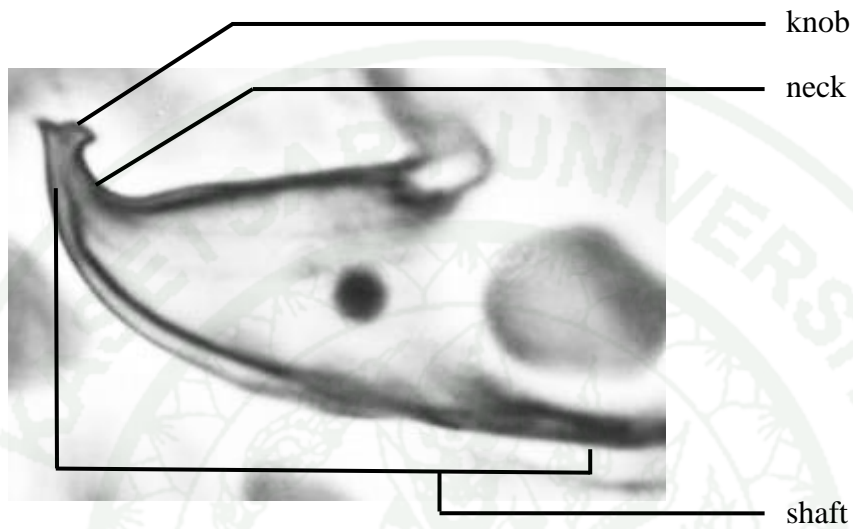


Figure 104 Aedeagus of *Tetranychustruncatus*.

Aedeagus of *T.urticae* with small knob, pointed anterior and posterior projections of equal size, dorsal surface convex (Figure 105).

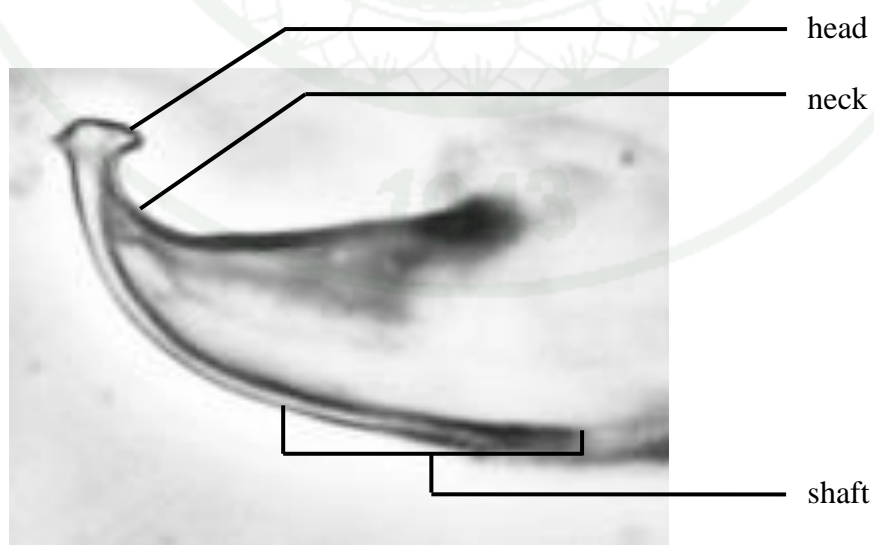
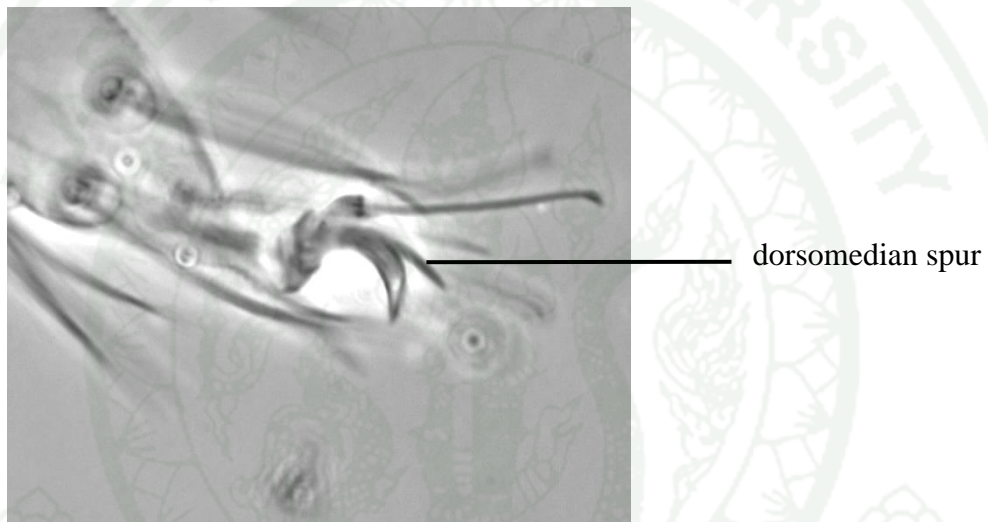


Figure 105 Aedeagus of *Tetranychusurticae*.

Morphology of *Tetranychus (Tetranychus) truncatissimus* sp. nov.(group 6)

Tetranychus (Tetranychus)truncatissimus **sp. nov.** is assigned into the sixth group (Flechtmann and Knihinicki, 2002). The morphological characters of this group are as followed; female tarsus I with proximal pair of duplex setae in line with 3 tactile setae, one tactile setae proximal to proximal duplex and female empodium with dorsomedian spur obvious (Figure 106), this species can be separated from its allied species by the shape of the male aedeagus (Figure 107).



Figur106 Empodium with obvious dorsomedian spur in *Tetranychus truncatissimus*.

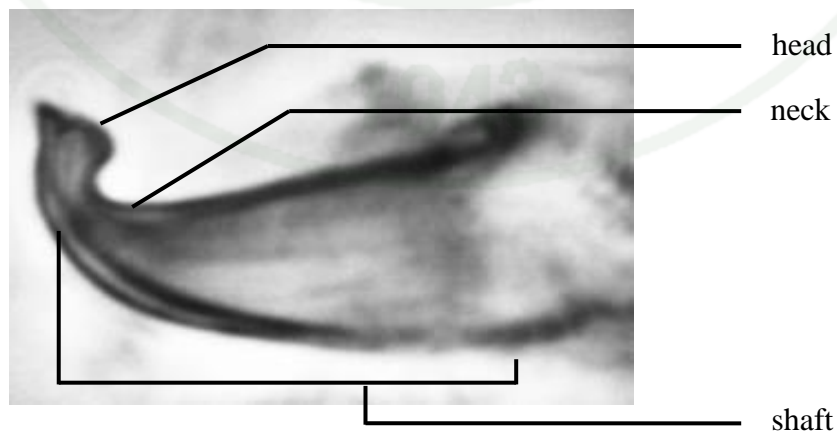
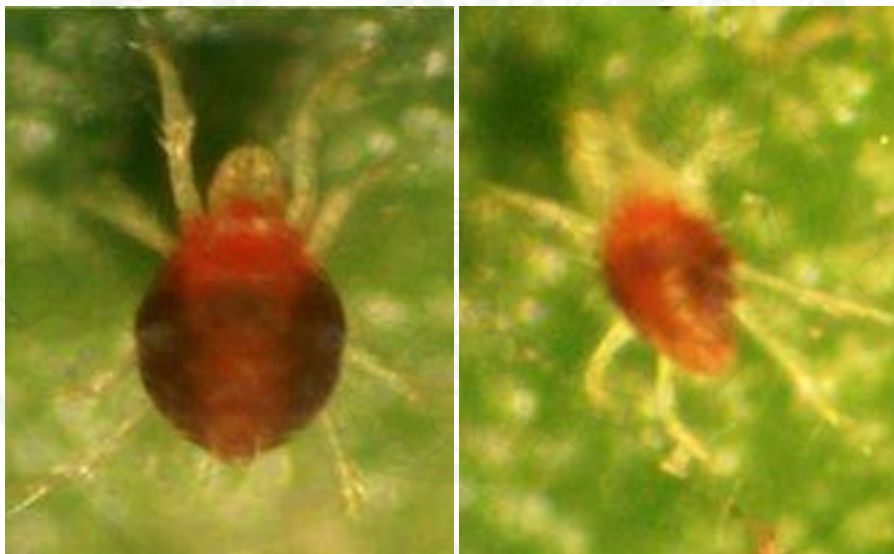


Figure 107 Aedeagus of *Tetranychus truncatissimus* sp. nov.

Aedeagus of *T. truncatissimus* sp. nov. with shaft bent dorsad at a nearly right angle, neck very short, aedeagal knob small, asymmetrical, with rounded anterior projection and pointed duck-beak like posterior projection posteriodorsally directed. Shallow depression present on the dorsal margin of the knob between the two projections.

Morphology of *T. Fijiensis* (Fijiensis group)

T. fijiensis is only one member of Fijiensis group of the genus *Tetranychus* (Figure 108). The distinctive characteristic of this species is that empodium with 2 pairs of proximoventral hairs instead of 3 in other tetranychus species. The species is easily recognized by its long and filamentous aedeagus.



Female

Male

Figure 108 Female and male of *Tetranychus fijiensis*.

Gnathosoma:

Stylophore rounded, peritreme strongly elbowed, ending in a simple bulb (Figure 109), spinneret with 6.3 μm long and 4.5 μm wide.

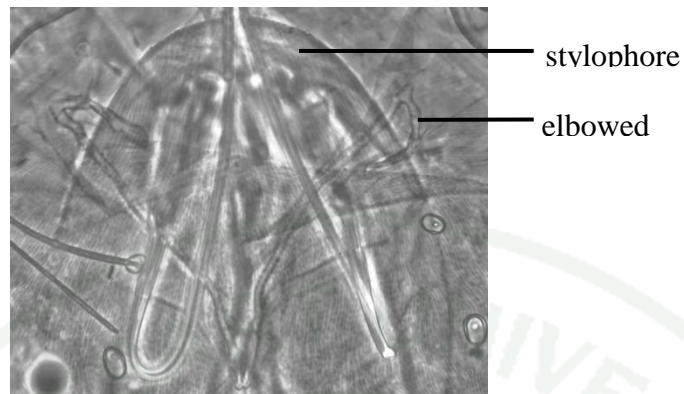


Figure 109 Stylophore and peritreme of *Tetranychus fijiensis*.

Idiosoma:

Dorsal integument striae between third pair of dorsocentral setae (e_1) inner sacral setae form a diamond-shaped pattern. Dorsal hysterosomal setae long and tapering to tip.

Venter:

Opisthosoma with 2 pairs of anal setae and 1 pair of para-anal setae, pregenital striae entire though can be weak medially (Figure 110).

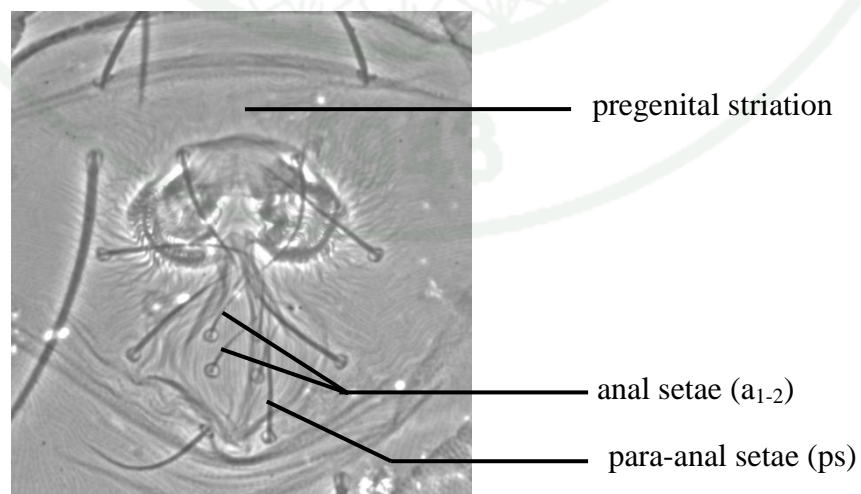


Figure 110 Pregenital and anal regions of *Tetranychus fijiensis*.

Legs:

Tarsus I with 2 sets of duplex setae widely spaced from each other (Figure 111), empodium is composed of 2 pairs of well developed hairs and a medio-dorsal spur that is half as long as the longest pairs of ventrally directed hairs (Figure 112).

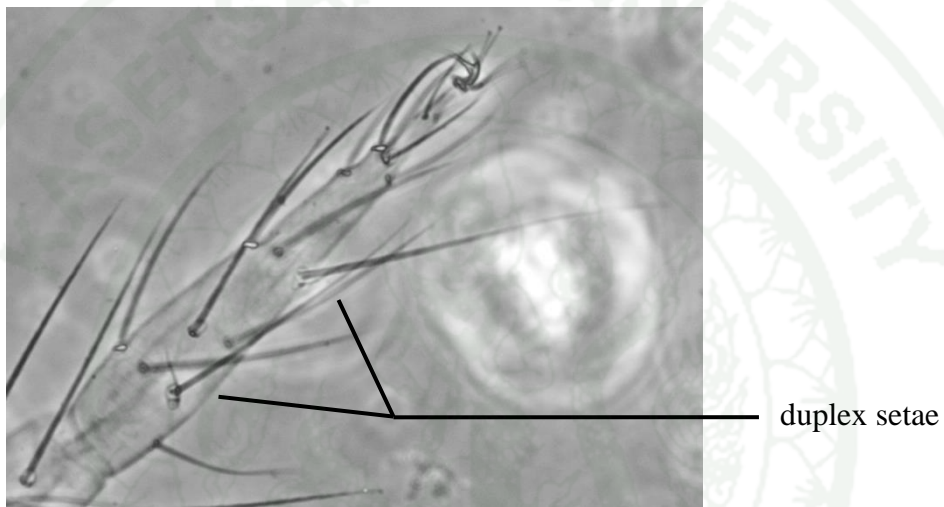


Figure 111 Tarsus I of *Tetranychus fijiensis* showing widely spaced duplex setae.

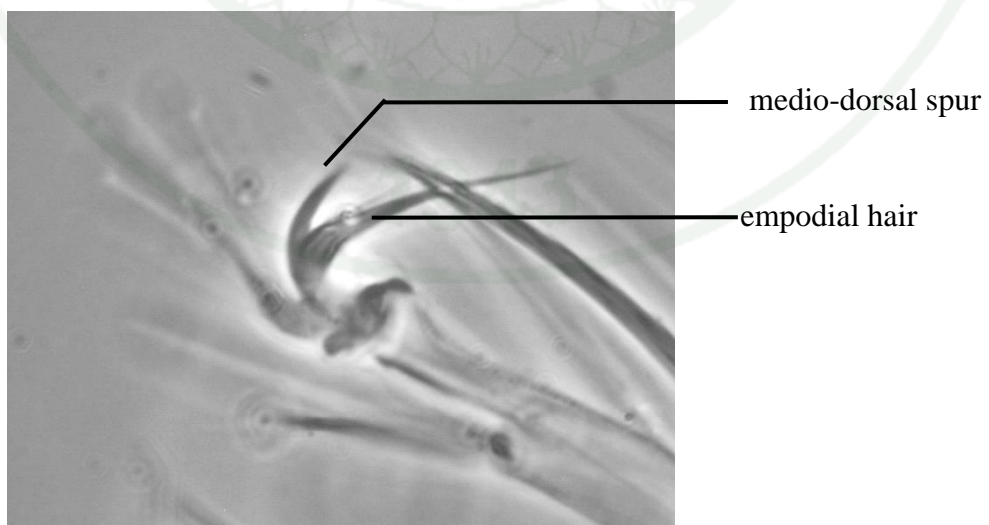


Figure 112 Tarsus I of *Tetranychus fijiensis* showing empodial hair and spur.

Aedeagus:

Aedeagus of *T. fijiensis* is distinctive in that it is long, almost whiplike, tapering and curved dorsad (Figure 113).

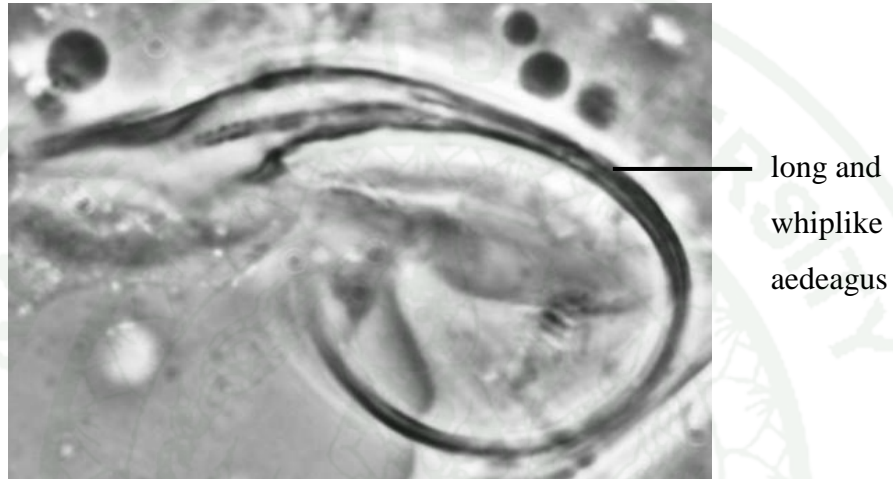


Figure 113 Aedeagus of *Tetranychus fijiensis*.

Family Tetranychidae **Donnadieu**

Subfamily Tetranychinae **Berlese, 1913**

Tetranychini Berlese, 1913; Berlese, 1913: *Acrotheca Italica*. Firenze: 17.

Tetranychinae Reck, 1950: *Trudy Zoologicheskogo Instituta. Akademiia Nauk Gruzinsko? SSR. Tbilisi*,9: 123.

Tetranychinae Pritchard and Baker, 1955; Pritchard & Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2:96.

Tetranychidae Reck, 1952; Reck, 1952: *Akademii Nauk Gruzinskoj SSR. 13 (7)*: 423.

Diagnosis:

Females with one or two pairs of anal setae and male with four pairs of genito-anal setae; empodium absent, or if present without tenent hairs (Baker and Tuttle, 1994).

Tribe Eurytetranychini **Reck, 1950**

Diagnosis:

Tarsus I with loosely associated setae or with 1 pair of duplex setae; when 2 pairs of duplex setae on tarsus I then no pairs on tarsus II, without duplex setae, or if present, not associated, empodium claw-like or rudimentary (Baker and Tuttle, 1994; Ehara, 1999; Key to the genera of the world, 2000).

Genus *Aponychus* Rimando, 1966

Type species: *Aponychus corpuzae* Rimando, 1966

Aponychus Rimando, 1966; Rimando, 1966: *Philippine Agriculturist*, USA, 50: 105.

Aponychus Rimando, 1966; Tuttle and Baker, 1968: *Tuscon, Usa, The University of Arizona Press*: 82.

Aponychus Rimando, 1966; Meyer, 1974: *Entomology Memoir, Department of Agricultural Technical Services, Republic of South Africa*, 1-291: 156.

Description of Genus *Aponychus*

Opisthosoma with 10 pairs of dorsal setae, 1 pair of anal setae; tarsus I dorsally with loosely associated duplex setae or without duplex setae, empodium usually rudimentary or absent (Baker and Tuttle, 1994; Ehara, 1999; Key to the genera of the world, 2000).

Aponychus siamensis Ehara & Wongsiri, 1975 (Figure 114)

Aponychus siamensis Ehara & Wongsiri, 1975; Ehara & Wongsiri, 1975: *Mushi*, 48: 151.

Diagnosis:

Legs of male relatively longer than those of female; tarsus I and II without characteristic duplex setae, tarsus I with a pairs of loosely associated setae probably homologous with one of the pairs of duplex setae, however, the alveoli not coalescence, empodium rudimentary, with a small round knob; with one pair of anal setae (Baker and Tuttle, 1994).

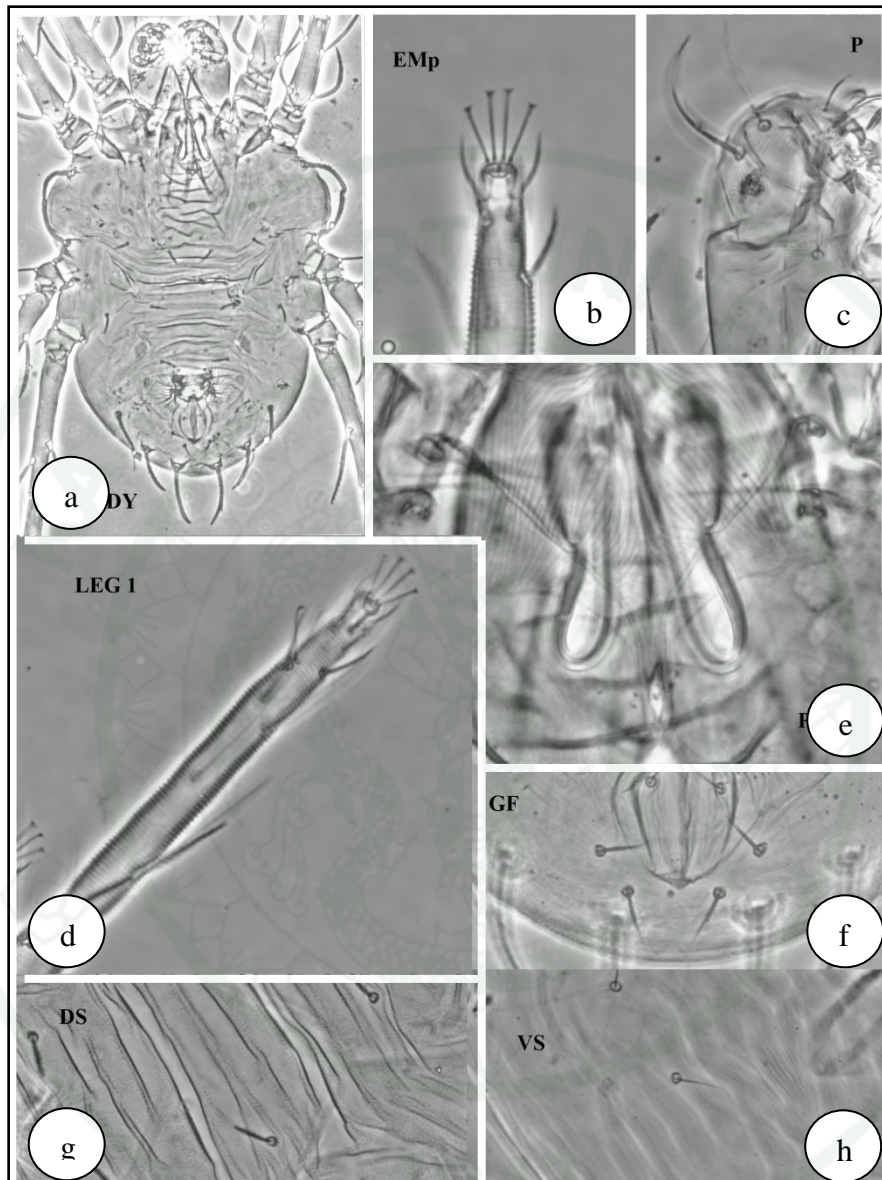


Figure 114 *Aponychus siamensis* (Tucker, 1926): a) dorsum of female, b) empodium, c) palp, d) peritreme, e) leg I, f) genital flap, g) dorsal striation and h) ventral striation.

Description of *Aponychus siamensis* Ehara & Wongsiri, 1975

Male:

Three males measured, Idiosoma: length 131-149 μm (including gnathosoma), width 79-85 μm .

Gnathosoma:

Palptarsus with spinneret slender and 10.8 μm long. Peritreme very narrow and hooked distally.

Aedeagus:

Bent dorsad at a right angle with dorsal margin of the shaft, abruptly tapering, with acute tip pointing caudad.

Female:

Three females measured. Idiosoma: length 213-229 μm (including gnathosoma), width 119-125 μm .

Dorsum:

Body oblong; idiosoma with dorsal integument wrinkled. Dorsal body setae spatulate, serrate; length of body setae; v_2 (11-13); sc_1 (36-41); sc_2 (41-44); c_1 (8.7-9.8); c_2 (7.9-8.7); c_3 (35-41); d_1 (10-13); d_2 (11-14); e_1 (9-11); e_2 (28-32); f_1 (7.8-8.3); f_2 (29-34); h_1 (37-42). Distances between setae: c_1-c_1 27-29; d_1-d_1 52-55; e_1-e_1 40-43; c_1-d_1 33-39; d_1-e_1 33-37.

Gnathosoma:

Stylophore deeply cleft mediolaterally. Spinneret slender and more or less 3 times as long as broad, 5.1-5.5 μm long, 1.5-1.9 μm wide. Peritreme very narrow.

Venter:

Ventral striation without lobes, genital flap and area immediately anterior to it bearing transverse striation. Two pairs of para-anal and 1 pair of anal setae are present.

Legs:

Empodia I-IV similar. Leg chaetotaxy as follows:

- I 2 - 1 - 6 - 3 - 5 + (1) - 12 + 2 duplexes;
 II 2 - 1 - 5 - 3 - 3 - 11 + 1 duplex;
 III 1 - 1 - 4 - 2 - 2 - 7 [8] + (1);
 IV 1 - 1 - 1 - 2 - 2 - 7 [8] + (1).

Biological observations:

The eggs are rounded in shape and flattened, yellowish white in color. All stages of immatures and matures are also flat and pale yellow in color. The mite was found undersides of the leaves.

Remarks:

This species was described on *Bambusa* sp. and is only found in Thailand since 1975.

Host in Thailand:

Bambusa sp.

Distribution in Thailand:

Mt. Doi Chiang Dao

Distribution in other countries: -

-

Specimens examined:

Three ♀♀ and 2 ♂♂ on *Bambusa* sp. (L.) Kasetsart University campus, Khet Bangkhen, Bangkok, Thailand, (8/2/2010) Leg. H.H. Naing.

Genus *Eutetranychus* Banks, 1917**Type species:** *Tetranychus banksi* McGregor

Eutetranychus Banks, 1917; Banks, 1917: *Entomological News*, 28: 197.

Neotetranychus (*Eutetranychus*) Banks, 1917; Banks, 1917: *Entomological News*, 28: 197.

Eutetranychus Banks, 1917; McGregor, 1950: *American Midland Naturalist*, 44: 267.

Eutetranychus Banks, 1917; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 111.

Eutetranychus Banks, 1917; Wainstein, 1960b: *Entomologicheskoe Obozrenie*, 39:226.

Eutetranychus Banks, 1917; Tuttle and Baker, 1968: *Tuscon, Usa, The University of Arizona Press*: 82.

Eutetranychus Banks, 1917; Meyer, 1974: *Entomology Memoir, Department of Agricultural Technical Services, Republic of South Africa, 1-291*: 136.

Description of Genus *Eutetranychus*

Opisthosoma with 10 pairs of dorsal setae, 2 pairs of anal setae; tarsus I and II without characteristic duplex setae, tarsus I with a pairs of loosely associated setae probably homologous with one of the pair of duplex setae, however, the alveoli not coalescence, empodium rudimentary, with a small round knob. Legs of male relatively longer than those of female (Baker and Tuttle, 1994; Ehara, 1999; Key to the genera of the world, 2000).

***Eutetranychus africanus* (Tucker, 1926) (Figure 115)**

Eutetranychus africanus (Tucker, 1926); Tucker, 1926: *South African Department of Agricultur Division of Entomology Memories, 5*: 5
Anychus africanus Tucker, 1926; Tucker (1926): Tucker, 1926: *South African Department of Agricultur Division of Entomology Memories, 5*: 5.
Eutetranychus africanus (Tucker, 1926); Baker and Pritchard, 1960: *Hilgardia, 29*: 464.

Eutetranychus orientalis nec (Klein, 1936); *Bulletin Israel Agric. Res. Stn. Rehovot, 21*: Ehara and Yogi, 1998: *Plant Protection (Tokyo), 52*: 530.

Eutetranychus orientalis nec (Klein, 1936); Ehara and Gotoh, 2007: *Zootaxa, 1646*: 51.

Eutetranychus sambiranensis Gutierrez and Helle, 1971; Gutierrez and Helle, 1971: *Entomologische Berichten, Amsterdam, 31*: 48.

Eutetranychus sambiranensis Gutierrez and Helle, 1971; Gutierrez and Etienne, 1986: *Agronomie Tropicale, 41*: 84.

Diagnosis:

Dorsal setae of this species serrate, sub-spatulate borne on tubercles. Dorsocentral setae c_1 , d_1 , e_1 and f_1 half the length of corresponding dorso-laterals c_2 , d_2 , e_2 and f_2 which are long and slender.

Description of *Eutetranychus africanus***Male:**

Two males measured, 320 μm long, 214–278 μm long (including gnathosoma).

Aedeagus:

Bent portion is no longer than the dorsal margin of the shaft. The tip of the head is blunt.

Female:

Three females measured. Idiosoma: length 325-359 μm (excluding gnathosoma), width 274-280 μm .

Dorsum:

Dorsal setae serrate, sub-spatulate borne on tubercles. The length of dorsocentral setae: v_2 24 (22-25); sc_1 27 (26-28); sc_2 25 (24-26); c_1 10; c_2 17 (16-18); c_3 22 (20-24); d_1 11 (10-12); d_2 22 (20-24); e_1 11 (10-13); e_2 21 (19-23); f_1 13 (12-14); f_2 22 (20-24); h_1 22 (20-24). Distances between setae: c_1 - c_1 39-43; d_1 - d_1 69-75; e_1 - e_1 29-33; c_1 - d_1 39-46; d_1 - e_1 42-48. Distance between setae d_1 - d_1 most widened basally.

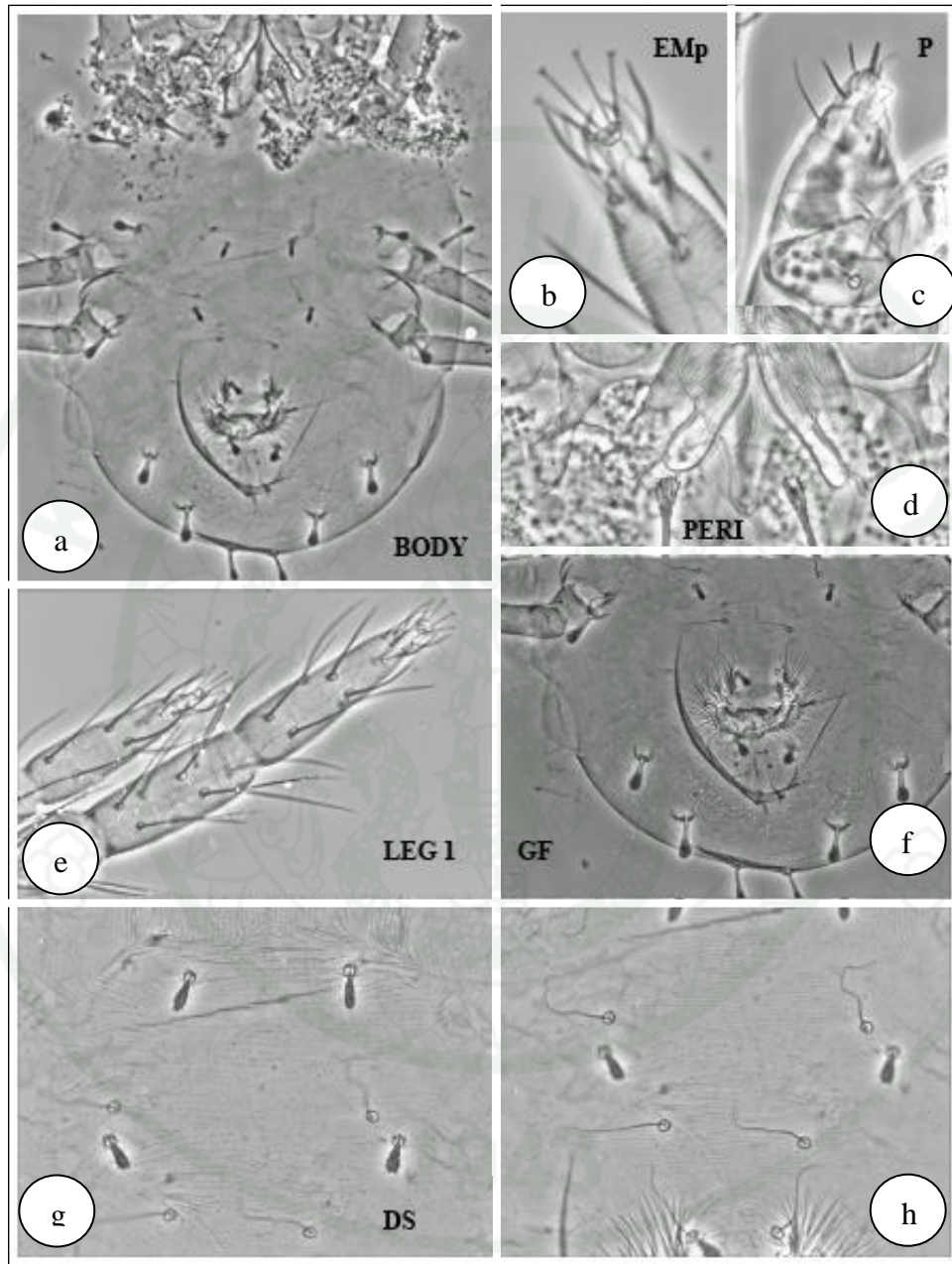


Figure 115 *Eutetranychus africanus* (Tucker, 1926): a) dorsum of female, b) empodium, c) palp, d) peritreme, e) leg I, f) genital flap, g) dorsal striation and h) ventral striation.

Gnathosoma:

Palptarsus with spinneret about 3 times as long as broad, 6.8-7.0 μm long, 2.0-2.5 μm wide. Peritreme ends with simple bulb.

Venter:

Ventral striation without lobes, genital flap and area immediately anterior to it bearing wavy transverse striation. Two pairs of para-anal and two pairs of anal setae are present.

Legs:

Leg chaetotaxy as follows:

- I 2 - 1 - 7 - 5 - 9 + (1) - 14 + 2 duplexes;
 II 2 - 1 - 5 - 5 - 5 - 11 + 1 duplex;
 III 1 - 1 - 3 - 2 - 5 - 10;
 IV 1 - 1 - 1 - 2 - 6 - 7 + 9.

Biological observations:

This mite was found on the upper surface of the leaves of many host plants, more common on papaya in Thailand. The mite showed more flattened than other spider mite species. The eggs are also flattened and spherical in shape, transparent and white in colour, turning into dark before hatching. Both male and female adults have the long legs and mostly are dark greenish in colour in every stages of their life cycle.

Remarks:

This species was first described from *Citrus limon*, *Citrus sinensis* and *Plumeria* sp. from South Africa by Tucker in 1926. According to the literature, only *Eutetranychus orientalis* Klein was reported from Thailand by Baker (1975) and

Ehara and Wongsiri (1975). However, the mites collecting by Thai researchers showed that all *Euteratnychus* found in Thailand are actually *E. africanus*. This mite is now considered as the most serious pests of several economic crops in Thailand such as papaya, durian and citrus plants. *E. africanus* can feed on more than 300 plant species and also a cosmopolitan species where more than 100 countries are listed for its distribution (Migeon and Dorkeld, 2006-2013).

Specimens examined:

Eight ♀♀ and 4 ♂♂ on papaya, *Carica papaya*(Caricaceae), 5 ♀♀ and 2 ♂♂ on *Buahinia acuminata* (Caesalpiniaceae), Kasetsart University Campus, Khet Bangkhen, Bangkok, Thailand, 20/11/2009, Leg. H.H.Naing.

Tribe Tetranychini Reck, 1950

Tetranychinae Reck, 1950; Reck, 1950: *Trudy Zoologicheskogo Instituta Akademia Nauk Gruz.S.S.R.*, 9:123.

Tetranychini Pritchard and Baker, 1955; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 124.

Diagnosis:

Fourth pairs of dorsocentral setae (f_1) in the normal position; with two pairs of closely associated duplex setae on tarsus I, and a single pairs on tarsus II; empodium either clawlike or split distally (Baker and Tuttle, 1994; Key to the genera of the world).

Genus *Eotetranychus* Oudemans, 1931

Eotetranychus Oudemans, 1931b; Oudemans, 1931b: *Entomologische Berichten, Amsertdam*, 8: 224

Eotetranychus Pritchard and Baker, 1955; Pritchard and Baker, 1955:

Memoirs Series, San Francisco, Pacific Coast Entomological Society, 2: 38.

Eotetranychus Tuttle and Baker, 1968; Tuttle and Baker, 1968: *Tuscon, Usa, The University of Arizona Press*: 85.

Schizotetranychus (Eotetranychus) Wainstein 1960b; Wainstein 1960b: *Trudy Nauchno-Issled. Inst. Zashchita Rastenii Kazakh.*, 5

Type-species: *Trombidium tiliarium* Hermann, 1804

Description of Genus *Eotetranychus*

Dorsal body setae as long as or longer than the intervals between their bases. Opisthosoma with transverse striae on dorsocentral area with small lobes, longitudinally on prodorsum; genital area with various striation patterns, 2 pairs of para-anal setae; tarsus I with duplex setae distal and adjacent, empodium split into 3 pairs of ventrally directed hairs or ending in a tuft of hairs (Baker and Tuttle, 1994; Key to the genera of the world).

***Eotetranychus celtis* Ehara, 1965**

Eotetranychus celtis Ehara, 1965; Ehara, 1965: *Journal of the Faculty of Sciences, Hokkaido University, Series VI, Zoology*, 15: 620, Figs. 15-25.

Eotetranychus celtis Ehara, 1965; Ehara and Gotoh, 1993b: *Zenkoku Noson Kyoiku Kyokai, Tokyo*:72.

Diagnosis:

The dorsal idiosomal setae of the female are much longer than the distances between their bases. The adeagus abruptly narrows to the middle and nearly perpendicularly bends ventral to form L-shaped, slender distal portion; the ventral

margin of the shaft is nearly straight. The male palpus lacks a spinneret on the distal segment (Baker and Tuttle, 1994).

Description of *Eotetranychus celtis*

Male:

Holotype 320 μm long, 2 males measured, 314–378 μm long (including gnathosoma).

Gnathosoma:

Spinneret absent, peritreme hooked distally forming as U-shaped to L-shaped.

Legs:

Leg chaetotaxy are as follows:

- I 2 – 1 – 10 – 5 – 9 + (4) – 13 + (3) + 2 duplexes;
 II 2 – 1 – 7 – 5 – 8 – 13 + (1) + 1 duplex;
 III 1 – 1 – 4 – 4 – 6 – 10 + (1);
 IV 1 – 1 – 4 – 4 – 7 – 10 + (1).

Four tactile and 3 solenidia proximal to duplex setae on tarsus I; 3 tactile and 1 solenidion proximal to duplex setae on tarsus II.

Aedeagus:

Abruptly narrowing to the middle, nearly perpendicularly bent ventrad there; the bent distal part tapering posteriorly, it nearly perpendicularly bent caudad near its middle.

Female:

Only one female measured. Idiosoma: length 395 μm (including gnathosoma), width 209 μm .

Dorsum:

Dorsal setae of idiosoma slender, tapering, pubescent, longer than distances between their bases; f_1 setae longer than f_2 setae. Dorsal setae length: v_2 (49.5); sc_1 (34.9); sc_2 (35.7); c_1 (38.4); c_2 (43.1); c_3 (42.5); d_1 (39.6); d_2 (41.5); e_1 (40.5); e_2 (41.6); f_1 (32.8); f_2 (38.2); h_1 (22.5). Distances between setae: c_1-c_1 (24); d_1-d_1 (33); e_1-e_1 (21); c_1-d_1 (48); d_1-e_1 (43).

Gnathosoma:

Palptarsus with spinneret about twice as long as broad. Peritreme hooked distally.

Venter:

Genital flap with transverse striae; area immediately anterior to flap with variable, usually oblique striae. Two pairs of para-anal and two pairs of anal setae are present.

Legs:

Leg chaetotaxy as follows:

- I 2 – 1 – 10 – 5 – 9 + (1) – 14 + (1) + 2 duplexes;
 II 2 – 1 – 7 – 5 – 8 – 13 + (1) + 1 duplex;
 III 1 – 1 – 4 – 4 – 6 – 10 + (1);
 IV 1 – 1 – 4 – 4 – 7 – 10 + (1).

Five tactile and 1 solenidion proximal to duplex setae on tarsus I; 3 tactile and 1 solenidion proximal to duplex setae on tarsus II.

Biological observations:

All stages of immatures and matures are yellowish in colour. The eggs are rounded. On guava, they can be found on underside of the leaves.

Remarks:

This species was described on *Celtis sinensis* Pers. in Japan (Ehara, 1965) and later recorded from 4 host plants in Thailand (Ehara & Wongsiri 1975). This is the new record of host plant for this mite on guava *Aegle marmelos* (L.) Corr. (Rutaceae) from Nakhom Pathom province, Thailand.

Host in Thailand:

Morus alba., *Ziziphus mauritiana* Lam., *Vitis vinifera* L., and *Sauropus albicans* Blume.

Distribution in Thailand:

Nakhon Ratchasima, Nakhom Pathom

Distribution in other countries:

China, Japan.

Specimens examined:

One ♀ and 3 ♂♂ males on *Aegle marmelos* (L.) Corr. (Rutaceae), Nakhom Pathom province, Thailand, 23/12/2011, Leg. H.H. Naing, A. Chandrapatya, P. Konvipasruang.

***Eotetranychus cendanai* Rimando, 1962 (Figure 116)**

Eotetranychus cendanai Rimando 1962; Rimando 1962: *Philippine Agriculturist*, 45: 537, fig.2.

Eotetranychus cendanai Rimando 1962; Manson, 1963: 356, figs. 26-35.

Diagnosis:

Peritreme straight distally, dilated at distal end ; idiosoma with dorsal setae long and slender, pubescent; first dorsocentrals about as long as distances to second dorsocentrals, the latter as long as, or slightly longer than distances to third dorsocentrals; f_1 setae are noticeably longer than f_2 , the latter noticeably longer than h_1 setae. (Ehara and Wongsiri, 1975).

Description of *Eotetranychus cendanai***Male:**

Three males measured, 279–294 μm long (including gnathosoma).

Dorsum:

Dorsal setae of idiosoma slender, tapering, pubescent, longer than distances between their bases, f_1 setae longer than f_2 setae.

Gnathosoma:

Spinneret absent, dorsal sensillum fusiform, peritreme straight distally dilated at distal end.

Legs:

Leg chaetotaxy are as follows:

- I 2 – 1 – 9 – 5 – 8 + (4) – 13 + (3) + 2 duplexes;
 II 2 – 1 – 7 – 5 – 5 – 10 + (1) + 1 duplex;
 III 1 – 1 – 4 – 4 – 5 – 9 + (1);
 IV 1 – 1 – 2 – 4 – 5 – 9 + (1).

Four tactile setae and 3 solenidia proximal to duplex setae on tarsus I; 1 tactile seta and 1 solenidion proximal to duplex on tarsus II.

Aedeagus:

Bent to form a slender, sigmoid distal part.

Female:

Two females measured. Idiosoma: length 245 – 274 μm (including gnathosoma), width 109 – 124 μm .

Dorsum:

Dorsal setae of idiosoma long and slender, pubescent, length of c_1 setae about as long as distances to d_1 , the latter as long as , or slightly longer than distances to e_1 . Length of dorsal setae: v_2 26 (24-28); sc_1 42 (39-46); sc_2 31 (29-33); c_1 54 (48-59); c_2 37 (34-40); c_3 35 (32-38); d_1 38 (36-40); d_2 42 (38-45); e_1 40 (38-42); e_2 45 (42-

47); f_1 26 (24-28); f_2 19 (18-22); h_1 18 (15-21). Distances between setae: c_1-c_1 29-33; d_1-d_1 34-41; e_1-e_1 22-27; c_1-d_1 64-72; d_1-e_1 51-57.

Gnathosoma:

Palptarsus with spinneret about one and half times as long as broad, peritreme straight distally dilated at distal end.

Venter:

Ventral striae without lobes. Genital flap and area anterior to flap with transverse striae.

Legs:

Leg chaetotaxy as follows:

- I 2 – 1 – 9 – 5 – 8 + (1) – 13 + (1) + 2 duplexes;
 II 2 – 1 – 7 – 5 – 5 – 11 + 1 duplex;
 III 1 – 1 – 4 – 4 – 5 – 9 + (1);
 IV 1 – 1 – 2 – 4 – 5 – 9 + (1)

Four tactile setae and 1 solenidion proximal to duplex setae on tarsus I; 1 tactile seta and 1 solenidion present proximad of duplex setae, and 1 tactile seta present near duplex setae.

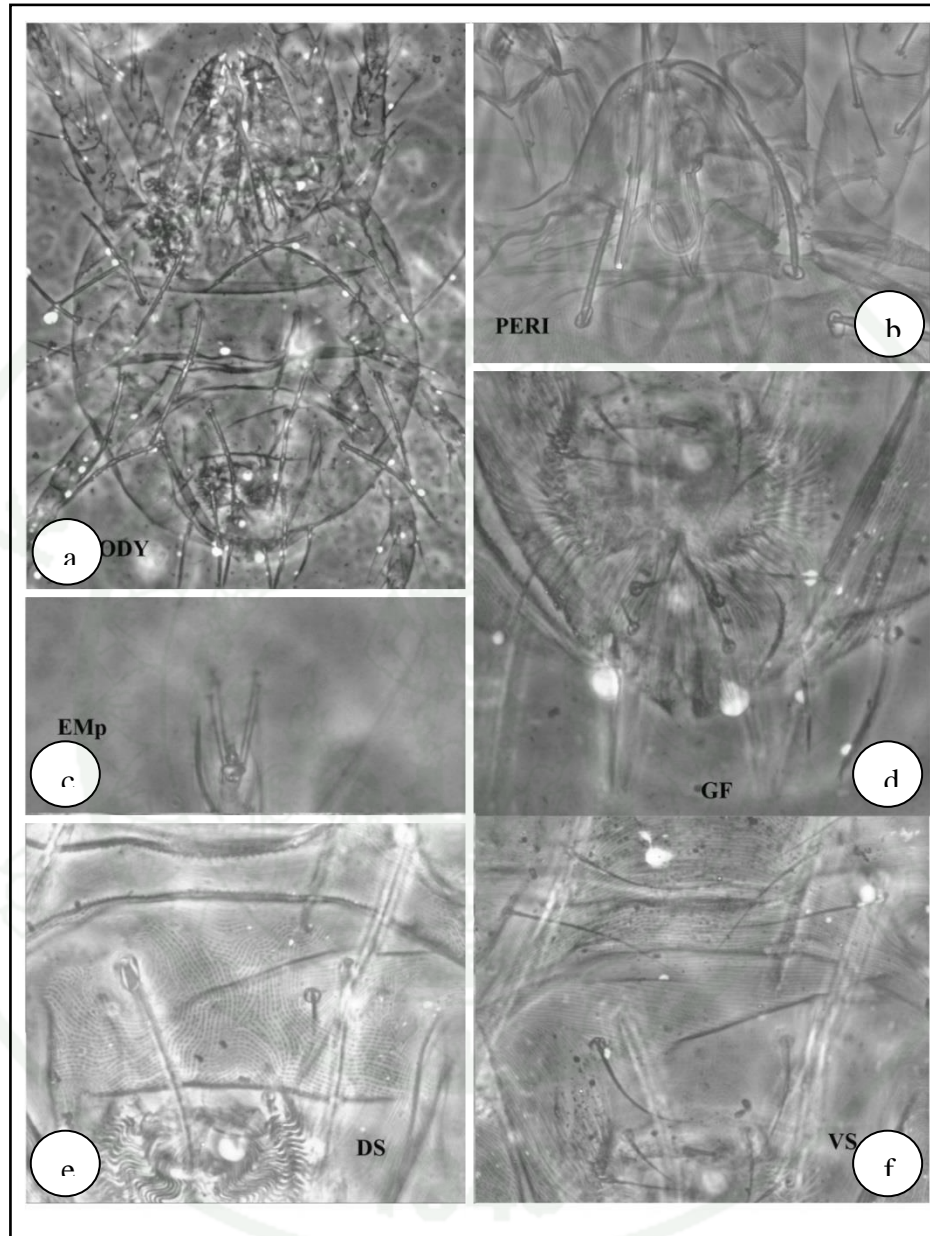


Figure 116 *Eotetranychus cendanai* Rimando, 1962: a) dorsum of female, b) peritreme, c) empodium of leg I, d) genital flap, e) dorsum striation and f) ventral striation.

Biological observations:

This mite can be found on the upper surfaces of the leaves of their host plants. The eggs of this yellowish mite are creamy white in colour and rounded in shape.

Remarks:

This species was firstly described on *Citrus aurantium* in the Philippines (Rimando, 1962). One year later, this species was found on citrus in Bangkok, Chiangmai and Chanthaburi by Manson (1963). Later, it was recorded on *Citrus hystrix*, *Citrus sinensis*, *Citrus aurantiifolia*, *Citrus medica* and *Citrus* sp. in Thailand (Baker 1975; Ehara & Wongsiri 1975). The live mite is quite small and light-yellow in colour. It can be found on both leaf and young citrus fruits. To date, the mite is only known from the Philippines, Cambodia, China, Taiwan and Thailand and 11 plant species are recorded being fed by this mite where seven host plants belong to the Citrus group.

Host in Thailand:

Citrus aurantiifolia, *Citrus hystrix*, *Citrus sinensis*, *Citrus* sp., *Gliricidia sepium*, *Murraya paniculata*, *Sesbania grandiflora* and *Zoysia japonica*.

Distribution in Thailand

Bangkok, Chiangmai, Chanthaburi, Pathum Thani, Phra Nakhorn Si Ayutthaya.

Distribution in other countries:

Cambodia, China, Philippines, Taiwan.

Specimens examined:

Two ♀♀ and 3 ♂♂ on *Citrus hystrix* (Family: Rutaceae), Khonkaen province, Northern Thailand, 23/5/2011, Leg. A. Chandrapatya.

Two females and two males orange jasmine, *Murraya paniculata* (Family: Rutaceae), Kasetsart University campus, Khet Bangkhen, Bangkok, Thailand, 20/11/2009, Leg. H.H.Naing.

***Eotetranychus thailandicus* Ehara & Wongsiri, 1975 (Figure 117)**

Eotetranychus thailandicus Ehara and Wongsiri, 1975; Ehara and Wongsiri, 1975: *Mushi*, 48: 158

Diagnosis:

Empodium composed of three pairs of hairs. Peritreme hooked and L-shaped distally. Genital flap with transverse striae. Dorsal idiosomal striae slender. Pubescent, longer than distances between consecutive setae; f_2 and h_1 setae are much shorter than f_7 setae (Ehara and Wongsiri, 1975).

Description of *Eotetranychus thailandicus***Male:**

Two males measured, 246-267 μm long (including gnathosoma).

Gnathosoma:

Palptarsus terminal sensillum absent, dorsal sensillum fusiform.

Legs:

Leg chaetotaxy are as follows:

- I 2 – 1 – 10 – 5 – 9 + (4) – 13 + (3) + 2 duplexes;
 II 2 – 1 – 6 – 8 – 5 – 8 – 13 + (1) + 1 duplex;
 III 1 – 1 – 4 – 4 – 6 – 10 + (1);
 IV 1 – 1 – 4 – 4 – 7 – 10 + (1).

Four tactile setae and 3 solenidion present proximad of proximal set of duplex setae on tarsus I, 3 tactile setae and 1 present near duplex setae.

Aedeagus:

Aedeagus of *E. thailandicus* with short shaft, curved dorsad from its base, and then bent ventrad to form a narrower distal part, the tip slightly dilated.

Female:

Three females measured. Idiosoma: length 326 – 334 μm (including gnathosoma), width 196 – 234 μm .

Dorsum:

Dorsal body setae slender, pubescent, longer than distances between consecutive setae; outer sacrals and clunals much shorter than inner sacrals. Length of dorsal setae: v_2 (20-26); sc_1 (39-42); sc_2 (15-18); c_1 (28-31); c_2 (31-32); c_3 (22-27); d_1 (28-31); d_2 (33-35); e_1 (23-27); e_2 (29-33); f_1 (28-32); f_2 (12-13); h_1 (13-14). Distances between setae: c_1 - c_1 23-25; d_1 - d_1 18-21; e_1 - e_1 16-17; c_1 - d_1 18-20; d_1 - e_1 21-22.

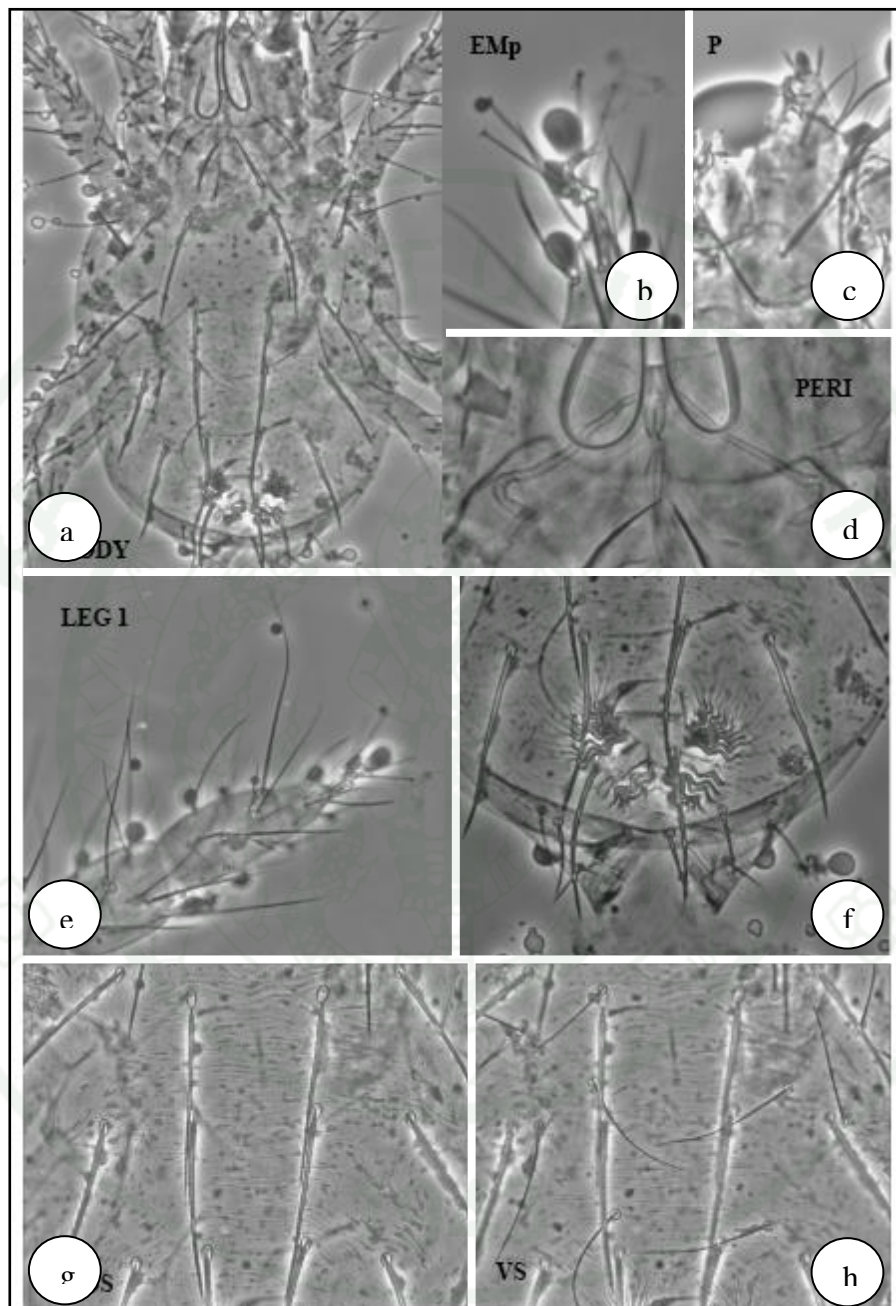


Figure 117 *Eotetranychus thailandicus* Ehara and Wongsiri, 1975: a) dorsum of female, b) empodium, c) palp, d) peritreme, e) leg I, f) genital flap, g) dorsum striation and h) ventral striation.

Gnathosoma:

Palptarsus spinneret about twice as long as broad, 5.3-5.6 μm long, 2.6-2.8 μm wide. Peritreme hooked and L-shaped distally.

Venter:

Ventral striation without lobes, genital flap and area immediately anterior to it bearing transverse striation. Two pairs of para-anal and two pairs of anal setae are present.

Legs:

Leg chaetotaxy as follows:

- I 2 – 1 – 10 – 5 – 9 + (1) – 14 + (1) + 2 duplexes;
 II 2 – 1 – 7 – 5 – 8 – 13 + 1 duplex;
 III 1 – 1 – 4 – 4 – 8 – 10 + (1);
 IV 1 – 1 – 4 – 4 – 7 – 10 + (1).

Five tactile setae and 1 solenidion present proximad of proximal set of duplex setae on tarsus I; 3 tactile setae and 1 solenidion present proximad of duplex setae, and 1 tactile seta present near duplex setae.

Biological observations:

These small mites resemble yellow mite since all stages from egg to adult are yellow in colour. They infest the host plants by living undersides of the leaves.

Remarks:

The yellow spider mite, *E. thailandicus* was first described from fig plant (*Ficus* sp.) (Family: Moraceae) in Thailand (Ehara and Wongsiri, 1975). Later, it was

known to attack mulberry leaves in northeastern Thailand. All active stages are yellow in color, hence it is called the yellow mite. This mite usually feeds on the lower leaf surface and that is where the symptoms appeared first. Symptoms such as white small patches occurred on the upper leaf surface and in severe cases, mites can spread on the whole leaf.

Host in Thailand:

Ficus sp.

Distribution in Thailand:

Chiangmai

Distribution in other countries: -

-

Specimens examined:

Ten ♀♀ and 7 ♂♂ males on edible fig plant (*Ficus carica* L.) (Moraceae), Nonthaburi, Thailand, 4/4/2010, Leg. A. Chandrapatya. Four ♀♀ and 3 ♂♂ on mulberry plant (*Morus alba* L.) (Moraceae), Khonkaen province, Northern Thailand, 23/5/2011, Leg. A. Chandrapatya.

Genus *Neotetranychus* Trägårdh, 1915

Type-species: *Neotetranychus rubi* Trägårdh (1915)

Description of Genus *Neotetranychus*

Dorsal body setae long and set on tubercles; female opsithosoma bearing mostly transverse striae which may form a basket-wave patterns or grouped into

reticulated clusters; 2 pairs of para-anal (h_{2-1}) and 2 pairs of anal setae (ps_{1-2}) present on venter; empodia split distally (Meyer, 1987)

***Neotetranychus lek* Flechtmann, 2013 (Figure 118)**

Neotetranychus lek Flechtmann, 2013: *Flechtmann, 2013: Persian Journal of Acarology*, 2: 35

Diagnosis:

Dorsal integument entirely striated, striae with small irregular lobes. Most dorsal setae (sc_1 , sc_2 , c_1 , c_2 , d_1 , d_2 , e_1 , e_2 , f_2) long, longer than longitudinal distance to basis of consecutive pair of setae, and set on strong tubercles. Smallest of the known species.

Description of *Neotetranychus lek*

Female:

Idiosoma 283 long, including gnathosoma 347 long, 255 wide.

Dorsum:

Body outline near orbicular, only slightly longer than wide. Dorsal integument entirely striated, striae with small irregular lobes, longitudinal on propodosom, irregularly transverse between setae c_1 - c_1 , d_1 - d_1 , f_1 - f_1 and caudally, but longitudinal between setae e_1 , and striae longitudinal around bases of tubercles of setae d_1 and e_1 , forming a near diamond shaped pattern. Dorsum with 13 pairs of setae, setae c_3 situated more ventrally; setae c_3 , f_1 and h_1 are the shortest; the remaining dorsal setae are long, reaching past the bases of setae next behind. Dorsal setae length: v_2 38; sc_1 67; sc_2 39; c_1 58; c_2 49; c_3 31; d_1 63; d_2 58; e_1 broken off; e_2 49; f_1 54; f_2 24; h_1 24; h_2 19; h_3 18 (h_2 and h_3 ventral). Distances between setae: c_1 - c_1 45; d_1 - d_1 55; e_1 - e_1 40; f_1 -

$f_1 71$; h_1-h_1 22. Dorsal setae cylindrical, slightly expanded distally, thickly pubescent, inserted on strong tubercles. Two pairs of pore-like structures dorso laterally, in between setae sc_2-c_3 and c_3-d_2 .

Gnathosoma:

Stylophore rounded anteriorly, longitudinally striated. Peritremes straight ending in a slightly expanded bulb. Terminal sensillum of palp (spinneret) as long as broad.

Venter:

Genital flap with arched striae; area immediately anterior to it with transverse striae. Medioventral striae without lobes.

Legs:

Leg I longest, 268, leg II shortest, leg III 190 and leg IV 202 long.

Leg chaetotaxy are as follows:

I 2 – 1 – 9/10 – 5 – 9 + (1) – 13 + (1) + 2 duplexes;

II 2 – 1 – 7 – 5 – 7 – 13 + (1) + 1 duplex;

III 1 – 1 – 4 – 4 – 6 – 10 + (1);

IV 1 – 1 – 3 – 3 – 6 – 10 + (1).

Femur I presented 9 setae on one leg and 10 setae on the other.

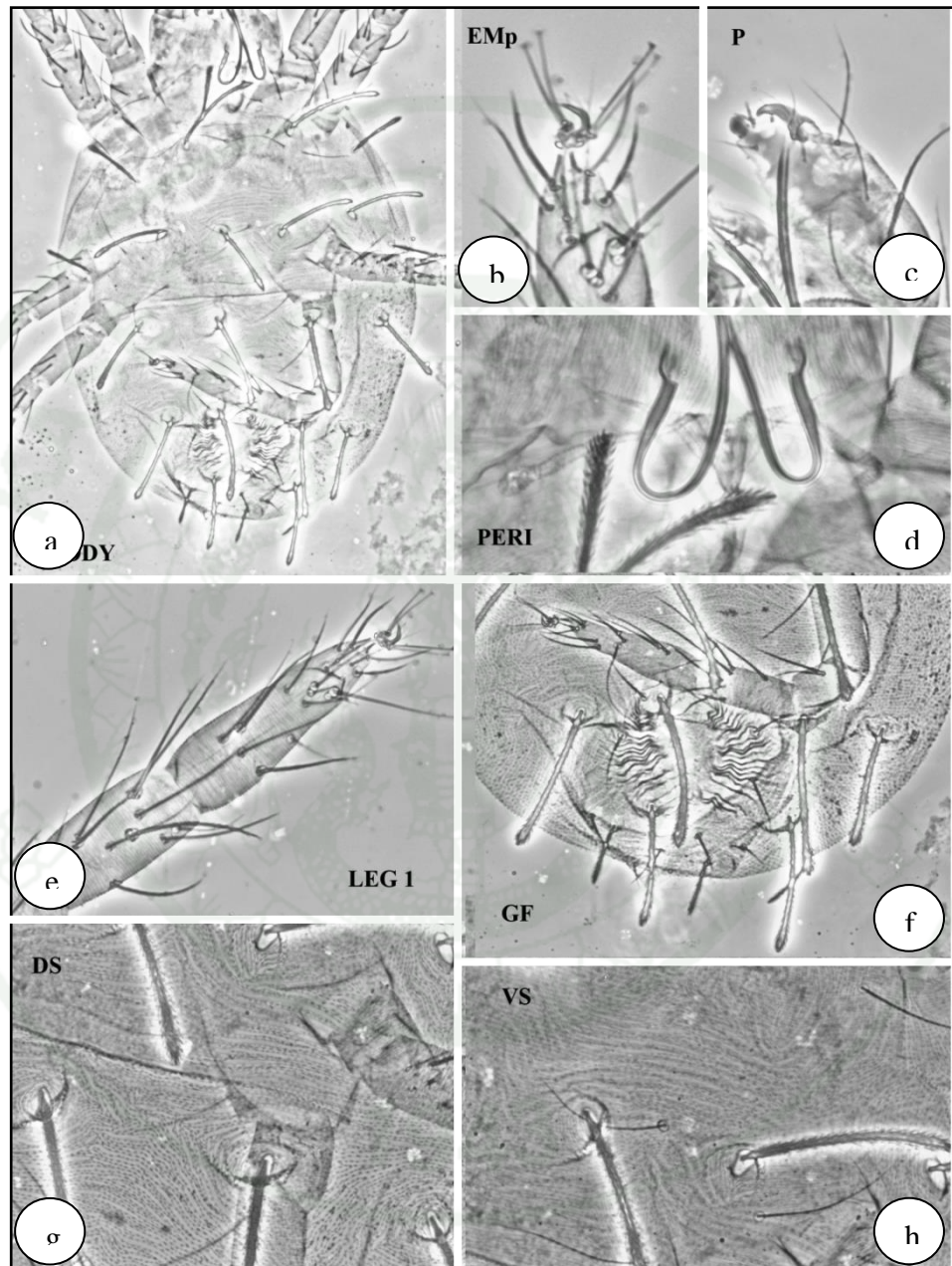


Figure 118 *Neotetranychus lek.* Flechtmann, 2013: a) dorsum of female, b) empodium, c) palp, d) peritreme, e) leg I, f) genital flap, g) dorsum striation and h) ventral striation.

Biological observations:

This mite is small and yellow in colour, collected from cassava.

Remarks:

This species is the same leg chaetotaxy as *Neotetranychus asper* Feres and Flechtmann, 2002, but differs in presenting a striae dorsal integument (ornamentation in calice shaped structures in *N. asper*).

Host in Thailand:

Cassava (*Manihot esculenta* L.)

Distribution in Thailand:

Pak Chong (Nakhon Ratchasima)

Distribution in other countries: -

-

Specimens examined:

Seven ♀♀ on Cassava, *Manihot esculenta* L. (Euphorbiaceae), Pak Chong, Nakhon Ratchasima, Thailand, 9/2/2010, Leg. H.H. Naing, A. Chandrapatya and P. Konvipasruang.

Genus *Oligonychus* Berlese, 1886

Type-species: *Heteronychus brevipodus* Targioni Tozzetti, 1878

Oligonychus Berlese, 1886: Acari Dann. Piante Coltiv.:24

Paratetranychus Zacher, 1913: *Mitt. Kais. Biol. Anst. Land-Forst.*, 14: 39.

Oligonychus Pritchard & Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 270.

Oligonychus Wainstein, 1960b: *Trudy Nauchno-Issled. Inst. Zashchita Rastenii Kazakh.*, 5: 203.

Oligonychus Tuttle & Baker, 1968: *Tuscon, Usa, The University of Arizona Press*: 116.

Oligonychus Meyer, 1974: *Entomology Memoir, Department of Agricultural Technical Services, Republic of South Africa*: 248.

Diagnosis:

Dorsal body setae usually not set on tubercles, female opisthosomal striae transverse on anterior portion of dorsocentral area and various in patterns on posterior portion, 1 pair of para-anal setae; tarsus I with 2 sets of duplex setae distal and adjacent to each other, empodium claw-like, with pairs of proximoventral hairs (Key to the genera of the world).

***Oligonychus biharensis* (Hirst, 1924) (Figure 119)**

Oligonychus biharensis (Hirst, 1924); Hirst, 1924: *Proceedings of the Zoological Society of London*: 69, fig.5.

Paratetranychus biharensis Hirst, 1924; Hirst, 1924: *Proceedings of the Zoological Society of London*: 69, fig. 15.

Oligonychus biharensis (Hirst, 1924); Pritchard and Baker, 1955: figs. 316-318.

Oligonychus biharensis (Hirst, 1924); Ehara, 1966b: *Journal of the Faculty of Sciences, Hokkaido University, Series VI, Zoology*, 16: 17, figs. 40-47.

Oligonychus biharensis (Hirst, 1924); Ehara, 1969c: *The Journal of the Faculty of Education, Tottori University, Natural Science*, 20: 95, fig. 41.

Oligonychus biharensis (Hirst, 1924); Ehara and Wongsiri, 1975: *Mushi*, 48: 177, fig. 97.

Oligonychus biharensis (Hirst, 1924); Wang, 1981: *Econ. Insect Fauna China, Science Press*, 23: 95, fig. 83.

Oligonychus biharensis (Hirst, 1924); Ehara and Tho, 1988: *The Journal of the Faculty of Education, Tottori University, (Natural Science)*, 37: 17, fig. 68.

Oligonychus biharensis (Hirst, 1924); Gotoh *et al.*, 1996: *Journal of the Acarological Society of Japan* 5: 91.

Oligonychus (Pritchardinychus) biharensis (Hirst, 1924); Flechtmann and Baker, 1970: *Annals of the Entomological Society of America*: 157.

Paratetranychus hawaiiensis McGregor, 1950; McGregor, 1950: *American Midland Naturalist*, 44: 340.

Oligonychus hawaiiensis McGregor, 1950; Pritchard & Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 364.

Diagnosis:

The females are dark red. The aedeagus is distinct in having the terminal knob convex dorsally, with a very long, downward-bending posterior projection (Ehara and Wongsiri, 1975).

Description of *Oligonychus biharensis*

Male:

Two males measured, 290–328 µm long (including gnathosoma).

Gnathosoma:

Palpus with spinneret about twice as long as broad, 5.8 μ m long, 2.9 μ m wide. Peritreme hooked distally.

Aedeagus:

Aedeagus with terminal knob convex dorsally, with a very long, downward-bending posterior projection.

Female:

Three females measured. Idiosoma: length 319-337 μ m (including gnathosoma), width 261-295 μ m.

Dorsum:

Longitudinal striae between e_1 setae, dorsocentral area between setae d_1 and e_1 transverse striation with small lobes. Length of dorsal body setae: v_2 38 (36-40); sc_1 66 (65-67); sc_2 50 (46-53); c_1 59 (56-62); c_2 63 (60-67); c_3 56 (54-57); d_1 54 (52-58); d_2 58 (53-62); e_1 53 (49-57); e_2 58 (57-59); f_1 46 (44-48); f_2 47 (42-53); h_1 23 (20-26). Distances between setae: c_1-c_1 46-51; d_1-d_1 52-57; e_1-e_1 49-55; c_1-d_1 41-47; d_1-e_1 44-51.

Gnathosoma:

Palp tarsus with spinneret twice as long as broad, peritreme hooked terminally.

Venter:

Ventral striation without lobes; in female 2 pairs of anal setae and a pair of para-anal setae are present; genital flap with area immediately anterior to it bearing broken longitudinal striation.

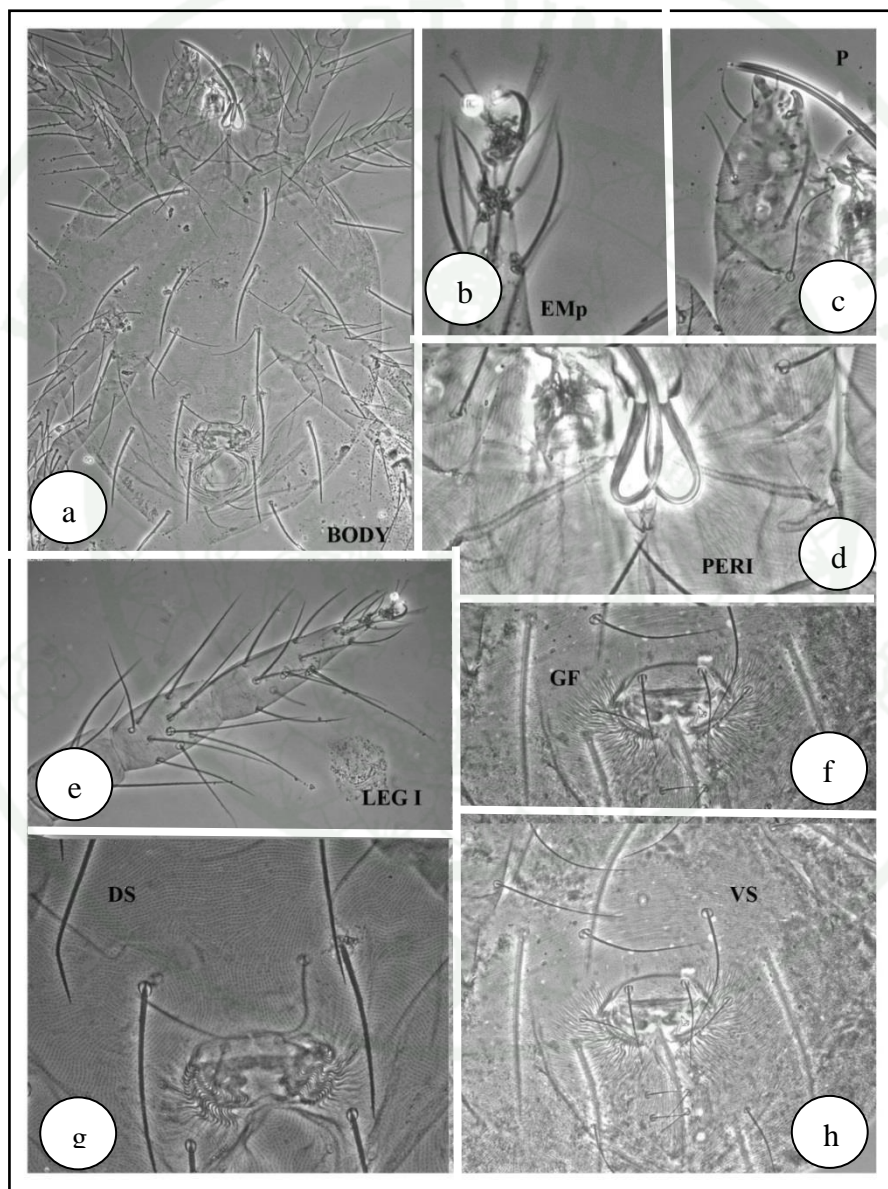


Figure 119 *Oligonychus biharensis* (Hirst, 1924): a) dorsum of female, b) empodium, c) palp, d) peritreme, e) leg I, f) genital flap, g) dorsum striation and h) ventral striation.

Legs:

Leg chaetotaxy as follows:

I 2 – 1 – 8 – 5 – 7 + (1) – 11 + (1) + 2 duplexes;

II 2 – 1 – 6 – 5 – 5 – 11 + 1 duplex;

III 1 – 1 – 2 – 2 – 5 – 7 + (1);

IV 1 – 1 – 1 – 2 – 5 – 7 + (1).

Biological observations:

The dark red colour in females is distinct and easy to recognize this mite mostly on the upper surfaces of the leaves. In severe infestation, they disperse on both lower and upper sides of the leaves.

Remarks:

This mite was first described from *Rosa* sp. (Rosaceae) in India (Hirst, 1924). Manson (1963) present the first record of *O. biharensis* collected from Petchaboon province, Thailand. Later, Baker (1975) reported the occurrence of *O. biharensis* on 15 host plants in 6 provinces and Ehara and Wongsiri (1975) listed 4 host plants for *O. biharensis* collected in 4 provinces of Thailand. At present, 70 host plants are infested by this mite and only 14 species are reported as host plants of *O. biharensis* in Thailand (Manson, 1963; Baker, 1975; Ehara and Wongsiri, 1975).

Host in Thailand:

Achras zapota, *Bauhinia purpurea*, *Bauhinia* sp., *Durio zibethinus*, *Erythrina variegata*, *Eugenia* sp., *Goniothalamus undulatus*, *Hevea* sp., *Hibiscus tiliaceus*, *Lepisanthes senegalensis*, *Litchi chinensis*, *Mangifera indica*, *Musa* sp., *Rosa* sp., *Ziziphus cambodianus* and *Pyrus communis*.

Distribution in Thailand:

Phra Nakhon Sri Ayutthaya, Bangkok, Nonthaburi, Chanthaburi, Chiangmai, Petchaboon, Ratchaburi, Songkhla.

Distribution in other countries:

Antigua, Australia, Bangladesh, Barbuda, Brazil China, Fiji, France, French Polynesia (France), Guadeloupe (France), Hawaiian Is., India, Japan, Java, Malaysia, Mauritius, Mexico, New Caledonia (France), Papua New Guinea, Philippines, Samoa, South Africa, South America, Taiwan, Tonga.

Specimens examined:

Five ♀♀ and 9 ♂♂ on cassava (*Manihot esculenta* L.) (Euphorbiaceae), Pak Chong, Nakhom Ratchasima province, Thailand, 9/2/2010, Leg. H.H. Naing, A. Chandrapatya, P. Konvipasruang.

***Oligonychus mangiferus* (Rahman and Sapro), 1940 (Figure 120)**

Oligonychus mangiferus (Rahman and Sapro, 1940); Rahman and Sapro, 1940: *Proceedings of the Indian Academy of Science, Ser. B, 11*: 192.

Paratetranychus mangiferus Rahman and Sapro, 1940; Rahman and Sapro, 1940: Rahman and Sapro, 1940: *Proceedings of the Indian Academy of Science, Ser. B, 11*: 192.

Paratetranychus insularis McGregor, 1950; McGregor, 1950: *American Midland Naturalist, 44*: 341.

Paratetranychus insularis McGregor, 1950; Pritchard and Baker, 1955: Pritchard & Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society, 2*:330.

Paratetranychus mangiferus Rahman and Sapra, 1940; Rahman and Sapra, 1940: *Proceedings of the Indian Academy of Science, Ser. B, 11*: 192.

Oligonychus mangiferus (Rahman and Sapra, 1940); Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2:330.

Oligonychus (Oligonychus) mangiferus (Rahman and Sapra, 1940); Tseng, 1990: 122.

Paratetranychus terminalis Sayed, 1946; Sayed, 1946: 94.

Oligonychus terminalis (Sayed, 1946); Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2:316.

Oligonychus terminalis (Sayed, 1946); Zaher *et al.*, 1984: *Prog. U.S.A. proj. E G - ARS*: 30: 1-181.

Diagnosis:

The females are dark red. This species is discriminated from the closely related species *Oligonychus coffeae* (Nietner, 1861) in the leg chaetotaxy and the shape of aedeagus (Ehara, 1999). However, this species differs from *O. coffeae* in the angle of the neck of aedeagus with the shaft; in the former the angle is about or more than 90° and in the latter it is less than 90° (Baker, 1975).

Description of *Oligonychus mangiferus*

Male:

2 males measured, 203–212 µm long (including gnathosoma).

Gnathosoma:

Palp tarsus with spinneret about as long as wide, 3.6-3.8 µm long and 3.6-3.7µm wide. Peritreme curved terminally.

Legs:

Leg chaetotaxy as follows:

- I 2 – 1 – 8 – 5 – 7 + (4) – 11 + (3) + 2 duplexes;
 II 2 – 1 – 6 – 5 – 5 – 12 + (1) + 1 duplex;
 III 1 – 1 – 2 – 2 – 5 – 8 + (1);
 IV 1 – 1 – 1 – 2 – 5 – 8 + (1).

Aedeagus:

Bent portion is no longer than the dorsal margin of long shaft, abruptly tapering, with acute tip pointing caudad.

Female:

Three females measured. Idiosoma: length 289-309 μm (excluding gnathosoma), width 265-280 μm .

Gnathosoma:

Palpus with spinneret about as long as wide, peritreme curved terminally.

Dorsum:

Dorsal striation transverse with small lobes, more prominent lobes in area between setae d_1 and e_1 . Dorsal body setae length: v_2 78 (74-83); sc_1 94 (90-97); sc_2 44 (39-48); c_1 87 (84-91); c_2 89 (87-92); c_3 63 (60-67); d_1 86 (81-91); d_2 92 (89-95); e_1 82 (77-88); e_2 88 (83-93); f_1 77 (70-84); f_2 71 (68-74); h_1 49 (46-52). Setae sc_2 and c_3 not widened proximally, obviously pubescent, h_1 slightly broadened proximally and distally pubescent. Other dorsal setae widened proximally, e_2 and f_2 less widened basally. Distances between setae: c_1-c_1 63-70; d_1-d_1 63-72; e_1-e_1 53-62; c_1-d_1 47-52; d_1-e_1 44-51.

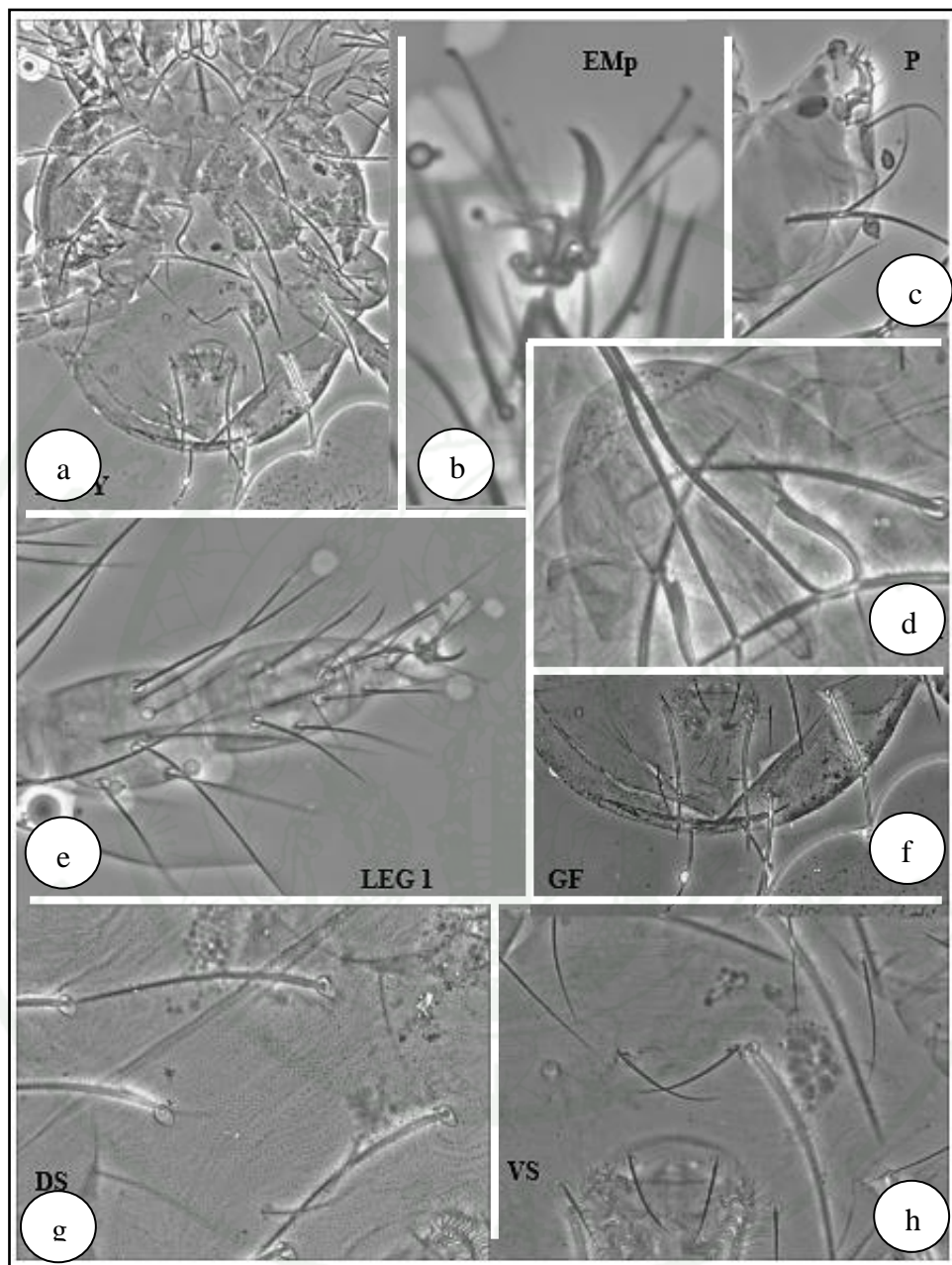


Figure 120 *Oligonychus mangiferus* (Rahman and Sapro), 1940: a) dorsum of female, b) empodium, c) palp, d) peritreme, e) leg I, f) genital flap, g) dorsum striation and h) ventral striation.

Venter:

Ventral striation transverse, no lobes; genital flap with area immediately anterior irregular. Two pairs of anal and a pair of para-anal setae are present.

Legs:

Leg chaetotaxy as follows:

- I 2 – 1 – 8 – 5 – 7 + (1) – 11 + (1) + 2 duplexes;
 II 2 – 1 – 6 – 5 – 5 – 12 + (1) + 1 duplex;
 III 1 – 1 – 2 – 2 – 5 – 8 + (1);
 IV 1 – 1 – 1 – 2 – 5 – 8 + (1).

Biological observations:

This mite can be found on the upper surface of the mango leaves with distinct symptom of their feeding showing bronzed area and malformation of leaves occurred.

Remarks:

This mite was first described as *Paratetranychus mangiferus* from *Mangifera indica* in Pakistan by Rahman and Sapra in 1940. Later, it was moved to genus *Oligonychus* by Pritchard and Baker (1955). Baker (1975) found this mite on 6 hosts plants collected from 2 provinces of Thailand. This is the second record of such species in Thailand.

Host in Thailand:

Bauhinia acuminata, *Delonex* sp., *Mangifera indica*, *Musa* sp., *Rosa* sp. and *Terminalia catappa*.

Distribution in Thailand:

Bangkok, Songkhla.

Distribution in other countries:

Australia, Brazil, Chile, China, Egypt, El Salvador, Hawaiian Is., India, Israel, Mauritius, Mozambique, Pakistan, Peru, Reunion (France), South Africa, Taiwan, Yemen.

Specimens examined:

Two ♀♀ and 3 ♂♂ on *Mangifera indica* L. (Family: Anacardiaceae), Kasetsart University campus, Bangkok, Khet Bangkhen, Bangkok, Thailand, 20/11/2009, Leg. H.H.Naing.

***Oligonychus modestus* Bank, 1900 (Figures 121)**

Tetranychus modestus Banks, 1900; Banks, 1900: *U.S. Dep. Agric. Div. Entomol. Tech. Ser.*, 8: 73

Paratetranychus modestus (Banks, 1900); Banks, 1915: *U.S. Dep. Agric. Rep.*: 37

Oligonychus modestus (Banks, 1900); Pritchard and Baker, 1955: Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 355

Oligonychus (Reckiella) modestus (Banks, 1900); Tuttle and Baker 1968: *Tuscon, Usa, The University of Arizona Press*: 123

Oligonychus notabilis Beglyarov & Mitrofanov, 1973; Beglyarov & Mitrofanov, 1973: *Biological Revue, Zoology*, 7: 23

Oligonychus notabilis Beglyarov & Mitrofanov, 1973; Mitrofanov, Strunkova and Livshits, 1987: *SSR, I.o.Z.a.P.E.N.P.T., Dushanbe, Donish*:

Oligonychus shinkajii Ehara, 1963: Ehara, 1963: *Japanese Journal of Applied Entomology & Zoology*, 7: 228

Oligonychus (Reckiella) shinkajii Ehara, 1963; Lo & Ho, 1989: *Journal of Taiwan Museum*, 42: 69

Oligonychus shinkajii Ehara, 1963; Ehara & Gotoh, 2007: *Zootaxa*, 1646: 54.

Oligonychus trachycarpus Lo, 1969; Lo, 1969: *Bulletin Sun Yat-sen Cult. Foundation*, 4: 67

Oligonychus trachycarpus Lo, 1969; Lo & Ho, 1989: *Journal of Taiwan Museum*, 42: 69

Diagnosis:

Dorsal body setae extending about one-half length beyond bases of next row. Peritreme straight, slightly thicker distally. Aedeagus abruptly upturned at right angle to shaft, neck short, head narrow and flat dorsally (Baker and Tuttle, 1994).

Description of *Oligonychus modestus*

Male:

One male measured, 223 μm long (including gnathosoma).

Dorsum:

Dorsal body setae extending about one-half length beyond bases of next row. Prodorsal striae longitudinal, opisthosomal striae transverse, except for longitudinal pattern between f1 setae; lobes small, broader than tall.

Gnathosoma:

Palpus with spinneret less than twice as long as wide. Peritreme straight, slightly thicker distally.

Aedeagus:

Abruptly upturned at right angle to shaft, neck short, head narrow and flat dorsally.

Female:

Three females measured. Idiosoma: length 203-280 μm (including gnathosoma), width 117-164 μm .

Dorsum:

Dorsal body setae extending about one-half length beyond bases of next row. Prodorsal striae longitudinal, opisthosomal striae transverse, except for longitudinal pattern between f1 setae; lobes small, broader than tall. Dorsal setae length: v_2 29 (28-30); sc_1 42 (39-45); sc_2 33 (31-36); c_1 37 (35-39); c_2 40 (38-41); c_3 37 (35-39); d_1 36 (35-38); d_2 41 (39-43); e_1 33 (31-36); e_2 41 (37-45); f_1 33 (30-35); f_2 35 (32-38); h_1 23 (20-26). Distances between setae: c_1-c_1 26-35; d_1-d_1 33-38; e_1-e_1 22-24; c_1-d_1 26-28; d_1-e_1 17-21.

Gnathosoma:

Palpus with spinneret less than twice as long as wide. Peritreme straight, slightly thicker distally.

Venter:

Ventral striation transverse, lobed, becoming longitudinal anterior to genital flap, flap pattern longitudinal on anterior margin and then becoming transversely arched.

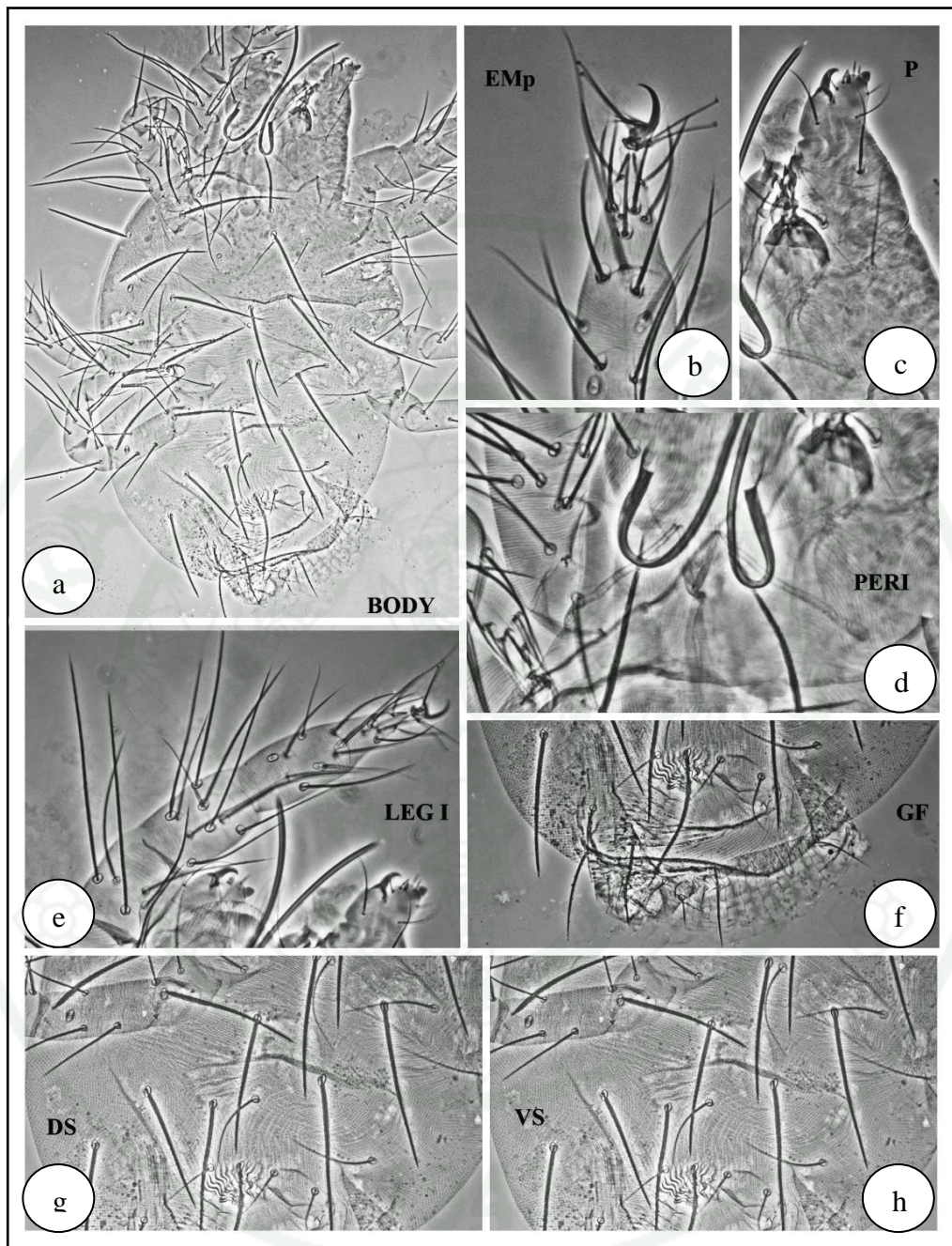


Figure 121 *Oligonychus modestus* Banks, 1900: a) dorsum of female, b) empodium, c) palp, d) peritreme, e) leg I, f) genital flap, g) dorsum striation and h) ventral striation.

Legs:

Empodial claws slender, elongate.

Biological observations:

This mite species infest on the undersurface of the coconut leaves. All stages of immatures and matures are pale yellow or straw in colour.

Remarks:

Female is straw in colour. It is originally found and described from *Zea mays* in United States.

Host in Thailand:

Cocos nucifera

Distribution in Thailand:

Nonthaburi

Distribution in other countries:

United States, Guadeloupe (France), Suriname, China (Oriental), Nansei-shoto (Japan), Taiwan, Thailand, China (Palearctic), Japan, Korea (Rep. South).

Specimens examined:

Two ♀♀ and 3 males on *Cocos nucifera*(Palmaceae), Nakhom Pathom Province, Thailand, 20/7/2011, Leg. H.H. Naing and Dr. Atriach Noosidum.

***Oligonychus orthius* Rimando, 1962 (Figure 122)**

Tetranychus exsicicator (Zehntner) sensu Kishida, 1959; Kishida, 1959: *An annotated list of animals of Okinawa Islands*: 382.

Oligonychus orthius Rimando, 1962; Rimando, 1962: *Univ. Philippines Col. Agric. Techn. Bul.*, 11: 22.

Oligonychus (Reckiella) orthius Rimando, 1962; Lo and Ho, 1989: *Journal of Taiwan Museum*, 42: 68.

Oligonychus orthius Rimando, 1962: *Univ. Philippines Col. Agric. Techn. Bul.*, 11: 22, fig. 11.

Oligonychus orthius Ehara 1966b: *Journal of the Faculty of Sciences, Hokkaido University, Series 6, Zoology*, 16: 13, figs. 22-30.

Oligonychus orthius Ehara 1969b: *The Journal of the Faculty of Education, Tottori University, Natural Science*, 20: 21, figs. 1-3, 13.

Oligonychus (Reckiella) orthius Lo and Ho, 1989: *Journal of Taiwan Museum*, 42: 68, 7H.

Oligonychus (Reckiella) orthius Tseng, 1990: *Taiwan Museum Special Publication Series*, 9: 132, figs. 364-371.

Diagnosis:

Aedeagus without terminal knob, peritreme is more or less bent at the distal end, but not U-shaped (Ehara and Wongsiri, 1975).

Description of *Oligonychus orthius*

Male:

One male measured, 267 µm long (including gnathosoma).

Dorsum:

Dorsal body setae long, slender and pubescent.

Gnathosoma:

Palptarsus with spinneret of last palpal segment smoothly rounded at tip, slightly more than twice as long as wide at base. Peritreme straight distally.

Legs:

Empodia I claw like with a pair of spur in place of proximoventral hairs, empodia II-IV claw like with 3 pairs of proximoventral hairs.

Aedeagus:

The aedeagus is distinctive in having the upturned distal portion slender and sigmoid.

Female:

Two females measured. Idiosoma: length 356–372 μm (including gnathosoma), width 234–256 μm .

Dorsum:

Dorsum of body with striation mostly transverse but longitudinal in area between inner sacral setae. Dorsal body setae length: *unavailable*.

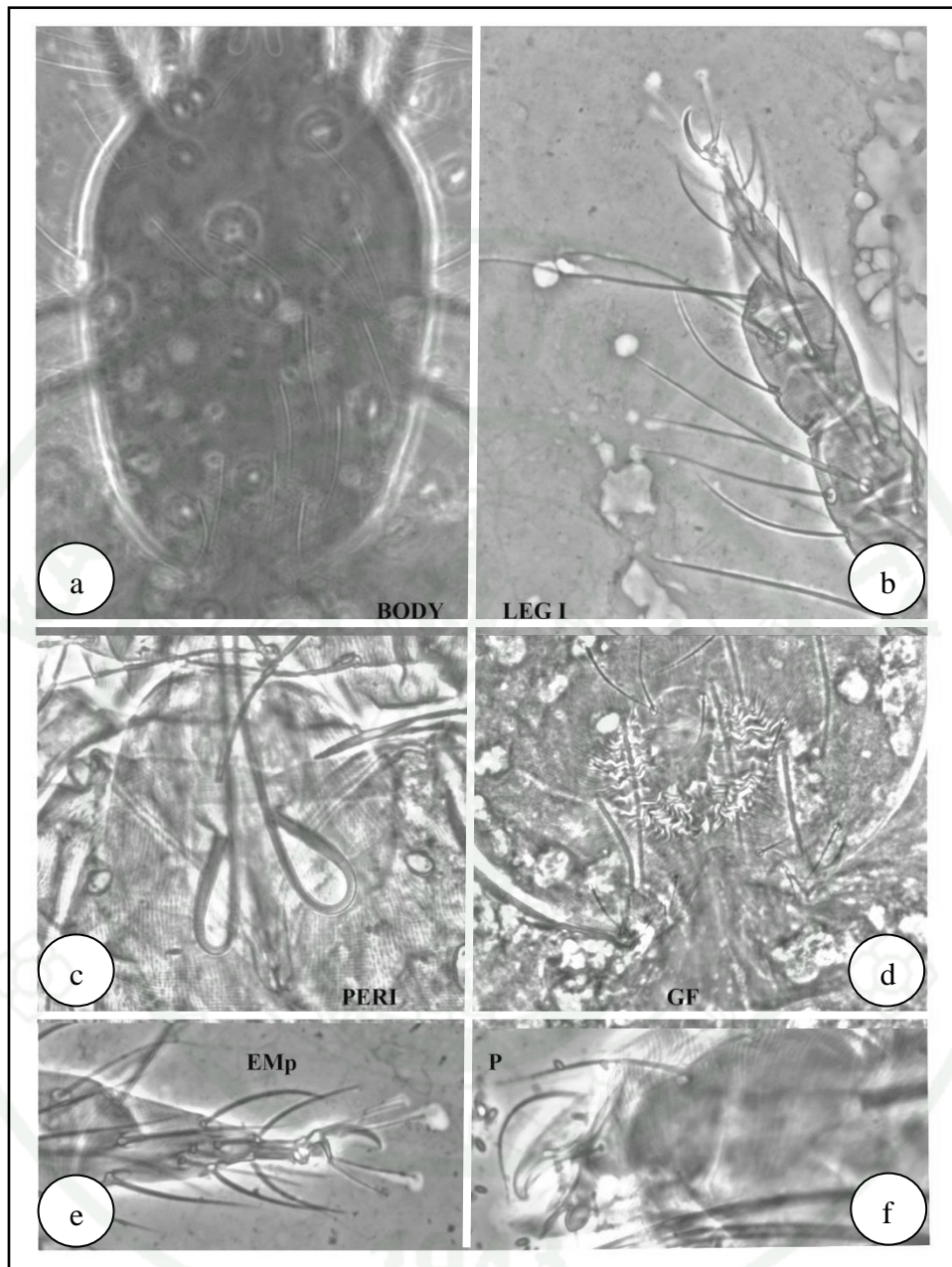


Figure 122 *Oligonychus orthius* Rimando, 1962: a) dorsum of female, b) leg I, c) peritreme, d) genital flap, e) empodium and f) palp.

Gnathosoma:

Palptarsus spinneret about 1.5 as long as broad, Peritreme is more or less bent at the distal end.

Legs:

Empodia claw like, roundly curved, each with three pairs of proximoventral hairs. Four tactile setae and 1 solenidion proximal to the duplex on tarsus I, 4 tactile and 1 solenidion proximal to duplex setae and 2 tactile setae distoventral.

Biological observations:

This mite species infest on the undersurface of the banana leaves. All stages of immatures and matures are pale yellow or straw in colour.

Remarks:

Female is straw in colour. It is originally found and described from *Saccharum officinarum* in the Philippines.

Host in Thailand:

Imperata cylindrica, *Miscanthus sinensis*, *Saccharum officinarum*

Distribution in Thailand:

Kanchanaburi, NaKhon Ratchasima, Khon Khaen

Distribution in other countries:

Japan, Korea, the Philippines, Taiwan, China, Vietnam

Specimens examined:

Two ♀♀ and 3 males on *Musa sp.* (Musaceae), Phetchaburi province, Thailand, 18/5/2011, Leg. H.H. Naing and P. Konvipasruang.

***Oligonychus punicae* Hirst, 1926**

Paratetranychus coiti McGregor, 1941; McGregor, 1941: *Proceedings of the Entomological Society of Washington*, 43: 85.

Paratetranychus coiti McGregor, 1941; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 335.

Paratetranychus punicae Hirst, 1926; Hirst, 1926: *Proceedings of the Zoological Society of London*: 830.

Hirstiella punicae Hirst, 1926; Zacher, 1949: *Prog. U.S.A. proj. E G – ARS*.

Oligonychus punicae Hirst, 1926; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 335.

Oligonychus (Oligonychus) punicae Hirst, 1926; Tuttle, Baker and Abbatiello, 1976: *International Journal of Acarology*, 2: 73.

Oligonychus viridis (Banks) sensu Beer and Lang, 1958; Beer and Lang, 1958: *University of Kansas Scientific Bulletin*, 38: 1245.

Oligonychus viridis (Banks) sensu Beer and Lang, 1958; Zaher, Gomaa and El-Enany, 1982: *International Journal of Acarology*, 8: 110.

Diagnosis:

Dorsal body setae extending well-beyond bases of next row. Stylophore rounded anteriorly. Peritremes expanded distally in females and enlarged distally in males. Aedeagus hook rather broad with distal end abruptly narrowing to pointed tip (Baker and Tuttle, 1994).

Description of *Oligonychus punicae*

Male:

Unknown.

Female:

One female measured. Idiosoma: length 345 μm (including gnathosoma), width 232 μm .

Dorsum:

Dorsal body setae extending well-beyond bases of next row. Dorsal striae lobes broader than tall, forming an irregular pattern (with whorls and U-shape on prodorsum, transverse on opisthosoma, bowed at e1-f1 setae). Dorsal setae length: $v_2 42$; $sc_1 56$; $sc_2 48$; $c_1 51$; $c_2 55$; $c_3 51$; $d_1 55$; $d_2 50$; $e_1 49$; $e_2 49$; $f_1 55$; $f_2 50$; $h_1 24$. Distances between setae: $c_1-c_1 24$; $d_1-d_1 35$; $e_1-e_1 30$; $c_1-d_1 33$; $d_1-e_1 37$.

Gnathosoma:

Palptarsus spinneret short, about as long as broad. Peritreme expanded distally.

Venter:

Ventral striation without lobes, the area immediately anterior to genital flap bearing transverse striation and then down to genital flap with longitudinal design.

Legs:

Tarsi III-IV solenidia proximal and shorter than tactile setae.

Biological observations:

This species occurs on the upper surface of leaves causing minor damage. Adults are dark pinkish with blotches of purplish-brown.

Remarks:

Female is reddish brown to brown color. It is originally found and described from *Punica granatum*, *Vitis vinifera* in India.

Host in Thailand:

Prunus persica

Distribution in Thailand:

Chiangmai

Distribution in other countries:

Australia, United States, Brazil, Chile, Colombia, Costa Rica, Cuba, El Salvador, Guatemala, Honduras, Nicaragua, Panama, Peru, India, China, Egypt, France.

Specimens examined:

Three ♀♀ from peach, *Prunus persica* (Rosaceae), Chiangmai province, Thailand, 19/4/2011, Leg. H.H. Naing and Dr. Manita's mite working group, DOA, Thailand.

***Oligonychus sacchari* McGregor, 1942**

Paratetranychus sacchari McGregor, 1942; McGregor (1942): *Proceedings of the Entomological Society of Washington*, 43: 91.

Oligonychus sacchari (McGregor, 1942); Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 355.

Diagnosis:

The aedeagus of this species is significantly different from other species. They possess sigmoid shape knob and terminal end of knob curved strongly downward.

Description of *Oligonychus sacchari*

Male:

Unknown.

Aedeagus:

Aedeagus is distinctive in having the distal end of the aedeagus bent dorsad, tapering, strongly sigmoid, and with the tip turned down.

Female:

One female measured. Idiosoma: length 381 μm (including gnathosoma), width 230 μm .

Dorsum:

Dorsal body setae widened near the base, tapering distally not well exceeding base of seta next behind but barely reaching base or about as long as longitudinal interval to base of seta next behind (variations of 4 paratypes): v_2 (50-53); sc_1 (48-51); sc_2 (41-44); c_1 (44-49); c_2 (41-45); c_3 (56-58); d_1 (46-49); d_2 (42-45); e_1 (44-48); e_2 (42-44); f_1 (44-46); f_2 (44-46); h_1 (49-52). Setae sc_2 and c_3 not widened proximally, obviously pubescent, h_1 slightly broadened proximally and distally pubescent. Other dorsal setae widened proximally, e_2 and f_2 less widened basally. Distances between setae: c_1-c_1 44-49; d_1-d_1 46-49; e_1-e_1 44-48; c_1-d_1 44-48; d_1-e_1 43-49. Hysterosomal striation transverse with rounded to oblong lobes, most of them wider than tall.

Gnathosoma:

Palptarsus spinneret about two and half time as long as broad, 5.5 μm long, 2.1 μm wide. Peritreme dilated distally.

Venter:

Ventral striation irregular. 2 pairs of para-anal and two pairs of anal setae are present.

Legs:

Strong claw like empodium with proximoventral hairs.

Biological observations:

Females are oblong and slender shape in dark yellowish colour. The eggs are rounded and pale yellow.

Remarks:

In Asia this species was previously recorded from India (Gupta & Gupta 1994).

Host in Thailand:

Cymbopogon citratus

Distribution in Thailand:

Phetchaburi

Distribution in other countries:

Japan, Korea, the Philippines, Taiwan

Specimens examined:

Two ♀♀ and 3 ♂♂ on *Cymbopogon citratus* (DC.) Stapf (Poaceae), Phetchaburi province, Thailand, 18/05/2011, Leg. H.H. Naing.

***Oligonychus velascoi* Rimando, 1962 (Figure 123)**

Oligonychus velascoi Rimando, 1962b: *Univ. Philippines Col. Agric. Techn. Bul.*, 11: 23. fig.11.

Diagnosis:

Long knob directed straight angle from the shaft. Terminal knob of the aedeagus curved upward and blunt tipped.

Description of *Oligonychus velascoi*

Male:

Two males measured, 312–325 μm long (including gnathosoma).

Dorsum:

Body with dorsal striation mostly transverse, dorsal body setae slender, tapering, pubescent, longer than longitudinal distances between them.

Gnathosoma:

Palptarsus with spinneret twice as long as wide at base, peritreme straight distally, ending in a simple bulb.

Legs:

Empodia II-IV well developed claw, each with three pairs of proximoventral hairs.

Aedeagus:

Aedeagus bent dorsad with distal end slightly sigmoidal, tapering to a tiny dorsocaudal tip.

Female:

Two females measured. Idiosoma: length 403 – 424 μm (including gnathosoma), width 260 – 274 μm .

Dorsum:

Dorsal body setae widened near the base, tapering distally not well exceeding base of seta next behind but barely reaching base or about as long as longitudinal interval to base of seta next behind (variations of 4 paratypes): v_2 (50-53); sc_1 (48-51); sc_2 (41-44); c_1 (44-49); c_2 (41-45); c_3 (56-58); d_1 (46-49); d_2 (42-45); e_1 (44-48); e_2 (42-44); f_1 (44-46); f_2 (44-46); h_1 (49-52). Setae sc_2 and c_3 not widened proximally, obviously pubescent, h_1 slightly broadened proximally and distally pubescent. Other dorsal setae widened proximally, e_2 and f_2 less widened basally. Distances between setae: c_1-c_1 44-49; d_1-d_1 46-49; e_1-e_1 44-48; c_1-d_1 44-48; d_1-e_1 43-49. Hysterosomal striation transverse with rounded to oblong lobes, most of them wider than tall.

Gnathosoma:

Palptarsus spinneret less than twice as long as broad, Peritreme straight distally and ending in a simple bulb.

Venter:

Ventral striae transverse, lobed, genital flap with area immediately anterior to it bears longitudinal and then becoming transversely arched.

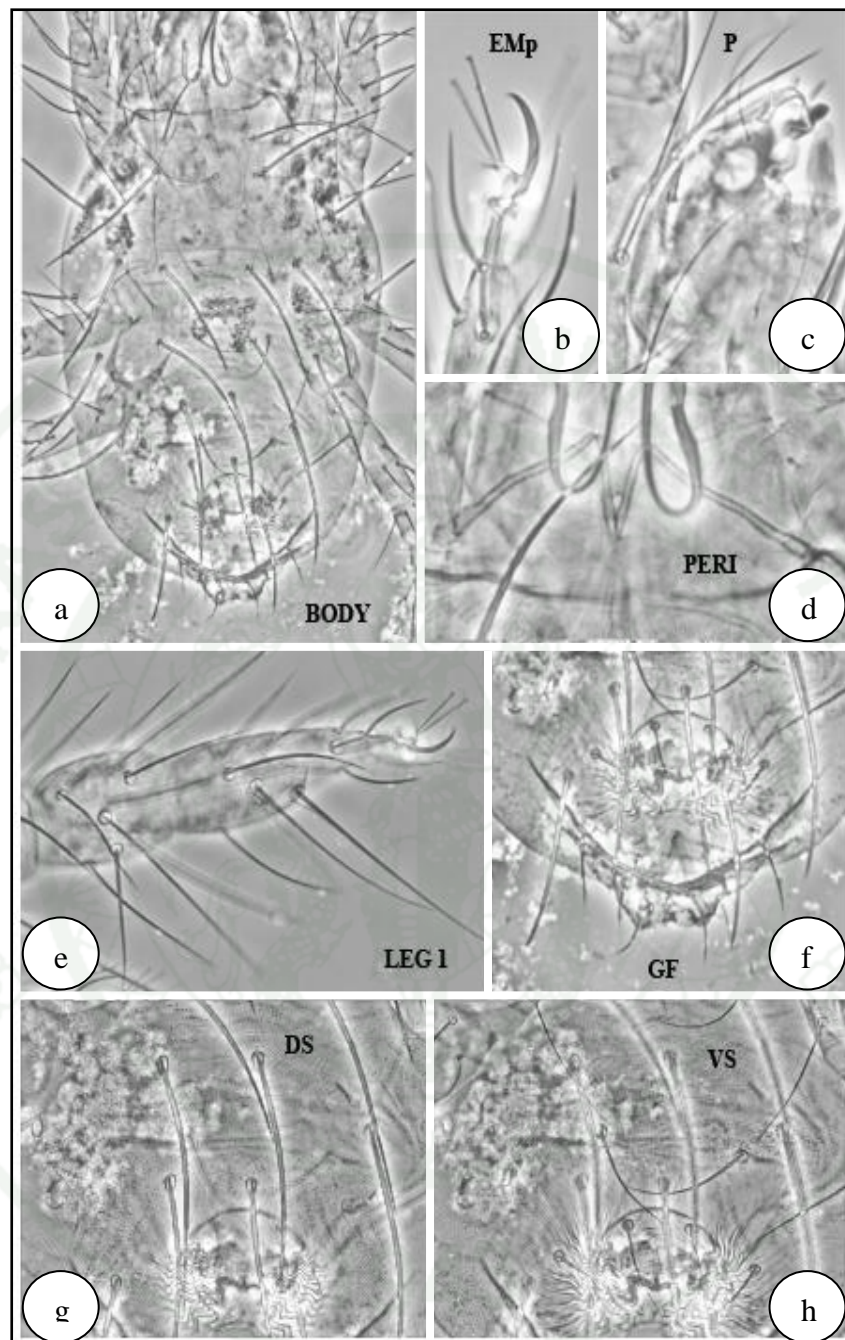


Figure 123 *Oligonychus velascoi* Rimando, 1962: a) dorsum of female, b) empodium, c) palp, d) peritreme, e) leg I, f) genital flap, g) dorsum striation and h) ventral striation.

Legs:

Empodium well developed curved claw and each with 3 pairs of proximoventral hairs. Leg chaetotaxy as follows:

- I 2 - 1 - 8 [9] - 5 - 7 + (1) - 10 + (1) + 2 duplexes;
 II 2 - 1 - 6 - 5 - 5 - 9 + 1 duplex;
 III 1 - 1 - 2 - 3 - 4 - 7 + (1);
 IV 1 - 1 - 2 - 3 - 5[4] - 7 + (1).

Four tactile and 1 solenidion proximal to duplex setae on tarsus II.

Biological observations:

These very small mites accompanied with the lower surface of the banana leaves. The eggs are pale yellowish white and rounded.

Remarks:

This mite was first described from coconut, Bolinao, Paigasinan and banana, Los Banos, Laguna in Philippines in 1955. Baker (1975) found such mite on corn and *Digitaria* sp., in Thailand and Ehara and Wongsiri (1975) also reported the same mite from Thailand feeding on coconut.

Host in Thailand:

Cocos nucifera, *Digitaria* sp. and *Zea mays*

Distribution in Thailand:

Bangkok, Chiangmai

Distribution in other countries:

Philippines

Specimens examined:

Two ♀♀ 4 ♂♂ on banana *Musa* sp. (Musaceae), Phetchaburi province, Thailand, 18/5/2011, Leg. H.H. Naing and P. Konvipasruang and coconut, *Cocos nucifera* (Palmaceae), Nakhom Pathom Province, Thailand, 20/7/2011, Leg. H.H. Naing and Dr. Atriach Noosidum.

Genus *Panonychus* Yokoyama, 1929

Panonychus Yokoyama, 1929: *Tokyo, Japan, Saishin Nippon Sangyo Gaichu Zensho. Meibun*: 531

Panonychus Ehara, 1956c: *Journal of the Faculty of Sciences, Hokkaido University, Series VI, Zoology, 12*: 499

Panonychus Meyer and Ryke, 1959: *Journal of the Entomological Society of Southern Africa, 22*: 350

Panonychus Baker and Pritchard, 1960: *Hilgardia, 29*: 471

Panonychus Tuttle and Baker, 1968: *Tuscon, Usa, The University of Arizona Press*: 84

Panonychus Ehara and Gotoh, 1992: *Applied Entomology & Zoology, 27*: 108

Metatetranychus Oudemans, 1931a: *Entomologische Berichten, Amsterdam, 8*: 199

Metatetranychus Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society, 2*: 127

Type species: *Panonychus mori* Yokoyama, 1929

Diagnosis:

Body globular, dorsal idiosomal setae set on prominent tubercles; opisthosoma with dorsocentral setae f_2 in normal position; with 2 pairs of para-anal setae; tarsus I with 2 pairs of duplex setae; empodium claw-like or split distally, empodium claw-like, empodium with proximoventral hairs (Ehara, 1999, Key to the genera of the world).

***Panonychus elongatus* Manson, 1963 (Figure 124)**

Panonychus elongatus Manson, 1963; Manson, 1963: *Acarologia*, 5: 353, figs. 2-8.

Panonychus elongatus Manson, 1963; Manson, 1968: *Journal of the Australian Entomological Society*, 7: 6, figs. 1-8, 10.

Panonychus elongatus Manson, 1963; Davis, 1968: *Queensland Journal of Agricultural & Animal Sciences*, 25: 75, fig. 1B.

Diagnosis:

Female with rounded body; dorsal idiosomal setae set on prominent tubercles; opisthosoma with longitudinal striae between pair of c_1 setae and between pair of c_2 setae; 2 pairs of para-anal setae present; 2 sets of duplex setae on tarsus I adjacent to each other; tibia I with 7 tactile setae; tibia II with 5 tactile setae; empodium claw-like, with 3 pairs of proximoventral hairs all in similar length and set at near right angle to claw, aedeagi dorsally sigmoid, tapering distally (Ehara, 1999, Key to the genera of the world).

Description of *Panonychus elongatus***Male:**

Only one male measured, 181 μm long (including gnathosoma).

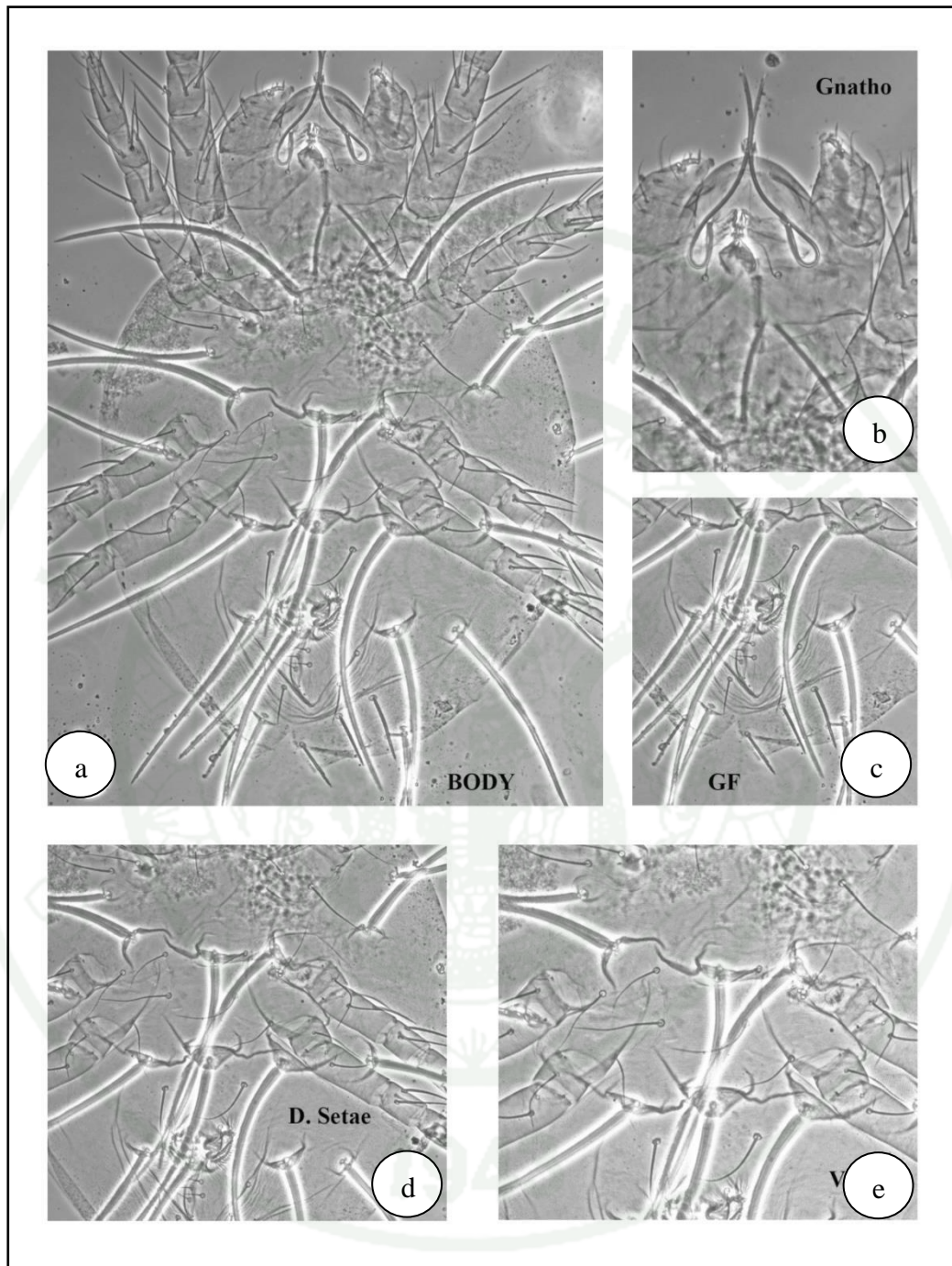


Figure 124 *Panonychus elongatus* Manson, 1963: a) dorsum of female, b) gnathosoma, c) genital flap, d) dorsal setae and e) ventral striation.

Dorsum:

Dorsal body setae short, subequal in length, sc_1 the longest. With the exception of sc_2 and c_3 setae, dorsal setae widened in their proximal portion, sc_1 and the four pairs of dorsocentral setae the most widened, f_2 and h_1 setae poorly widened proximally: v_2 28 (29-31); sc_1 33 (32-35); sc_2 23 (22-23); c_1 28 (31-32); c_2 22 (23-27); c_3 26 (25); d_1 28 (29-31); d_2 22 (23-27); e_1 25 (26-28); e_2 21 (21-24); f_1 25 (25-28); f_2 23 (21-23); h_1 22 (22-25).

Gnathosoma:

Palptarsus with spinneret about twice as long as broad, peritreme ending in a simple bulb.

Legs:

Three tactile and 3 solenidion proximal to duplex setae on tarsus I; 3 tactile and 1 sensory setae proximal to duplex of tarsus II.

Aedeagus:

Long, slender and tapering, without knob, curved dorsad with slightly concave margin of the shaft and terminal end narrow and sigmoid.

Female:

4 females measured. Idiosoma: length 475 – 524 μm (including gnathosoma), width 260 – 285 μm .

Dorsum:

Dorsal body setae set on prominent tubercles. Setae length: v_2 (50-53); sc_1 (48-51); sc_2 (41-44); c_1 (44-49); c_2 (41-45); c_3 (56-58); d_1 (46-49); d_2 (42-45); e_1 (44-48); e_2 (42-44); f_1 (44-46); f_2 (44-46); h_1 (49-52). Distances between setae: c_1-c_1 44-49; d_1-d_1 46-49; e_1-e_1 44-48; c_1-d_1 44-48; d_1-e_1 43-49.

Gnathosoma:

Spinneret about twice as long as broad, peritreme ending as a simple bulb.

Biological observations:

Females are bright red in colour and provided with strong, red tubercles that bear the dorsal setae.

Remarks:

This mite is firstly described from citrus in Myanmar (Manson, 1963). Later, Baker (1975) found this mite feeding on pear leaves in Chiangmai Province, northern part of Thailand. In the same year, Ehara and Wongsiri reported this mite feeding on peach in Chiangmai. Beside Myanmar and Thailand, this mite was also reported on 23 plants in other 4 countries outside Thailand (Migeon and Dorkeld, 2006-2013).

Host in Thailand:

Pyrus communis

Distribution in Thailand:

Chiangmai

Distribution in other countries:

Australia, China, Myanmar, Papua New Guinea and Taiwan.

Specimens examined:

Three ♀♀ on Peach, *Prunus persica* (Rosaceae), Chiangmai, Thailand, 19/4/2011, Leg. H.H. Naing and Dr. Manita's mite working group of DOA, Thailand.

Genus *Schizotetranychus* Trägrådh, 1915

Schizotetranychus Trägrådh, 1915: *Entomologiska Avdelningen*. 54: 277.

Schizotetranychus Pritchard & Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 225-227.

Schizotetranychus Wainstein, 1960: *Trudy Nauchno-Issled. Inst. Zashchita Rastenii Kazakh.*, 5: 166.

Schizotetranychus Tuttle and Baker, 1968: *Tuscon, Usa, The University of Arizona Press*: 92.

Schizotetranychus Meyer, 1974: *Entomology Memoir, Department of Agricultural Technical Services, Republic of South Africa*: 163.

Schizotetranychus Tuttle, Baker & Abbatiello, 1976: *International Journal of Acarology*, 2: 64.

Type species: *Tetranychus schizopus* Zacher, 1913.

Description of Genus *Schizotetranychus* Trägrådh, 1915

Female opisthosoma with transverse or longitudinal striae on anterior portion of dorsocentral area and with transverse striae on posterior portion; 2 pairs of paranal setae; tarsus I with 2 sets of duplex setae distal and adjacent to each other;

empodium claw-like, bifurcate, all three pairs of empodial hairs may or absent. (Ehara, 1999, Key to the genera of the world).

***Schizotetranychus colocasiae* Ehara and Tho, 1988 (Figure 125)**

Diagnosis:

Idiosoma with dorsal setae slender, pubescent, dorsocentral hysterosomal setae approximately as long as distance between their bases. Peritremes with distal end curved and dilated (Ehara and Pong, 1988).

Description of *Schizotetranychus colocasiae*

Male:

Two males measured, 270–284 μm long (including gnathosoma), 114–128 μm wide.

Gnathosoma:

Palptarsus without spinneret, dorsal sensillum slender, subfusiform. Peritreme tobacco-pipe-shaped (distal end curved and dilated).

Legs:

Empodia I-II with claw like parts practically smooth, empodia III and IV each with two very fine dorsal hairs on each claw like part.

Leg chaetotaxy are as follows:

I 2 – 1 – 9 – 5 – 9 + (4) – 13 + (3) + 2 duplexes;

II 2 – 1 – 7 – 5 – 7 – 12 + (1) + 1 duplex;

III 1 – 1 – 4 – 4 – 6 – 9 + (1);

IV 1 – 1 – 3 – 4 – 7 – 9 + (1).

Four tactile setae and 3 solenidia proximal to duplex setae on tarsus I; 2 tactile setae and 1 solenidium proximal to duplex of tarsus II.

Aedeagus:

Bent dorsad, terminal knob strong, slightly more than one half as long as dorsal margin of shaft, anterior projection of knob angular, very small but distinct, the posterior projection not obviously differentiated from the neck, elongate, tapering axis of knob forming an angle with dorsal margin of shaft.

Female:

Three females measured. Idiosoma: length 395 – 443 μm (including gnathosoma), width 208 – 235 μm .

Dorsum:

Idiosoma with dorsal setae slender, pubescent, dorsocentral hysterosomal setae approximately as long as distance between their bases. Striae of hysterosomal longitudinal to irregular between e_1 setae. Dorsal setae length: v_2 29 (27-31); sc_1 35 (32-36); sc_2 33 (31-36); c_1 32 (30-34); c_2 36 (35-38); c_3 32 (30-34); d_1 36 (34-37); d_2 37 (37-38); e_1 32 (31-34); e_2 36 (32-40); f_1 33 (30-37); f_2 37 (35-38); h_1 27 (26-28). Distances between setae: c_1-c_1 (24-26); d_1-d_1 31-35; e_1-e_1 28-33; c_1-d_1 35-40; d_1-e_1 30-35.

Gnathosoma:

Palptarsus with spinneret about twice as long as broad, dorsal sensillum slender, subfusiform, more or less shorter than the terminal, peritreme with distal end curved and dilated.

Venter:

Genital flap and area immediately anterior to it bearing transverse striation.

Legs:

Empodia I-IV similar, as in male. Leg chaetotaxy as follows:

I 2 – 1 – 9 – 5 – 9 + (1) – 13 + (1) + 2 duplexes;

II 2 – 1 – 7 – 5 – 7 – 12 + (1) + 1 duplex;

III 1 – 1 – 4 – 4 – 6 – 9 + (1);

IV 1 – 1 – 3 – 4 – 6[7] – 9 + (1).

Four tactile setae and 1 solenidion proximal to duplex setae on tarsus I; 2 tactile setae and 1 solenidia proximal to duplex of tarsus II.

Biological observations:

These mites are bright orange in colour with orange patch damage symptom. They can be found on the under side of the taro leaves.

Remarks:

This species was only known from Malaysia where it was found on *Colocasia* sp. (Ehara and Tho, 1988).

Host in Thailand:

Colocasia esculenta L.

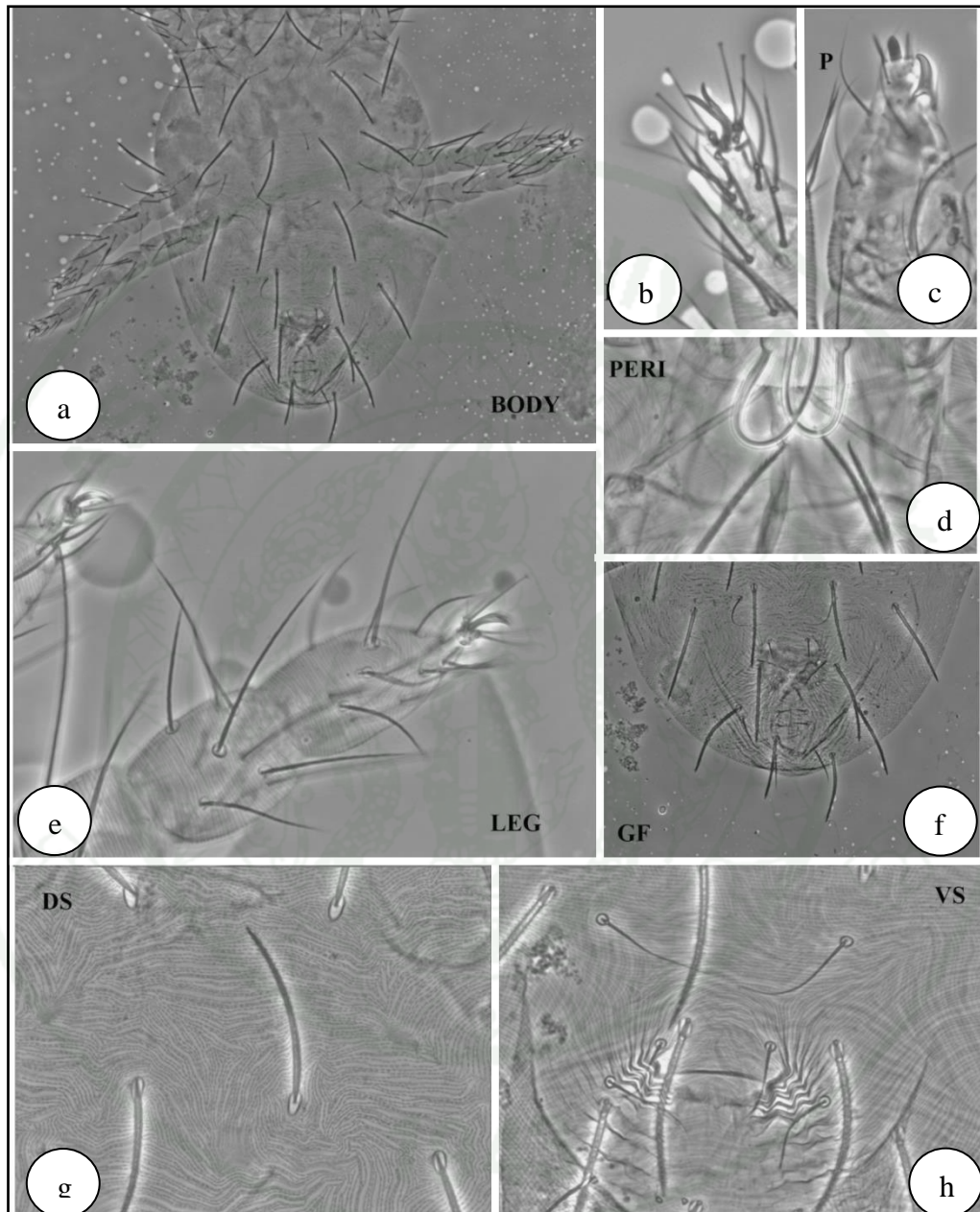


Figure 125 *Schizotetranychus colocasiae* Ehara and Tho, 1988: a) dorsum of female, b) empodium, c) palp, d) peritreme, e) leg I, f) genital flap, g) dorsal striation and h) ventral striation.

Distribution in Thailand:

Nakhom Pathom

Distribution in other countries:

Malaysia

Specimens examined:

Three ♀♀ and 3 ♂♂ on *Colocasia esculenta* (L.) Schott (Araceae), Amphoe Phutthamonthon, Nakhom Pathom province, Thailand, 23/12/2011, Leg. H.H. Naing and A. Chandrapatya.

Schizotetranychus krungthepensis* sp. nov. Naing & Auger (Figure 125-127)*Type specimens:**

Holotype (male), 2 male and 4 female paratypes on 7 preparations from sugarcane (*Saccharum officinarum* L.) (Poaceae), Ramintra, Bangkok, Thailand, 17/11/2010, Leg. H. H. Naing. Holotype, 1 male and 3 female paratypes deposited in the Insect museum of Department of Entomology, Faculty of Agriculture, Kasetsart University, Bangkok 10900, Thailand; 1 male and 1 female deposited in the collection of CBGP, coll. Auger-Migeon N° 1819-1820, 34988 Montferrier-sur-Lez, France

Diagnosis:

Female: Idiosoma oval-shaped, with dorsal integument striae, bearing dorsocentral hysterosomal setae about as long as longitudinal distance to base of seta next behind, genital area provided with a genital flap and the area anterior to it bearing a transverse striation design and with 7 tactile setae and one solenidion on the

tibia of the foreleg. End of the peritreme hooked. Male aedeagus bent dorsad with slender distal part slightly curved caudad.

**Description of *Schizotetranychus krungthepensis* sp. nov. Naing & Auger
(Figures 126-128)**

Male:

Holotype 320 μm long, 2 males measured, 314–378 μm long (including gnathosoma).

Dorsum:

Dorsal body setae short, subequal in length, sc_1 the longest. With the exception of sc_2 and c_3 setae, dorsal setae widened in their proximal portion, sc_1 and the four pairs of dorsocentral setae the most widened, f_2 and h_1 setae poorly widened proximally: v_2 28 (29-31); sc_1 33 (32-35); sc_2 23 (22-23); c_1 28 (31-32); c_2 22 (23-27); c_3 26 (25); d_1 28 (29-31); d_2 22 (23-27); e_1 25 (26-28); e_2 21 (21-24); f_1 25 (25-28); f_2 23 (21-23); h_1 22 (22-25).

Gnathosoma:

Palptarsus terminal sensillum between two and two and half times as long as broad, 4.7-5 μm long, 1.9-2.5 μm wide. Peritreme hooked distally.

Venter:

Ventral striae without lobes.

Legs:

Empodia I-IV similar, composed of two claws without appendant hairs.

Leg chaetotaxy are as follows:

- I 2 – 1 – 10 [9] – 5[4] – 7 + (2) – 10 + (1) + 2 duplexes;
 II 2 – 1 – 6 – 5 – 5 + (1) – 9 + (1) + 1 duplex;
 III 1 – 1 – 2 – 3 – 4 – 7 + (1);
 IV 1 – 1 – 2 – 3/2 – 5 – 7 + (1).

One tactile setae proximal to proximal duplex on tarsus I, one solenidion at or near the level of proximal duplex. One tactile setae and one solenidion proximal to duplex of tarsus II.

Aedeagus:

Bent dorsad at a right angle with dorsal margin of the shaft, abruptly tapering, with acute tip pointing caudad.

Female:

Four females measured. Idiosoma: length 475 – 524 μm (including gnathosoma), width 260 – 285 μm .

Dorsum:

Dorsal body setae widened near the base, tapering distally not well exceeding base of seta next behind but barely reaching base or about as long as longitudinal interval to base of seta next behind (variations of 4 paratypes): v_2 (50-53); sc_1 (48-51); sc_2 (41-44); c_1 (44-49); c_2 (41-45); c_3 (56-58); d_1 (46-49); d_2 (42-45); e_1 (44-48); e_2 (42-44); f_1 (44-46); f_2 (44-46); h_1 (49-52). Setae sc_2 and c_3 not widened proximally, obviously pubescent, h_1 slightly broadened proximally and distally pubescent. Other dorsal setae widened proximally, e_2 and f_2 less widened basally. Distances between setae: c_1 - c_1 44-49; d_1 - d_1 46-49; e_1 - e_1 44-48; c_1 - d_1 44-48; d_1 - e_1 43-49. Hysterosomal striation transverse with rounded to oblong lobes, most of them wider than tall.

Gnathosoma:

Palptarsus spinneret about 1.5 as long as broad, 5.2-5.4 μm long, 3.4-3.5 μm wide. Peritreme hooked distally.

Venter:

Ventral striation without lobes, genital flap and area immediately anterior to it bearing transverse striation. Two pairs of para-anal and two pairs of anal setae are present.

Legs:

Empodia I-IV similar, as in male.

Leg chaetotaxy as follows:

- I 2 – 1 – 8 [9] – 5 – 7 + (1) – 10 + (1) + 2 duplexes;
 II 2 – 1 – 6 – 5 – 5 – 9 + 1 duplex;
 III 1 – 1 – 2 – 3 – 4 – 7 + (1);
 IV 1 – 1 – 2 – 3 – 5[4] – 7 + (1).

One tactile setae proximal to proximal duplex on tarsus I, one solenidion at or near the level of proximal duplex. One tactile setae proximal to duplex of tarsus II, no solenidion present.

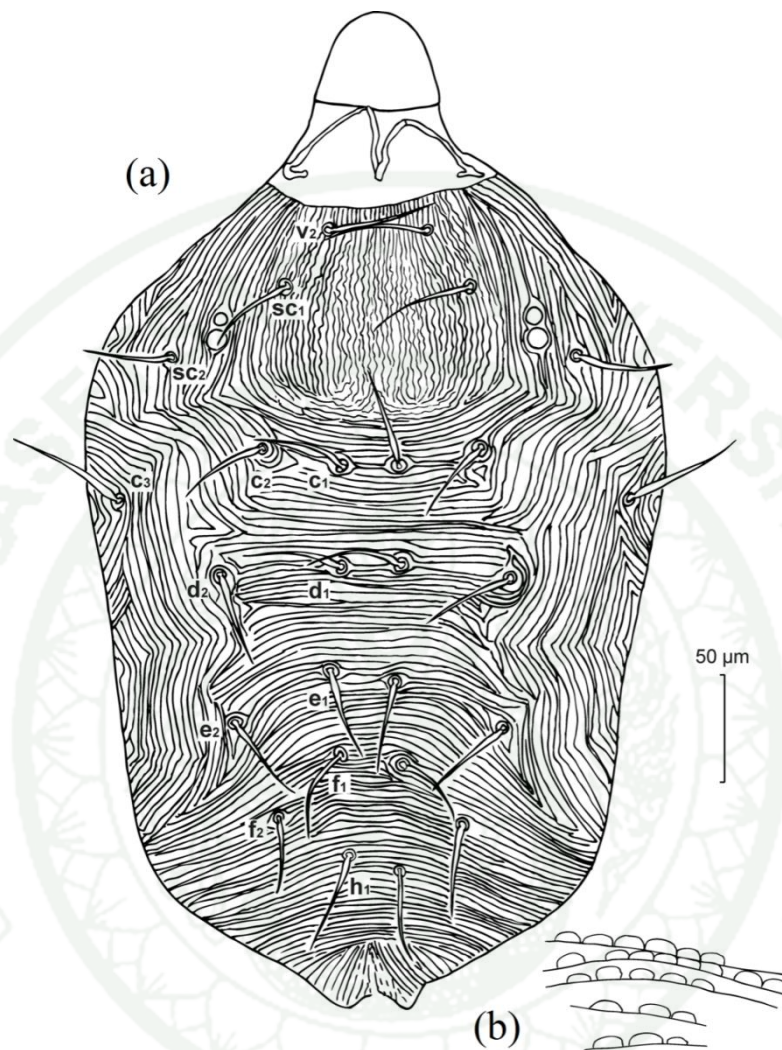


Figure 126 *Schizotetranychus krungthepensis* sp. nov., female: a) dorsal aspect and b) lobes on dorsal striae between f_1 and h_1 setae (enlarged).

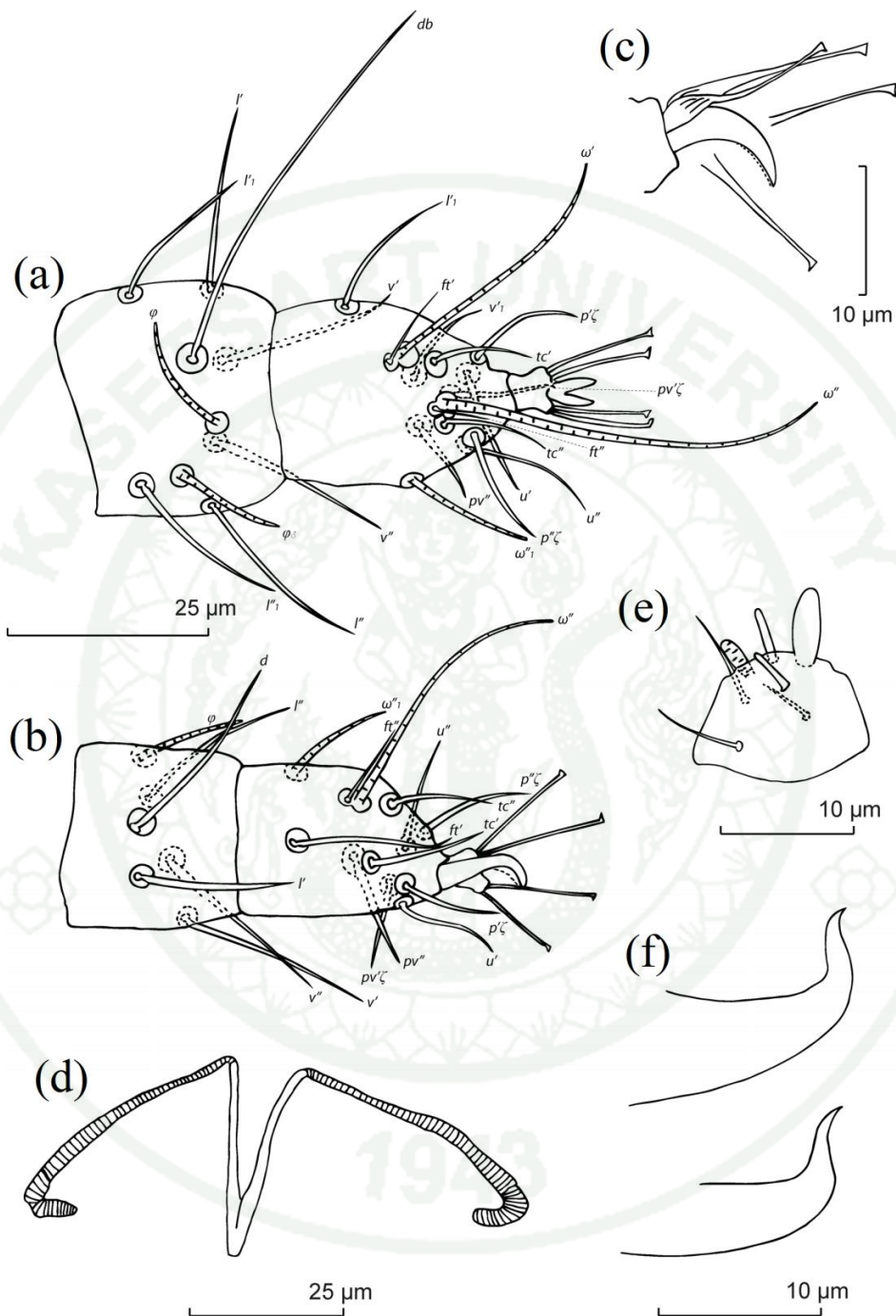


Figure 127 *Schizotetranychus krungthepensis* sp. nov., male: a) tarsus and tibia I, b) tarsus and tibia II, c) empodium I, d) peritreme, e) palptarsus and f) aedeagi (variations).

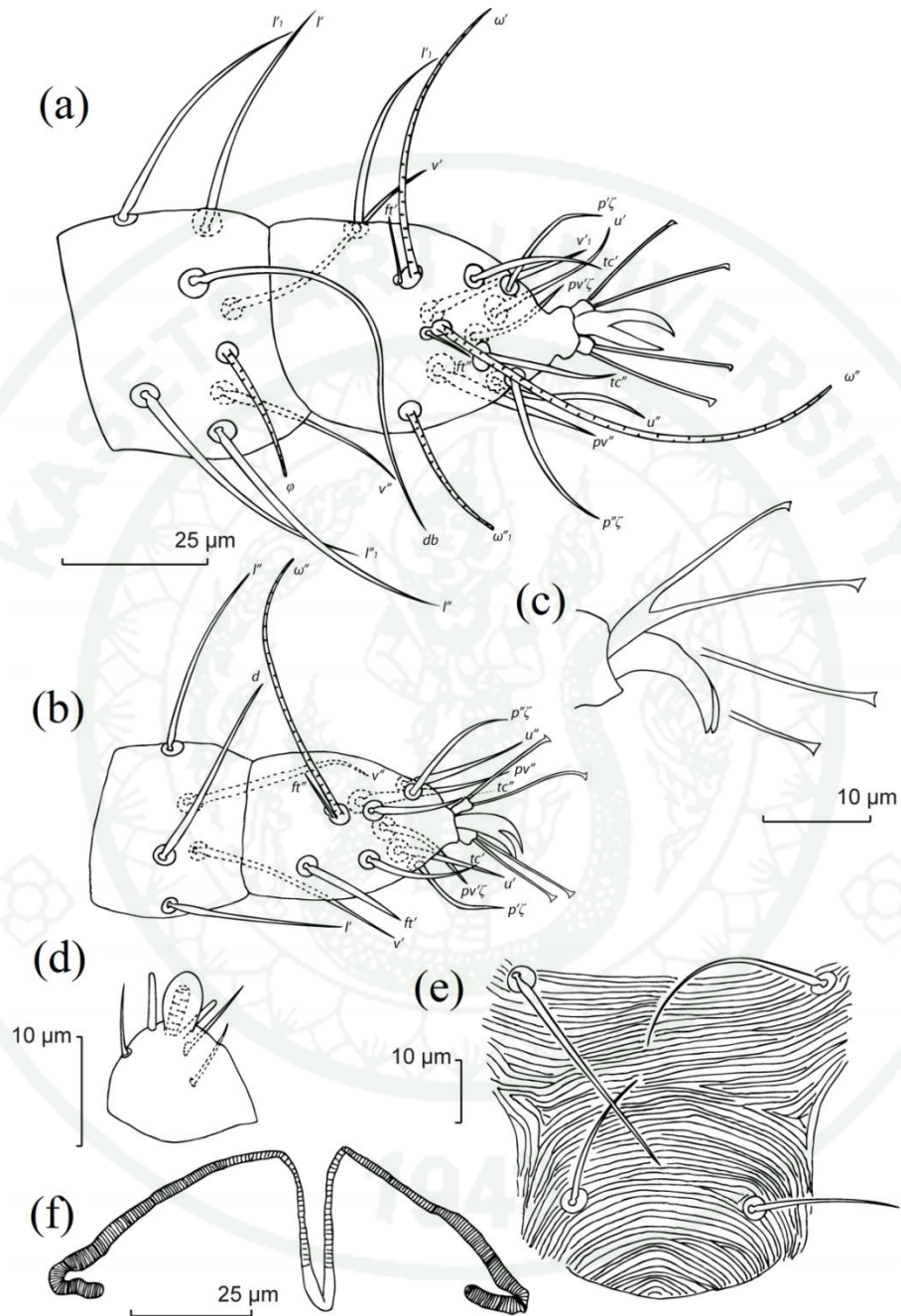


Figure 128 *Schizotetranychus krungthepensis* sp. nov., female: a) tarsus and tibia I, b) tarsus and tibia II, c) empodium, d) palptarsus, e) flap and anterogential area and f) Peritreme.

Etymology:

The species *krungthepensis* named after the location where the specimens were found, in Krungthep, meaning the City of Angels, the Thai name for capital city, Bangkok.

Biological observations:

The adult females are yellowish green in colour with two pairs of maculae. Eggs are white translucent becoming yellow with age. This species produces webnests (Saito, 1983) on the undersurface of the leaves.

Remarks:

Schizotetranychus krungthepensis n. sp. and 5 other species belong to the 8th group of *Schizotetranychus* (Flechtmann, 2012). In this group, it can be separated from *Schizotetranychus andropogoni* (Hirst) by the shape of the distal part of the peritreme (hooked distally in *S. krungthepensis* n. sp. versus dilated distally and straight in *S. andropogoni*), by the distal part of the aedeagus (thinner in its distal portion and tapering distally in *S. krungthepensis* n. sp. versus wider and not tapering distally in *S. andropogoni*), by the female spinneret size (about 1.5 as long as broad in *S. krungthepensis* n. sp. whereas slightly larger than wide in *S. andropogoni*). In addition, empodial tenent hairs often split into two or more fine components occurring in *S. andropogoni* (Ehara & Wongsiri 1975) are not present in *S. krungthepensis* n. sp.. The later also differs from *S. camur* Pritchard & Baker by the male spinneret (absent in the male of *S. camur*), by the overall appearance of the aedeagus (despite a similar sigmoid shape in the two species, the upturned part of the aedeagus of *S. camur* is not gradually narrowing as in *S. krungthepensis* n. sp.) and by the leg chaetotaxy. It can be distinguished from *S. paraelymus* feres & Flechtmann by the shape of the distal end of the peritreme (slightly bent in *S. paraelymus*), by the anterogenital striation (irregularly longitudinal in *S. paraelymus*), by the size and the shape of the palptarsus terminal sensillum (cylindrical in *S. paraelymus*) and by the leg chaetotaxy. It can be

separated from *S. undulatus* (Beer & Lang) mainly by the shape of ending part of the peritreme (only bent in *S. undulatus*) and by the shape of the aedeagus (upturned part bent at an angle about 45° and distal part not curved caudad with a right angle in *S. undulatus*). The last species of the group 8, *S. youngi* Tseng, can be easily distinguished from *S. krungthepensis* sp. by its aedeagus strongly S-shaped.

***Schizotetranychus malayanus* Ehara, 1988 (Figure 129)**

Schizotetranychus approximatus Ehara, 1988; Ehara and Tho, 1988: *The Journal of the Faculty of Education, Tottori University, Natural Science*, 37: 10

Schizotetranychus colocasiae Ehara, 1988; Ehara and Tho, 1988: *The Journal of the Faculty of Education, Tottori University, Natural Science*, 37: 4

Schizotetranychus kochummeni Ehara, 1988; Ehara and Tho, 1988: *The Journal of the Faculty of Education, Tottori University, Natural Science*, 37: 7

Schizotetranychus laevidorsatus Ehara, 1988; Ehara and Tho, 1988: *The Journal of the Faculty of Education, Tottori University, Natural Science*, 37: 12

Schizotetranychus malayanus Ehara, 1988; Ehara and Tho, 1988: *The Journal of the Faculty of Education, Tottori University, Natural Science*, 37: 6

Schizotetranychus saitoi Ehara, 1988; Ehara and Tho, 1988: *The Journal of the Faculty of Education, Tottori University, Natural Science*, 37: 14

Tetranychus bambusicola Ehara, 1988; Ehara and Tho, 1988: *The Journal of the Faculty of Education, Tottori University, Natural Science*, 37: 21

Tetranychus malaysiensis Ehara, 1988; Ehara and Tho, 1988: : *The Journal of the Faculty of Education, Tottori University, Natural Science*, 37:19

Diagnosis:

Peritreme tobacco-pipe-shaped. This species can be distinguished from its congeners by the aedeagus which upturned distally with a very small, slender terminal knob (Ehara and Tho, 1988). The female is characterized by having opisthosoma with transverse striae on the dorsocentral region, and dorsocentral opisthosomal setae about as long as the distances between consecutive setae (Ehara, 2004).

Description of *Schizotetranychus malayanus***Male:**

Two males measured, 264-297 μm long (including gnathosoma).

Dorsum:

Dorsal setae length: v2 42 (39-45); sc1 54 (52-56); sc2 43 (38-45); c1 50 (47-52); c2 52 (48-56); c3 53 (53); d1 46 (43-49); d2 54 (49-57); e1 43 (40-47); e2 56 (50-59); f1 39 (36-43); f2 25 (21-27); h1 20 (22-25).

Gnathosoma:

Palpus without spinneret, peritreme tobacco-pipe-shaped (distal end curved and dilated).

Legs:

Empodia I with dorsal hair absent on claw like division, empodia II-IV with 2 fine dorsal hairson each claw like division.

Leg chaetotaxy are as follows:

I 2 – 1 – 9 – 5 – 9 + (4) – 13 + (3) + 2 duplexes;

II 2 – 1 – 7 – 5 – 7 – 12 + (1) + 1 duplex;

III 1 – 1 – 4 – 5[4] – 6 – 9 + (1);

IV 1 – 1 – 3 – 5[4] – 7 – 9 + (1).

Four tactile setae and 3 solenidia or (2-3 solenidia) proximal to duplex setae on tarsus I; 2 tactile setae and 1 solenidion proximal to duplex on tarsus II.

Aedeagus:

Upturned distally, terminal knob slender, anterior projection of knob minute, acute, posterior projection elongate, gently tapering, axis of knob forming slight angle with ventral margin of shaft or subparallel with the latter.

Female:

Three females measured. Idiosoma: length 327-378 μm (including gnathosoma), width 189-210 μm .

Dorsum:

Opisthosomal striae of dorsocentral region transverse, dorsocentral setae about as long as distances between consecutive setae. Dorsal setae length: v2 42(40-44); sc1 61 (58-64); sc2 48 (44-52); c1 49 (45-55); c2 52 (46-57); c3 53 (47-60); d1 53 (48-58); d2 58 (57-59); e1 46 (41-52); e2 58 (52-63); f1 47 (46-48); f2 49 (47-53); h1 48 (44-52). Distances between setae: c1-c1 32-40; d1-d1 41-53; e1-e1 36-39; c1-d1 42-51; d1-e1 43-51.

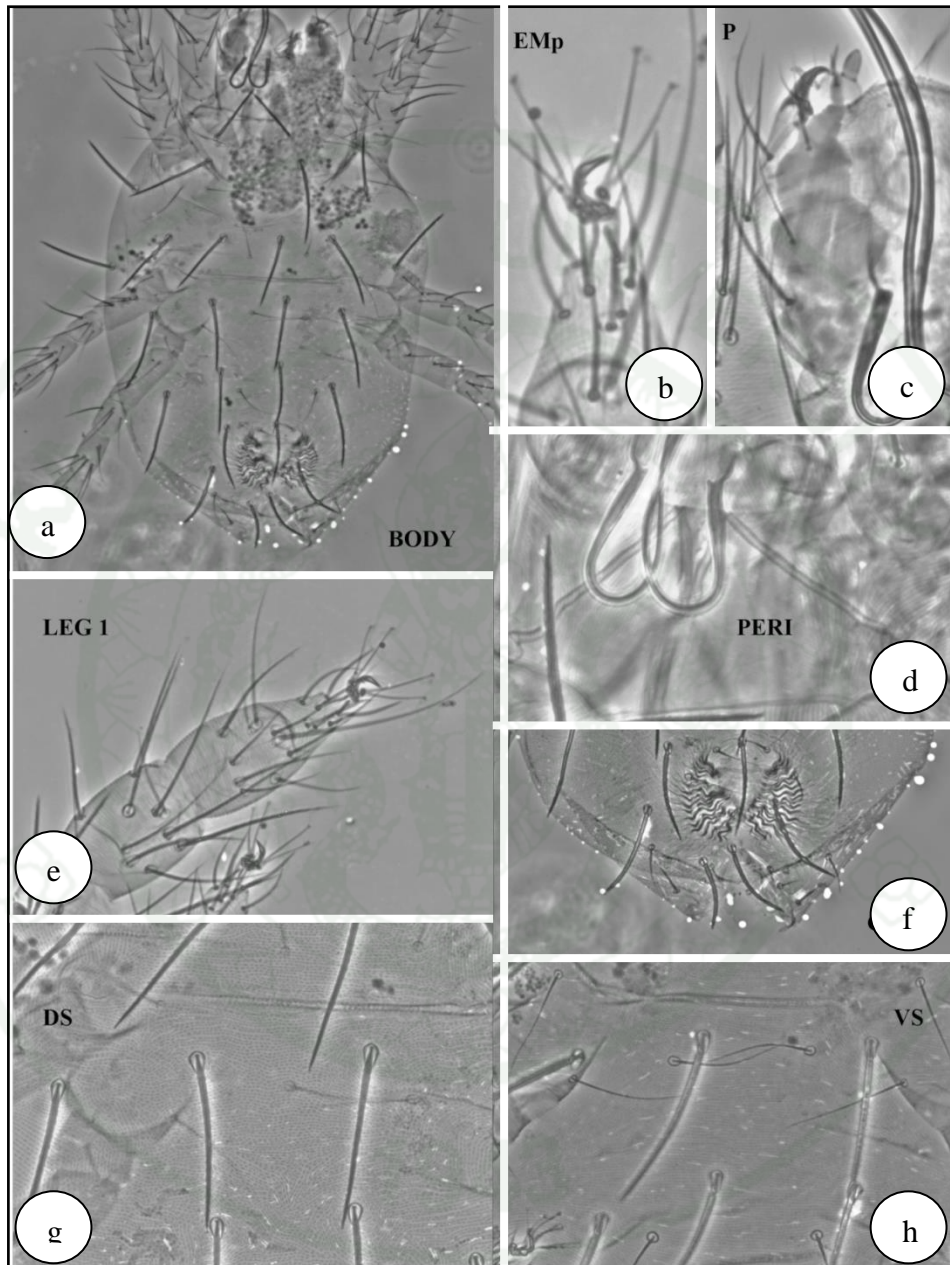


Figure 129 *Schizotetranychus malayanus* Ehara, 1988: a) dorsum of female, b) empodium, c) palp, d) peritreme, e) leg I, f) genital flap, g) dorsum striation and h) ventral striation.

Gnathosoma:

Palpus with spinneret about twice as long as broad, dorsal sensillum fusiform; peritreme tobacco-pipe-shaped (distal end curved and dilated).

Venter:

Ventral striae transverse without lobes, genital flap and area immediately anterior to it bearing transverse striation.

Legs:

Empodia with 2 fine dorsal hairs on each claw like division.

Leg chaetotaxy as follows:

- I 2 – 1 – 9 – 5 – 9 + (1) [3/4]– 13 + (1)[2/3] + 2 duplexes;
 II 2 – 1 – 7 – 5 – 7 – 12 + (1) + 1 duplex;
 III 1 – 1 – 4 – 4 – 6 – 9 + (1);
 IV 1 – 1 – 3 – 4 – 7 – 9 + (1).

Four tactile setae and 1 solenidion or (2-3 solenidia) proximal to duplex setae on tarsus I, 2 tactile setae and 1 solenidion proximal to duplex on tarsus II.

Biological observations:

These mites were found on the undersurfaces of wild grass and wild bean plant. All stages of immatures and matures are yellow in colour and the eggs are rounded and flattened in shape.

Remarks:

This mite was originally described only from males on cassava in Malaysia. This is the new record found in Thailand on the wild grass and wild bean plants.

Host in Thailand:

Wild grass, Wild bean plant.

Distribution in Thailand:

Bangkhen, Nakhon Pathom

Distribution in other countries:

Malaysia, China, Antigua and Barbuda

Specimens examined:

Four ♀♀ and 4 ♂♂ on wild grass from Kasetsart University Campus, Khet Bangkhen, Bangkok, Thailand, 20/11/2009, Leg. H. H. Naing.

Genus *Tetranychus* Dufour, 1832

Tetranychus Dufour, 1832: *Annales des Sciences Naturelles, Paris*, 25: 276.

Tetranychus Pritchard & Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 373.

Tetranychus Wainstein, 1960: *Trudy Nauchno-Issled. Inst. Zashchita Rastenii Kazakh.*, 5: 149.

Tetranychus Tuttle & Baker, 1968: *Tuscon, Usa, The University of Arizona Press*: 124

Tetranychus Meyer, 1974: *Entomology Memoir, Department of Agricultural Technical Services, Republic of South Africa*: 216.

Type species: *Tetranychus linterarius* Dufour, 1832

Description of Genus *Tetranychus*

Body setae not on tubercles; peritreme with distal portion hooked; dorsocentral area of opisthosoma with striae entirely or mostly transverse; 1 pair of para-anal setae; tibia II with tactile setae; duplex setae on tarsus I widely separated, dividing it into more or less three equal parts; empodia usually consisting of 3 pairs of ventrally directed hairs, mediodorsal spur present or absent; male empodium I usually composed of pair of short, tridigitate, claw-like divisions with or without mediodorsal spur; aedeagus bent dorsad; (Baker and Tuttle, 1994, Ehara, 1999, Pritchard and Baker, 1955).

Tetranychus fijiensis Hirst, 1924 (Figure 130)

Tetranychus fijiensis Hirst, 1924; Hirst, 1924: *Annals and Magazine of Natural History*, (ser. 9) 14: 523, pl. 17.

Tetranychus (Pentanychus) fijiensis Hirst, 1924; Wainstein, 1960: *Trudy Nauchno-Issled. Inst. Zashchita Rastenii Kazakh.*, 5: 160.

Pritchardina fijiensis (Hirst, 1924); Rimando, 1962: *Univ. Philippines Col. Agric. Techn. Bul.*, 11: 26.

Tetranychus fijiensis Hirst, 1924; Manson, 1963: *Acarologia*, 5: 362.

Tetranychus (Pritchardina) fijiensis Hirst, 1924; Tseng, 1990: *Taiwan Museum Special Publication Series*, 9:156.

Diagnosis:

Pregenital striae almost entirely weak medially; female with empodium I-IV with proximoventral hairs and large dorsal spur; male with extremely long and slender aedeagus lacking knob, empodium I claw-like (uncinate), with obvious dorsal spur, empodium II-IV with proximoventral hairs free and obvious dorsal spur (Seeman and Beard, 2011).

Description of *Tetranychus fijiensis*

Male:

2 males measured, 314–378 μm long (including gnathosoma).

Dorsum:

Dorsal body setae short, subequal in length, sc_1 the longest. With the exception of sc_2 and c_3 setae, dorsal setae widened in their proximal portion, sc_1 and the four pairs of dorsocentral setae the most widened, f_2 and h_1 setae poorly widened proximally: v_2 28 (29-31); sc_1 33 (32-35); sc_2 23 (22-23); c_1 28 (31-32); c_2 22 (23-27); c_3 26 (25); d_1 28 (29-31); d_2 22 (23-27); e_1 25 (26-28); e_2 21 (21-24); f_1 25 (25-28); f_2 23 (21-23); h_1 22 (22-25).

Gnathosoma:

Palptarsus terminal sensillum between two and two and half times as long as broad, 4.7-5 μm long, 1.9-2.5 μm wide. Peritreme hooked distally.

Venter:

Ventral striae without lobes.

Legs:

Leg chaetotaxy are as follows:

- I 2 – 1 – 10 [9] – 5[4] – 7 + (2) – 10 + (1) + 2 duplexes;
- II 2 – 1 – 6 – 5 – 5 + (1) – 9 + (1) + 1 duplex;
- III 1 – 1 – 2 – 3 – 4 – 7 + (1);
- IV 1 – 1 – 2 – 3/2 – 5 – 7 + (1).

One tactile setae proximal to proximal duplex on tarsus I, one solenidion at or near the level of proximal duplex. One tactile setae and one solenidion proximal to duplex of tarsus II.

Aedeagus:

Bent dorsad at a right angle with dorsal margin of the shaft, abruptly tapering, with acute tip pointing caudad.

Female:

4 females measured. Idiosoma: length 475 – 524 μm (including gnathosoma), width 260 – 285 μm .

Dorsum:

Dorsal body setae widened near the base, tapering distally not well exceeding base of seta next behind but barely reaching base or about as long as longitudinal interval to base of seta next behind (variations of 4 paratypes): v_2 (50-53); sc_1 (48-51); sc_2 (41-44); c_1 (44-49); c_2 (41-45); c_3 (56-58); d_1 (46-49); d_2 (42-45); e_1 (44-48); e_2 (42-44); f_1 (44-46); f_2 (44-46); h_1 (49-52). Setae sc_2 and c_3 not widened proximally, obviously pubescent, h_1 slightly broadened proximally and distally pubescent. Other dorsal setae widened proximally, e_2 and f_2 less widened basally. Distances between setae: c_1-c_1 44-49; d_1-d_1 46-49; e_1-e_1 44-48; c_1-d_1 44-48; d_1-e_1 43-49. Hysterosomal striation transverse with rounded to oblong lobes, most of them wider than tall.

Gnathosoma:

Palptarsus spinneret about 1.5 as long as broad, 5.2-5.4 μm long, 3.4-3.5 μm wide. Peritreme hooked distally.

Venter:

Ventral striation without lobes, genital flap and area immediately anterior to it bearing transverse striation. Two pairs of para-anal and two pairs of anal setae are present.

Legs:

Leg chaetotaxy as follows:

- I 2 – 1 – 8 [9] – 5 – 7 + (1) – 10 + (1) + 2 duplexes;
 II 2 – 1 – 6 – 5 – 5 – 9 + 1 duplex;
 III 1 – 1 – 2 – 3 – 4 – 7 + (1);
 IV 1 – 1 – 2 – 3 – 5[4] – 7 + (1).

One tactile setae proximal to proximal duplex on tarsus I, one solenidion at or near the level of proximal duplex. One tactile setae proximal to duplex of tarsus II, no solenidion present.

Biological observations:

Eggs are rounded in shape and red in colour. Immature stages are varying in colour from pale yellow to yellowish red when they gradually become later stages. The adult male and female are bright red colour and they possess very long legs in yellow colour. They can be found on the undersurfaces of the leaves on their host plants.

Remarks:

This mite was reported for the first time on *Cocos nucifera* in Fiji (Hirst, 1924). Manson recorded the occurrence of this mite in Thailand in 1963. In 1975 Baker found *T. fijiensis* fed on 4 host plants in Thailand and while Ehara and Wongsiri also reported that *Citrus* sp. and *Pyrus communis* are served as host plants

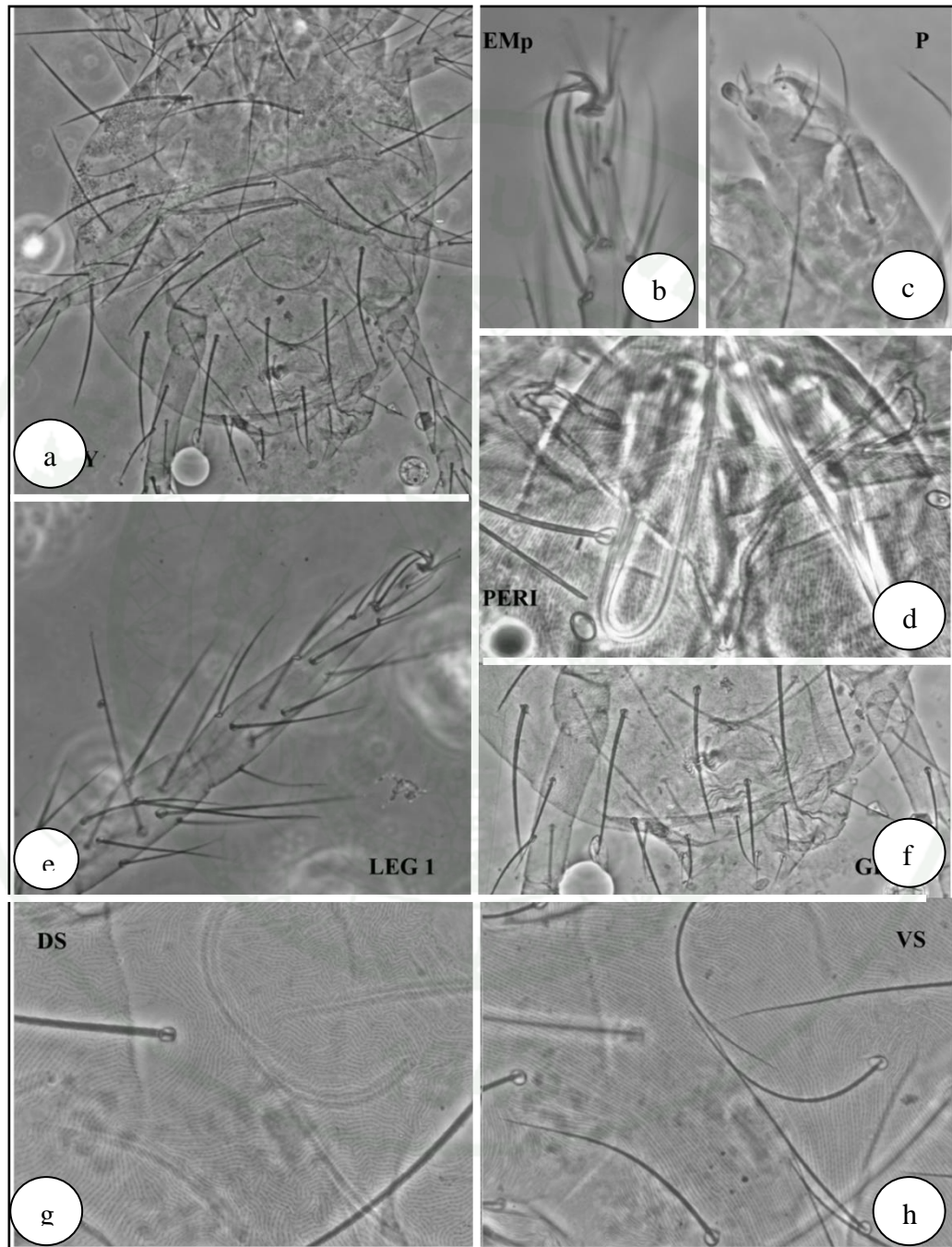


Figure 130 *Tetranychus fijiensis* Hirst, 1924: a) dorsum of female, b) empodium, c) palp, d) peritreme, e) leg I, f) genital flap, g) dorsum striation and h) ventral striation.

of this mite. At present, this mite distributed in several countries and feeds on more than 20 host plants.

Host in Thailand:

Citrus maxima (pumelo), *Citrus reticulata*, *Citrus* sp., *Cocos nucifera*, *Prunus persica*, *Ptychosperma macarthurii*, *Ptychosperma* sp., *Pyrus communis*.

Distribution in Thailand:

Bangkok, Chanthaburi, Chiangmai, Songkhla

Distribution in other countries:

Australia, China, Fiji, France, India, Kiribati, Malaysia, Marianas Islands, Papua New Guinea, Philippines, Seychelles, Taiwan.

Specimens examined:

Three ♀♀ and 6 ♂♂ on Coconut, *Cocos nucifera* (L.) (Palmaceae), Rayong, Thailand, 14/10/2010, Leg. H.H. Naing and P. Konvipasruang.

***Tetranychus kanzawai* Kishida, 1927 (Figure 131)**

Tetranychus hydrangeae Pritchard & Baker, 1955; Pritchard & Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 425, fig. 379.

Tetranychus (Tetranychus) hydrangeae Pritchard & Baker, 1955; Tuttle, Baker & Abbatiello, 1974: *Smithsonian Contributions to Zoology*, 171:17.

- Tetranychus hydrangeae* Pritchard & Baker, 1955; Navajas, Gutierrez, Williams, and Gotoh, 2001: *Bulletin of Entomological Research*, 91:117.
- Tetranychus japonicus* Hotta, 1928; Hotta, 1928: *Transactions of the Shizuoka prefectural agricultural Association*, 32:10.
- Tetranychus japonicus* Hotta, 1928; Ehara, 1956: *Journal of the Faculty of Sciences, Hokkaido University, Series VI, Zoology*, 12:505.
- Tetranychus kanzawai* Kishida, 1927; Kishida, 1927: *Zool. Mag.*, 39:105.
- Tetranychus (Tetranychus) kanzawai* Kishida, 1927; Tseng, 1990: *Taiwan Museum Special Publication Series*, 9:181.
- Tetranychus kanzawai* Kishida, 1927; Ehara, 1956c: *Journal of the Faculty of Sciences, Hokkaido University, Series VI, Zoology*, 12:504 fig 15-25.
- Tetranychus kanzawai* Kishida, 1927; Ehara, 1960: *Japanese Journal of Applied Entomology & Zoology*, 4:240.
- Tetranychus kanzawai* Kishida, 1927; Ehara, 1969c: *The Journal of the Faculty of Education, Tottori University, Natural Science*, 20: 98 fig 65-67.
- Tetranychus kanzawai* Kishida, 1927; Ehara and Tho, 1988: *The Journal of the Faculty of Education, Tottori University, Natural Science*, 37: 23 fig 10.
- Tetranychus kanzawai* Kishida, 1927; Ehara and Masaki, 1989: *Acta Arachnologica*, 38: 52 fig 14.

Diagnosis:

Peritreme hook; dorsal striae with diamond shape pattern between setae e_1 and f_1 , ventral striae without lobes; pregenital striae generally entire, sometimes weak with small breaks medially; tarsus I with sockets 4 tactile setae proximal to the socket of proximal duplex setae; female empodium with 6 haris; spurs on empodium I-IV minute or absent.

Male aedeagus with large knob (knob twice as long as neck), with blunt anterior projection and pointed posterior projection, dorsal surface convex, empodium I-II each with an obvious dorsal spur, empodium I claw like (uncinate), empodium II-IV with proximoventral hairs long and free, (Seeman and Beard, 2011).

Description of *Tetranychus kanzawai*

Male:

2 males measured, 314–378 μm long (including gnathosoma).

Dorsum:

Dorsal body setae short, subequal in length, sc_1 the longest. With the exception of sc_2 and c_3 setae, dorsal setae widened in their proximal portion, sc_1 and the four pairs of dorsocentral setae the most widened, f_2 and h_1 setae poorly widened proximally: v_2 28 (29-31); sc_1 33 (32-35); sc_2 23 (22-23); c_1 28 (31-32); c_2 22 (23-27); c_3 26 (25); d_1 28 (29-31); d_2 22 (23-27); e_1 25 (26-28); e_2 21 (21-24); f_1 25 (25-28); f_2 23 (21-23); h_1 22 (22-25).

Gnathosoma:

Palptarsus terminal sensillum between two and two and half times as long as broad, 4.7-5 μm long, 1.9-2.5 μm wide. Peritreme hooked distally.

Venter:

Ventral striae without lobes.

Legs:

Leg chaetotaxy are as follows:

- I 2 – 1 – 10 [9] – 5[4] – 7 + (2) – 10 + (1) + 2 duplexes;
 II 2 – 1 – 6 – 5 – 5 + (1) – 9 + (1) + 1 duplex;
 III 1 – 1 – 2 – 3 – 4 – 7 + (1);
 IV 1 – 1 – 2 – 3/2 – 5 – 7 + (1).

One tactile setae proximal to proximal duplex on tarsus I, one solenidion at or near the level of proximal duplex. One tactile setae and one solenidion proximal to duplex of tarsus II.

Aedeagus:

Bent dorsad at a right angle with dorsal margin of the shaft, abruptly tapering, with acute tip pointing caudad.

Female:

4 females measured. Idiosoma: length 475 – 524 μm (including gnathosoma), width 260 – 285 μm .

Dorsum:

Dorsal body setae widened near the base, tapering distally not well exceeding base of seta next behind but barely reaching base or about as long as longitudinal interval to base of seta next behind (variations of 4 paratypes): v_2 (50-53); sc_1 (48-51); sc_2 (41-44); c_1 (44-49); c_2 (41-45); c_3 (56-58); d_1 (46-49); d_2 (42-45); e_1 (44-48); e_2 (42-44); f_1 (44-46); f_2 (44-46); h_1 (49-52). Setae sc_2 and c_3 not widened proximally, obviously pubescent, h_1 slightly broadened proximally and distally pubescent. Other dorsal setae widened proximally, e_2 and f_2 less widened basally. Distances between setae: c_1 - c_1 44-49; d_1 - d_1 46-49; e_1 - e_1 44-48; c_1 - d_1 44-48; d_1 - e_1 43-49. Hysterosomal striation transverse with rounded to oblong lobes, most of them wider than tall.

Gnathosoma:

Palptarsus spinneret about 1.5 as long as broad, 5.2-5.4 μm long, 3.4-3.5 μm wide. Peritreme hooked distally.

Venter:

Ventral striation without lobes, genital flap and area immediately anterior to it bearing transverse striation. Two pairs of para-anal and two pairs of anal setae are present.

Legs:

Empodia I-IV similar, as in male.

Leg chaetotaxy as follows:

- I 2 – 1 – 8 [9] – 5 – 7 + (1) – 10 + (1) + 2 duplexes;
 II 2 – 1 – 6 – 5 – 5 – 9 + 1 duplex;
 III 1 – 1 – 2 – 3 – 4 – 7 + (1);
 IV 1 – 1 – 2 – 3 – 5[4] – 7 + (1).

One tactile setae proximal to proximal duplex on tarsus I, one solenidion at or near the level of proximal duplex. One tactile setae proximal to duplex of tarsus II, no solenidion present.

Biological observations:

Eggs are rounded in shape and white in colour and turned into dark colour before hatching. Immature stages are varying in colour from pale yellow to dark yellowish when they gradually become later stages. The adult males are dark yellow colour and females are carmine red in colour and produce silk. They can be found on the upper surfaces of the leaves on their host plants.

Remarks:

T. kanzawai was originally described from *Morus alba* in Japan (Kishida, 1927). In the past, *T. kanzawai* are distinguished from *T. hydrangeae* by the size of aedeagal knob before they were synonymized by Navajas et al., (2001) and *T. kanzawai* is the valid name since then. In Thailand, Baker (1975) reported the presence of *T. kanzawai* on corn and *T. hydrangeae* on 18 different host plants collected from 3 provinces. In the same year, Ehara & Wongsiri (1975) reported *T. hydrangeae* infesting 2 host plants. More reports on the occurrence of *T. kanzawai* in Thailand were also given by Masaki, Hayase and Miyajima (1991) and Takafuji and Hinomoto (2008). At present, *T. kanzawai* was reported to feed on 183 host plants and it is distributed in several countries including Thailand.

Host in Thailand:

Artocarpus integer, *Bambusa* sp., *Canavalia* sp., *Carica papaya*, *Chenopodium* sp., *Cucumis* sp., *Dahlia* sp., *Eucharis x grandiflora*, *Glycine max*, *Ipomoea aquatica*, *Melia* sp., *Morus* sp., *Rosa hybrid*, *Saccharum officinarum*, *Sandoricum koetjape*, *Sorghum bicolor*, *Vitis vinifera* and *Zea mays*.

Distribution in Thailand:

Bangkok, Chiangmai, Nakhon Pathom, Nonthaburi provinces.

Distribution in other countries:

Australia, China, Columbia, Congo, Greece, India, Indonesia, Japan, Korea, Malaysia, Mexico, Papua New Guinea, Philippines, South Africa, Taiwan, United States and Vietnam.

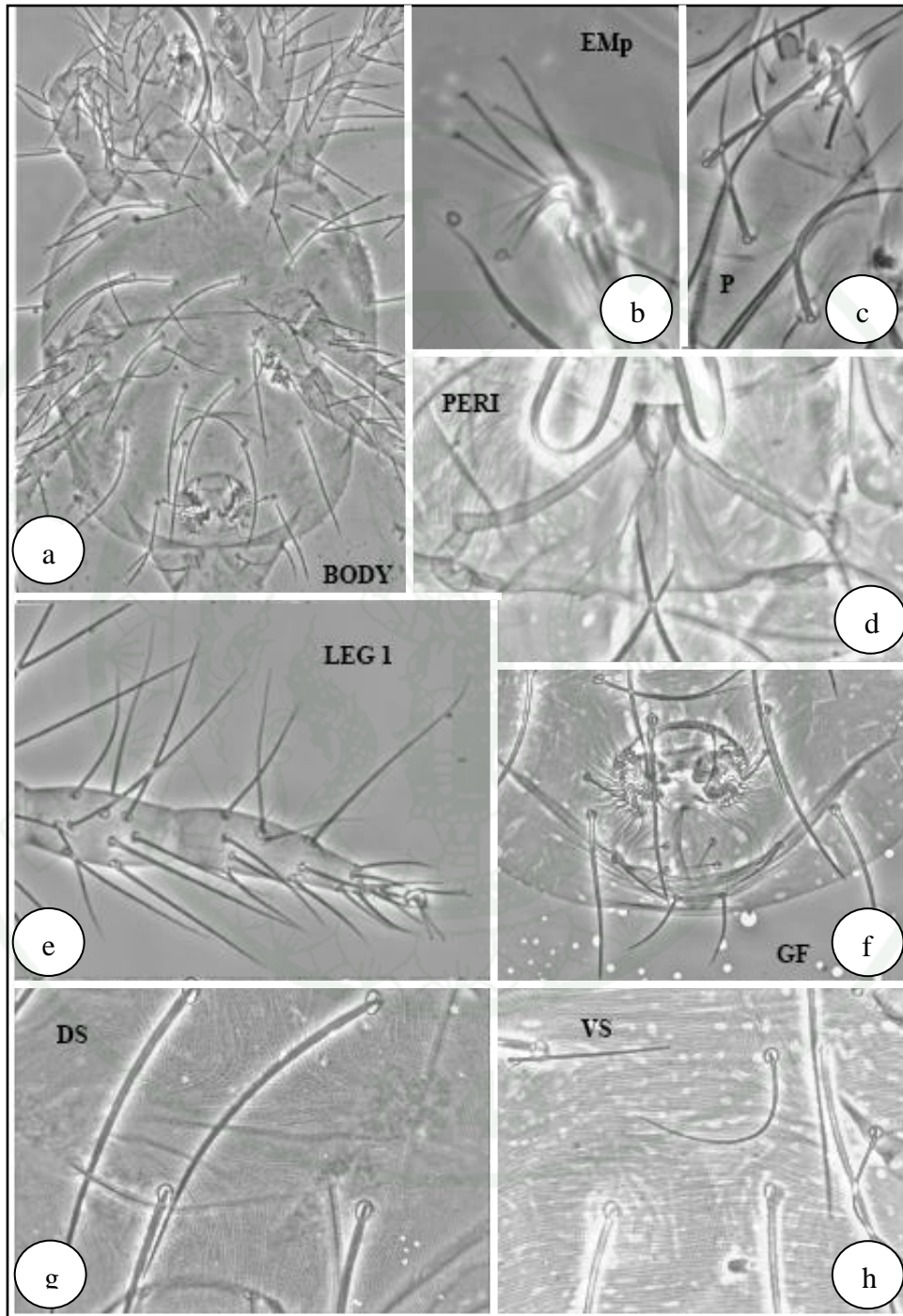


Figure 131 *Tetranychus kanzawai* Kishida, 1927: a) dorsum of female, b) empodium, c) palp, d) peritreme, e) leg I, f) genital flap, g) dorsum striation and h) ventral striation.

Specimens examined:

Five ♀♀ and 9 ♂♂ on Passion fruit, *Passiflora edulis* (L.) (Passifloraceae),
Ram Intra, Bangkok, Thailand, 23/5/2011, Leg. H.H. Naing.

***Tetranychus marianae* McGregor, 1950 (Figure 132)**

Tetranychus marianae McGregor, 1950; McGregor, 1950: *American Midland Naturalist*, 44: 291.

Tetranychus (Tetranychus) marianae McGregor, 1950; Tuttle, Baker and Abbatiello 1976: *International Journal of Acarology*, 2: 95.

Diagnosis:

Peritreme hook; dorsal striae forming diamond shape pattern, dorsal striae with obvious lobes; tarsus I with sockets of 0-2 tactile setae in line with the socket of the proximal duplex setae, 2-4 tactile setae just proximal to socket of proximal duplex setae; tarsus III with 1 proximal tactile seta; empodia with 6 proximoventral hairs; spurs on empodium I-IV minute (Seeman and Beard, 2011).

Description of *Tetranychus marianae***Male:**

2 males measured, 314–378 µm long (including gnathosoma).

Dorsum:

Dorsal body setae short, subequal in length, sc1 the longest. With the exception of sc2 and c3 setae, dorsal setae widened in their proximal portion, sc1 and the four pairs of dorsocentral setae the most widened, f2 and h1 setae poorly widened proximally: v2 28 (29-31); sc1 33 (32-35); sc2 23 (22-23); c1 28 (31-32); c2 22 (23-

27); c3 26 (25); d1 28 (29-31); d2 22 (23-27); e1 25 (26-28); e2 21 (21-24); f1 25 (25-28); f2 23 (21-23); h1 22 (22-25).

Gnathosoma:

Palptarsus terminal sensillum between two and two and half times as long as broad, 4.7-5 μm long, 1.9-2.5 μm wide. Peritreme hooked distally.

Venter:

Ventral striae without lobes.

Legs:

Leg chaetotaxy are as follows:

- I 2 – 1 – 10 [9] – 5[4] – 7 + (2) – 10 + (1) + 2 duplexes;
- II 2 – 1 – 6 – 5 – 5 + (1) – 9 + (1) + 1 duplex;
- III 1 – 1 – 2 – 3 – 4 – 7 + (1);
- IV 1 – 1 – 2 – 3/2 – 5 – 7 + (1).

One tactile setae proximal to proximal duplex on tarsus I, one solenidion at or near the level of proximal duplex. One tactile setae and one solenidion proximal to duplex of tarsus II.

Aedeagus:

Bent dorsad at a right angle with dorsal margin of the shaft, abruptly tapering, with acute tip pointing caudad.

Female:

4 females measured. Idiosoma: length 475 – 524 μm (including gnathosoma), width 260 – 285 μm .

Dorsum:

Dorsal body setae widened near the base, tapering distally not well exceeding base of seta next behind but barely reaching base or about as long as longitudinal interval to base of seta next behind (variations of 4 paratypes): v2 (50-53); sc1 (48-51); sc2 (41-44); c1 (44-49); c2 (41-45); c3 (56-58); d1 (46-49); d2 (42-45); e1 (44-48); e2 (42-44); f1 (44-46); f2 (44-46); h1 (49-52). Setae sc2 and c3 not widened proximally, obviously pubescent, h1 slightly broadened proximally and distally pubescent. Other dorsal setae widened proximally, e2 and f2 less widened basally. Distances between setae: c1-c1 44-49; d1-d1 46-49; e1-e1 44-48; c1-d1 44-48; d1-e1 43-49. Hysterosomal striation transverse with rounded to oblong lobes, most of them wider than tall.

Gnathosoma:

Palptarsus spinneret about 1.5 as long as broad, 5.2-5.4 μm long, 3.4-3.5 μm wide. Peritreme hooked distally.

Venter:

Ventral striation without lobes, genital flap and area immediately anterior to it bearing transverse striation. Two pairs of para-anal and two pairs of anal setae are present.

Legs:

Empodia I-IV similar, as in male.

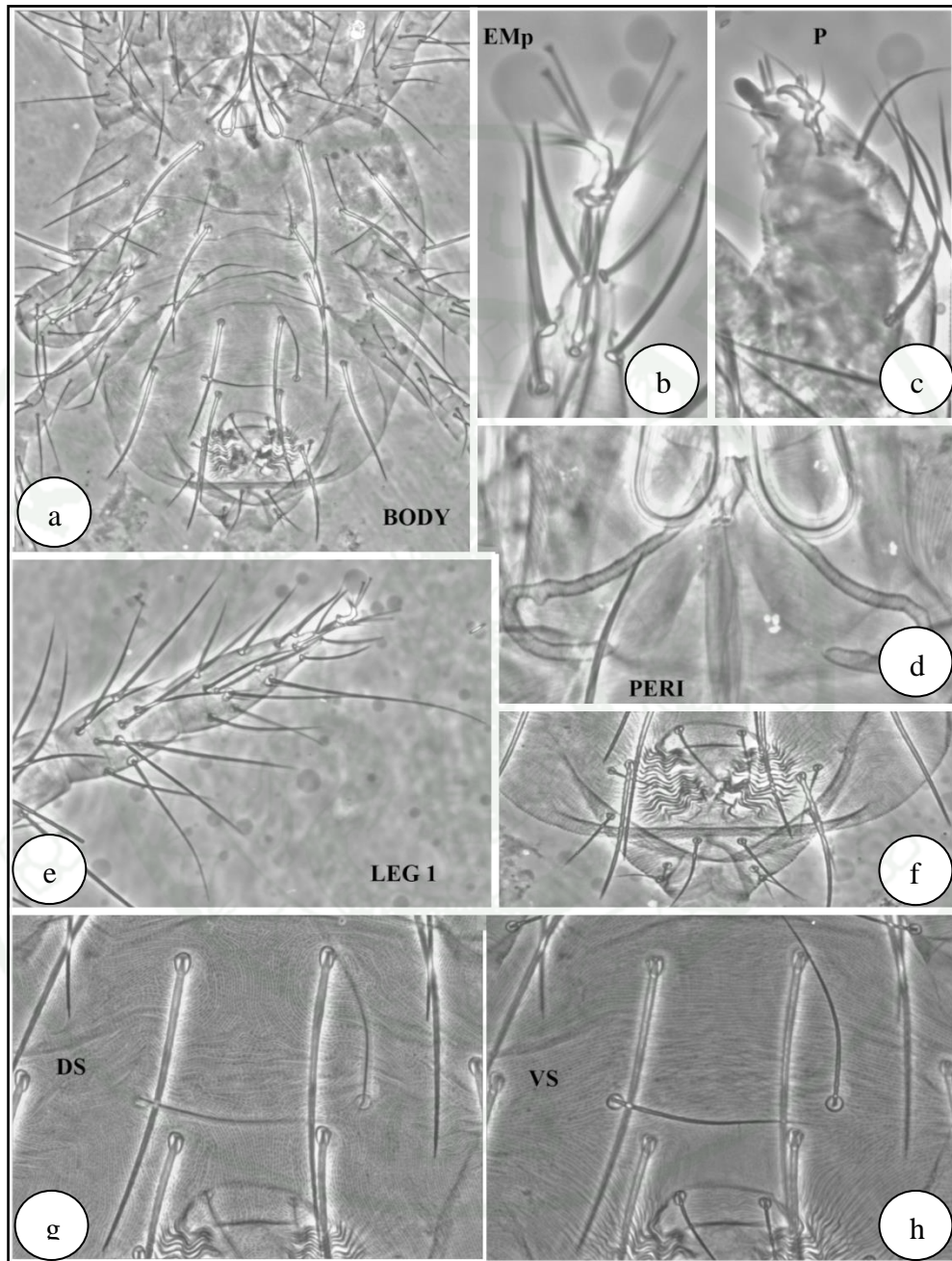


Figure 132 *Tetranychus marianae* McGregor, 1950: a) dorsum of female, b) empodium, c) palp, d) peritreme, e) leg I, f) genital flap, g) dorsum striation and h) ventral striation.

Leg chaetotaxy as follows:

- I 2 – 1 – 8 [9] – 5 – 7 + (1) – 10 + (1) + 2 duplexes;
 II 2 – 1 – 6 – 5 – 5 – 9 + 1 duplex;
 III 1 – 1 – 2 – 3 – 4 – 7 + (1);
 IV 1 – 1 – 2 – 3 – 5[4] – 7 + (1).

One tactile setae proximal to proximal duplex on tarsus I, one solenidion at or near the level of proximal duplex. One tactile setae proximal to duplex of tarsus II, no solenidion present.

Remarks:

This species was first described on *Argyreia* sp., *Passiflora foetida* in Marianas Northern (USA). This is the first record for the host plant *Passiflora foetida* L., in Thailand.

Host in Thailand:

Zea mays L., *Gliricidia sepium* (Jacq.) Walp., *entrosema pubescens* Benth., *Ipomoea aquatica* Forssk., *Bambusa* sp., *Manihot esculenta* Crantz, *Alocasia cucullata* (Lour.) G. Don, *Morus alba* L. (A. Chandrapatya – mite lists Tetranychidae in Thailand in Thai language).

Distribution in Thailand:

Chatuchak, Bangkok

Distribution in other countries:

Australia, Fiji, Guam (USA), Marianas Northern (USA), New Caledonia (France), Papua New Guinea, Samoa (American), Solomon Is., Vanuatu, Mexico,

United States, Argentina, Bahamas, Colombia, Costa Rica, Cuba, Guadeloupe (France), Nicaragua, Puerto Rico (USA), Philippines, Thailand, Vietnam.

Specimens examined:

Three ♀♀ and 3 ♂♂ on *Passiflora foetida* (L.) Corr. (Passifloraceae), Nakhom Pathom province, Thailand, 23/4/2011, Leg. H.H. Naing, and P. Maneesakorn.

***Tetranychus (Tetranychus) occultaspina* sp. nov. Naing & Auger
(Figures 133-135)**

Type specimens:

Holotype (male), 5 male and 7 female paratypes on 13 preparations from *Ipomoea aquatica* Forssk. (Convolvulaceae), Kasetsart University campus, Khet Bangkok, Bangkok, Thailand, 05/08/2011, Leg. H. H. Naing. Holotype, 3 male and 5 female paratypes deposited in the the Insect museum of Department of Entomology, Faculty of Agriculture, Kasetsart University, Bangkok 10900, Thailand; 2 males and 2 females deposited in the collection of the Centre de Biologie et de Gestion des Populations (CBGP), coll. Auger-Migeon N° 1821-1824, 34988 Montferrier-sur-Lez, France.

Diagnosis:

This species is a *Tetranychus sensu stricto* assigned into the ninth group as defined by Flechtmann and Knihinicki (2002). Females bear four tactile setae proximal to the proximal pair of duplex setae and the female empodia have no dorsomedian spur. Among *Tetranychus (T.)* belonging to this group, this species is distinctive by the shape of the aedeagus which has a shaft slightly upturned ending in a knob whose axis forms an acute angle with that of the shaft.

Description of *Tetranychus (Tetranychus) occultaspina* sp. nov. Naing & Auger

Male:

Holotype (415 μm long including gnathosoma). Five paratypes measured, 400–425 μm long, (including gnathosoma).

Dorsum:

Dorsal body setae long, linear lanceolate, well surpassing in length distance between consecutive bases (length of holotype and variations of 5 paratypes): v_2 48 (48-53); sc_1 105 (99-107); sc_2 69 (69-74); c_1 93 (91-100); c_2 94 (78-96); c_3 81 (77-82); d_1 94 (87-94); d_2 95 (91-95); e_1 87 (82-86); e_2 89 (89-93); f_1 63 (56-69); f_2 45 (43-48); h_1 26 (23-27). There are no lobes on the dorsal striation.

Gnathosoma:

Palptarsus terminal sensillum about 2.5 times as long as broad, 5.5-6 μm long, 2.3-2.6 μm wide. Peritreme hooked distally.

Venter:

Ventral striae without lobe.

Legs:

Empodium I bifid each side composed of one claw-like digit. Large mediodorsal spur present, about three-quarter the length of the appendages, difficult to see in a perfect lateral view because concealed by claw like digits. Empodia II, III and IV without dorsal spurs and with three pairs of proximoventral hairs. Leg chaetotaxy as follows:

I 2 – 1 – 10 [9] – 5 – 9 + (4) – 13 + (3) + 2 duplexes;

- II 2 – 1 – 5 – 5 – 7 – 13 + (1) + 1 duplex;
 III 1 – 1 – 4 – 4 – 6 – 9 + (1);
 IV 1 – 1 – 4 – 4 – 7 – 10 + (1).

Aedeagus:

Shaft of the aedeagus gradually narrows distally, slightly upturned. Neck short and wide, aedeagal knob axis forming an acute angle about 50° (range 43° – 52°, 5 males measured) with the axis of the shaft. Knob large 4.2 (3.9 - 4.3 μm), on average 1.7 times the width of the “neck” 2.9 (2.1 - 2.9 μm), asymmetrical with a poorly developed posterior rounded projection and a well-developed anterior rounded projection anterodorsally directed. Dorsal margin of the knob undulate.

Female:

Five females measured. Idiosoma: length 505 – 544 μm (including gnathosoma), width 334 – 342 μm.

Dorsum:

Dorsal body setae lanceolate, longer than distances between bases of consecutive setae (variations of 5 paratypes): v_2 60-74; sc_1 138-156; sc_2 104-114; c_1 134-148; c_2 126-142; c_3 118-126; d_1 134-152; d_2 132-142; e_1 126-134; e_2 130-142; f_1 112-120; f_2 96-100; h_1 42-46. Propodosomal striation longitudinal with rounded and oblong lobes becoming triangularly rounded and triangular near the dorso-hysterosomal setae. Hysterosomal striation transverse except between the bases of setae e_1 and f_1 (longitudinal) forming a diamond-shaped pattern between these setae, with lobes triangular, as tall as broad to taller than broad.

Gnathosoma:

Palpus with spinneret about one and a half as long as broad. Peritreme hooked distally.

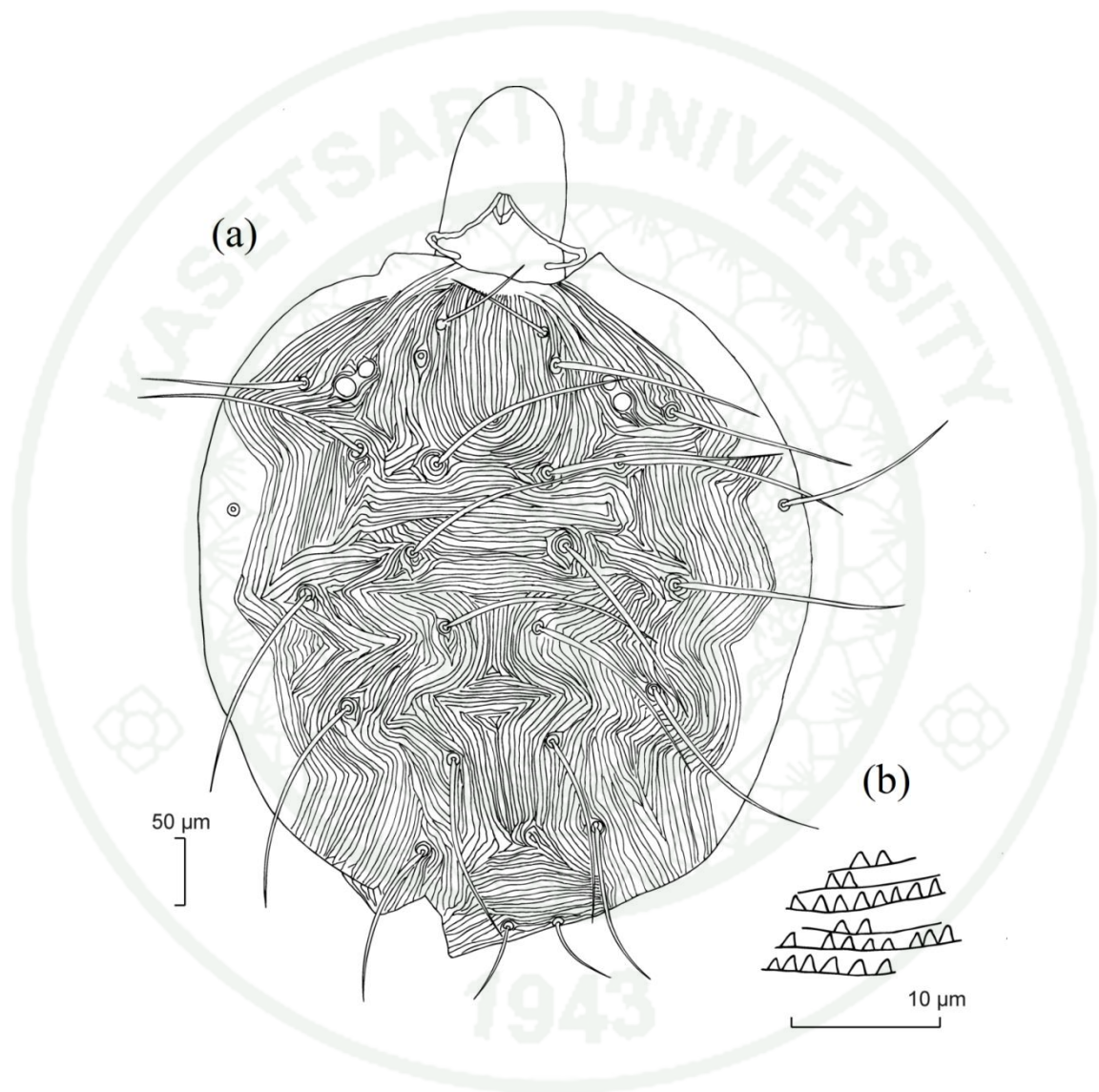


Figure 133 *Tetranychus (T.) occultaspina* sp. nov., female: a) dorsal aspect and b) triangular lobes on dorsal striae.

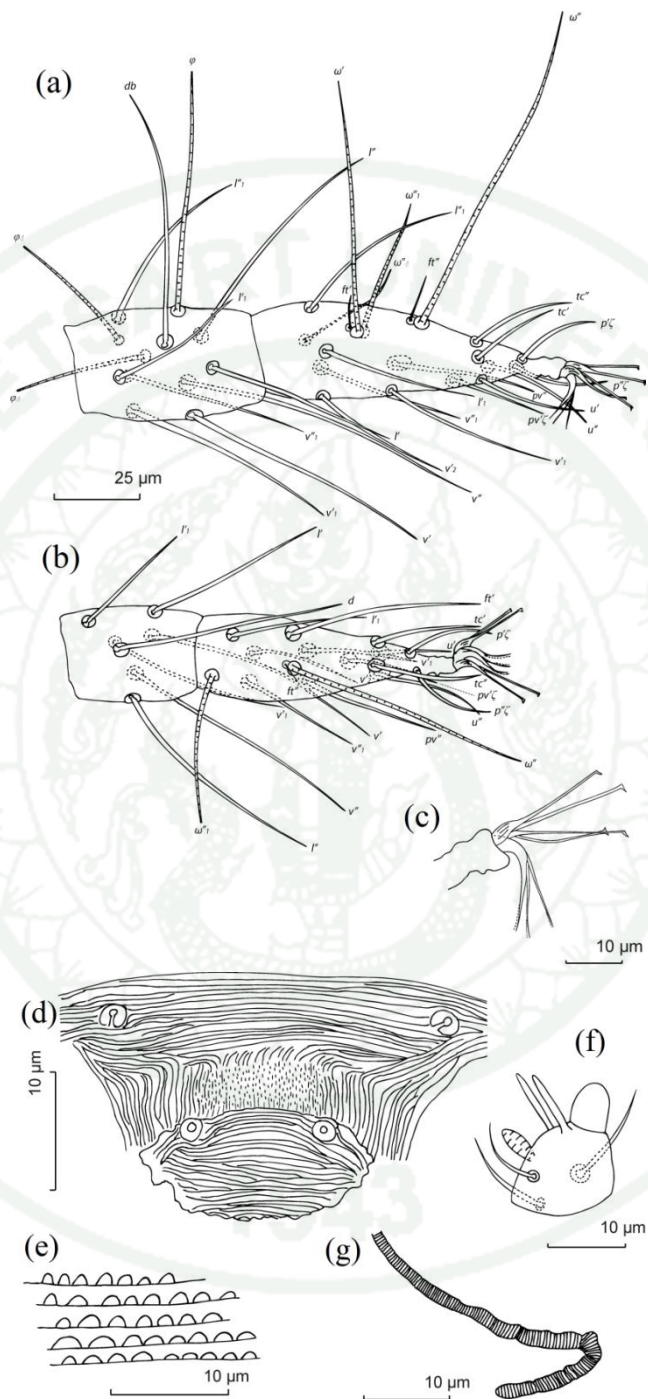


Figure 135 *Tetranychus (T.) occultaspina* sp. nov., female: a) tarsus and tibia I, b) tarsus and tibia II, c) empodium, d) flap and anterogenital area, e) lobes on ventral striation, (f) palptarsus and g) peritreme.

Venter:

Ventral striation with rounded lobes, broader than tall, a few oblong lobes also present. Area immediately anterior to genital flap with broken longitudinal striation, becoming dotted striation medially. Genital flap with transverse slightly arched striae. One pair of para-anal and two pairs of anal setae are present.

Legs:

Empodia I-IV bear three pairs of proximoventral hairs and no spur was observed.

Leg chaetotaxy as follows:

- I 2 – 1 – 10 – 5 – 9 + (1-3) – 13 + (1-3) + 2 duplexes;
 II 2 – 1 – 6 – 5 – 7 – 13 + (1) + 1 duplex;
 III 1 – 1 – 4 – 4 – 6 – 9 + (1);
 IV 1 – 1 – 4 – 4 – 7 – 10 [9 - 11] + (1).

Tarsus I with four tactile setae and up to two additional solenidia proximal to proximal duplex setae. One solenidion at or near the level of proximal duplex. Tibia I with up to three solenidia instead of one as usually observed in this group.

Etymology:

The species designation, “*occultaspina*”, is taken from Latin adjective and noun meaning hidden spine, and refers to the spur of male empodium I which is almost invisible when the empodium is observed in a perfect lateral view.

Biological observations:

The adult females are red in colour to dark red, darkening with age and produce silk. The adult males are yellowish brown and the eggs are pale amber in colour turning into dark orange/brownish-red before hatching.

Remarks:

Among the *Tetranychus* of the 9th group defined by Flechtmann and Knihinicki (2002) (including ungrouped species that bear 4 tactile setae proximal to the proximal duplex setae on tarsus I), *T. occultaspina* aedeagus is quite close to those of *Tetranychus bellottii* Flechtmann, *Tetranychus neocaledonicus* André, *Tetranychus puschelii* Meyer, *Tetranychus afrindicus* Nassar & Ghai, *Tetranychus papayae* Nassar & Ghai and *Tetranychus ismaili* Yusof & Zhang. *Tetranychus occultaspina* can be distinguished from *T. bellottii* by its anterior aedeagal angulation which is rounded vs. acute in *T. bellottii* and by the angle formed between the knob axis and the shaft axis which is greater in *T. occultaspina*. The aedeagus of *T. occultaspina* differs from those of *T. neocaledonicus* and *T. puschelii* by the shape of its aedeagal knob which is more flattened with a dorsal margin not indented but undulated. It can be separated from *T. afrindicus* and *T. papayae* according to the shape of its aedeagal anterior projection which is rounded whereas angulate in the two others species and by the angle formed between the knob axis and the shaft axis. In *T. ismaili* aedeagal projections are acute whereas rounded in *T. occultaspina*.

Tarsal and tibial foreleg female chaetotaxy of *T. occultaspina* is characterised by the possible presence of additional solenidia: one to two on tarsus I (proximal to the proximal duplex) and one to two on tibia I. This unusual chaetotaxy is not specific to *T. occultaspina*. Indeed, polychaete forms have already been reported in some strains of *Tetranychus* species belonging to the 9th group (Auger *et al.* 2013). It is known to occur in the two colour forms (green and red) of *Tetranychus urticae* Koch and also in *Tetranychus gloveri* Banks (e. g. McGregor (1950); Boudreaux (1956;1958)).

***Tetranychus piercei* McGregor, 1950 (Figure 136)**

Tetranychus piercei McGregor, 1950; McGregor, 1950: *American Midland Naturalist*, 44: 299, figs. 7, pl. 6, fig. 13.

Tetranychus piercei McGregor, 1950; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 431, figs. 385.

Tetranychus piercei McGregor, 1950; Rimando, 1962: *Univ. Philippines Col. Agric. Techn. Bul.*, 11: 28, figs. 12.

Tetranychus piercei McGregor, 1950; Ehara, 1966b: *Journal of the Faculty of Sciences, Hokkaido University, Series VI, Zoology*, 16: 20, figs. 50-52.

Tetranychus piercei McGregor, 1950; Ehara, 1969c: *The Journal of the Faculty of Education, Tottori University, Natural Science*, 20: 100, figs. 71-72.

Tetranychus manihotis Flechtmann, 1981; Flechtmann (1981): *International Journal of Acarology*, 7: 84.

Tetranychus manihotis Flechtmann, 1981; Flechtmann (1981): *International Journal of Acarology*, 7: 84.

Tetranychus manihotis Flechtmann, 1981; Bolland, Gutierrez & Flechtmann (1998): *Leiden, Brill Academic Publishers*: 206.

Tetranychus (Tetranychus) piercei McGregor, 1950; Tseng (1990): *Taiwan Museum Special Publication Series*, 9: 201.

Diagnosis:

Peritreme hook; dorsal striae forming diamond shape pattern, dorsal striae with lobes; tarsus I usually with sockets of 4 tactile setae proximal to the socket of the proximal duplex setae, occasionally socket of 1 tactile setae overlapping with the level of socket of the proximal duplex setae; tarsus III with 1 proximal tactile seta, empodium with 6 proximoventral hairs, empodium I-IV each with minute or absent dorsal spur (Seeman and Beard, 2011).

Description of *Tetranychus piercei*

Male:

2 males measured, 314–378 μm long (including gnathosoma).

Dorsum:

Dorsal body setae short, subequal in length, sc_1 the longest. With the exception of sc_2 and c_3 setae, dorsal setae widened in their proximal portion, sc_1 and the four pairs of dorsocentral setae the most widened, f_2 and h_1 setae poorly widened proximally: v_2 28 (29-31); sc_1 33 (32-35); sc_2 23 (22-23); c_1 28 (31-32); c_2 22 (23-27); c_3 26 (25); d_1 28 (29-31); d_2 22 (23-27); e_1 25 (26-28); e_2 21 (21-24); f_1 25 (25-28); f_2 23 (21-23); h_1 22 (22-25).

Gnathosoma:

Palptarsus terminal sensillum between two and two and half times as long as broad, 4.7-5 μm long, 1.9-2.5 μm wide. Peritreme hooked distally.

Venter: Ventral striae without lobes.

Legs:

Empodia I-IV similar, composed of two claws without appendant hairs. Leg chaetotaxy are as follows:

- I 2 – 1 – 10 [9] – 5[4] – 7 + (2) – 10 + (1) + 2 duplexes;
- II 2 – 1 – 6 – 5 – 5 + (1) – 9 + (1) + 1 duplex;
- III 1 – 1 – 2 – 3 – 4 – 7 + (1);
- IV 1 – 1 – 2 – 3/2 – 5 – 7 + (1).

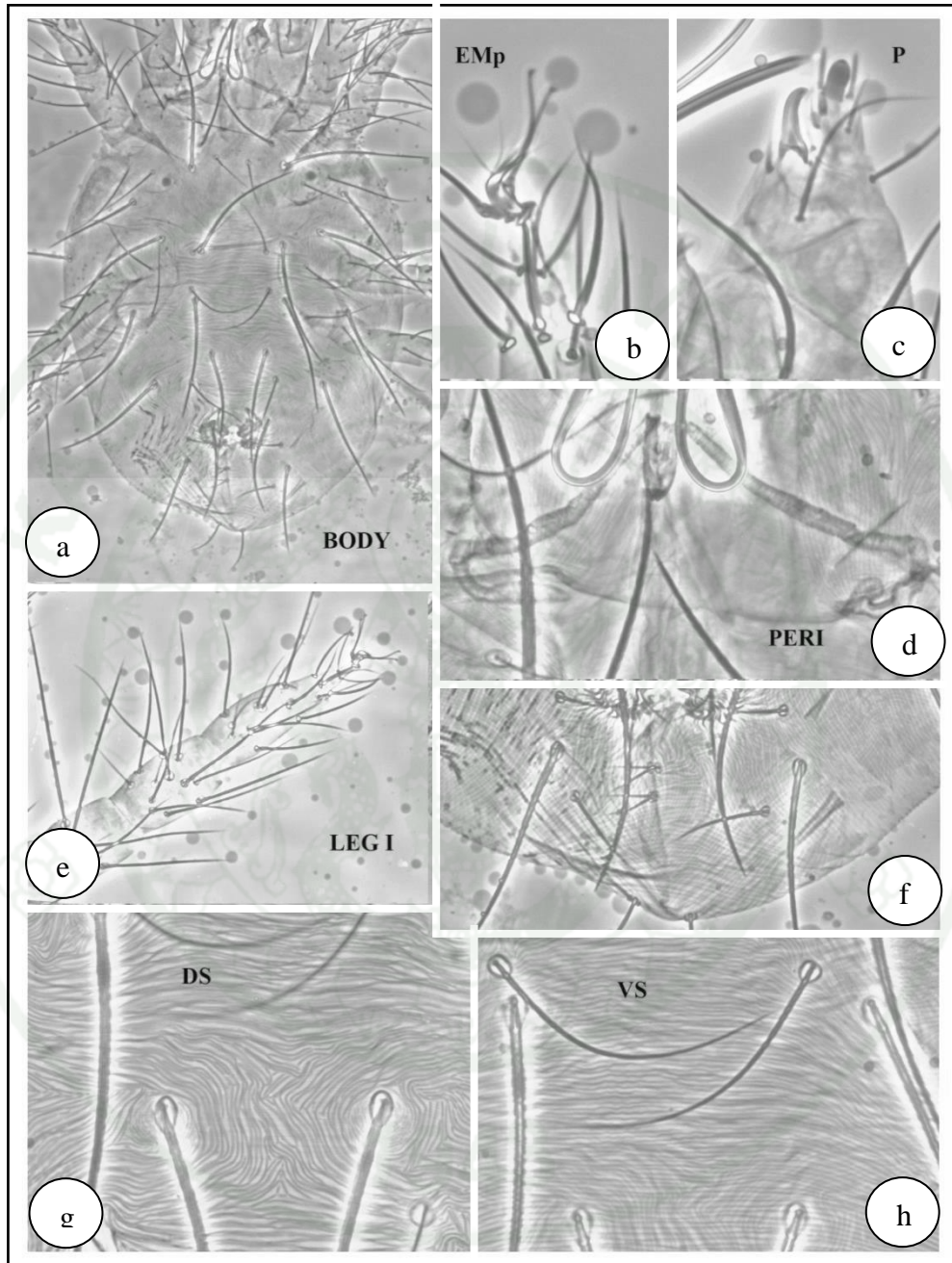


Figure 136 *Tetranychus piercei* McGregor, 1950: a) dorsum of female, b) empodium, c) palp, d) peritreme, e) leg I, f) genital flap, g) dorsum striation and h) ventral striation.

One tactile setae proximal to proximal duplex on tarsus I, one solenidion at or near the level of proximal duplex. One tactile setae and one solenidion proximal to duplex of tarsus II.

Aedeagus:

Bent dorsad at a right angle with dorsal margin of the shaft, abruptly tapering, with acute tip pointing caudad.

Female:

4 females measured. Idiosoma: length 475 – 524 μm (including gnathosoma), width 260 – 285 μm .

Dorsum:

Dorsal body setae widened near the base, tapering distally not well exceeding base of seta next behind but barely reaching base or about as long as longitudinal interval to base of seta next behind (variations of 4 paratypes): v_2 (50-53); sc_1 (48-51); sc_2 (41-44); c_1 (44-49); c_2 (41-45); c_3 (56-58); d_1 (46-49); d_2 (42-45); e_1 (44-48); e_2 (42-44); f_1 (44-46); f_2 (44-46); h_1 (49-52). Setae sc_2 and c_3 not widened proximally, obviously pubescent, h_1 slightly broadened proximally and distally pubescent. Other dorsal setae widened proximally, e_2 and f_2 less widened basally. Distances between setae: c_1 - c_1 44-49; d_1 - d_1 46-49; e_1 - e_1 44-48; c_1 - d_1 44-48; d_1 - e_1 43-49. Hysterosomal striation transverse with rounded to oblong lobes, most of them wider than tall.

Gnathosoma:

Palptarsus spinneret about 1.5 as long as broad, 5.2-5.4 μm long, 3.4-3.5 μm wide. Peritreme hooked distally.

Venter:

Ventral striation without lobes, genital flap and area immediately anterior to it bearing transverse striation. Two pairs of para-anal and two pairs of anal setae are present.

Legs:

Empodia I-IV similar, as in male.

Leg chaetotaxy as follows:

- I 2 – 1 – 8 [9] – 5 – 7 + (1) – 10 + (1) + 2 duplexes;
 II 2 – 1 – 6 – 5 – 5 – 9 + 1 duplex;
 III 1 – 1 – 2 – 3 – 4 – 7 + (1);
 IV 1 – 1 – 2 – 3 – 5[4] – 7 + (1).

One tactile setae proximal to proximal duplex on tarsus I, one solenidion at or near the level of proximal duplex. One tactile setae proximal to duplex of tarsus II, no solenidion present.

Biological observations:

Body of female rounded, bright red in colour. The eggs are yellowish red and rounded.

Remarks:

This mite was first described from *Clitoria ternatea* in Philippines (McGregor, 1950). It was discovered in Thailand by Baker (1975) on the same host plant grown in Bangkok. Presently, this mite was found on more than 80 different host plants in several countries.

Host in Thailand:

Clitoria ternatea

Distribution in Thailand:

Bangkok

Distribution in other countries:

China, Indonesia, Japan, Korea, Malaysia, Philippines, Surinam, Taiwan, Vietnam.

Specimens examined:

Seven ♀♀ and 11 ♂♂ on cassava, *Manihot esculenta* L. (Euphorbiaceae), Rayong, Thailand, 9/5/2010, Leg. H.H. Naing, A. Chandrapatya, P. Konvipasruang.

Three ♀♀ and 5 ♂♂ on butterfly pea, *Clitoria ternatea* L. (Fabaceae), Ram Intra, Bangkok, Thailand, 23/5/2011, Leg. H.H. Naing.

Two ♀♀ and 3 ♂♂ on Indian acalypha, *Acalypha indica* Linn. (Euphorbiaceae), Kasetsart University Campus, Khet Bangkhen, Bangkok, Thailand, 8/6/2010, Leg. H.H. Naing and A. Chandrapatya.

***Tetranychus (Tetranychus) truncatissimus* sp. nov. Naing & Auger
(Figures 137-140)**

Type specimens:

Holotype (male), 2 males and 9 females on 12 preparations from *Bambusa multiplex* (Lour.) Raeusch. ex Schult. (Poaceae), Chatuchak District, Bangkok,

Thailand, 19/10/2010, Leg. H. H. Naing, A. Chandrapatya, P. Maneesakorn.
 Holotype, 1 male and 8 female paratypes deposited in the Insect museum of
 Department of Entomology, Faculty of Agriculture, Kasetsart University, Bangkok
 10900, Thailand; 1 male and 1 females deposited in the collection of CBGP, coll.
 Auger-Migeon N° 1825-1826, 34988 Montferrier-sur-Lez, France.

Diagnosis:

This species is a *Tetranychus* (*Tetranychus*) assigned into the sixth group (Flechtmann & Knihinicki 2002). In this group (female tarsus I with proximal pair of duplex setae in line with 3 tactile setae, one tactile setae proximal to proximal duplex and female empodium with dorsomedian spur obvious), this species can be separated from its allied species by the shape of the male aedeagus.

Description of *Tetranychus* (*Tetranychus*) *truncatissimus* sp. nov.

Male:

Holotype 303 μm long, 2 males measured, (324–329) μm long (including gnathosoma).

Dorsum:

Dorsal body setae long (length of holotype and variations of 3 paratypes): v_2 44 (43-47); sc_1 82 (80); sc_2 55 (56-59); c_1 62 (66); c_2 62 (66-68); c_3 57 (65-66); d_1 68 (64-69); d_2 72 (66-68); e_1 60 (60-63); e_2 58 (63-68); f_1 38 (39-46); f_2 38 (35-38); h_1 20 (19). Lobes are present on dorsal striation (poorly developed in our mountings).

Gnathosoma:

Palptarsus terminal sensillum about 2.2 times as wide as broad, 4.5-4.6 μm long, 2-2.1 μm wide. Peritreme hooked distally.

Venter:

Ventral striae without lobes.

Legs:

Empodia I–IV each with obvious dorsal spur; more prominent in empodium I, smaller in empodium II and less prominent in empodia III and IV. Empodium I claw-like (uncinate), empodia II–IV each with proximoventral hairs long and free. Leg chaetotaxy as follows:

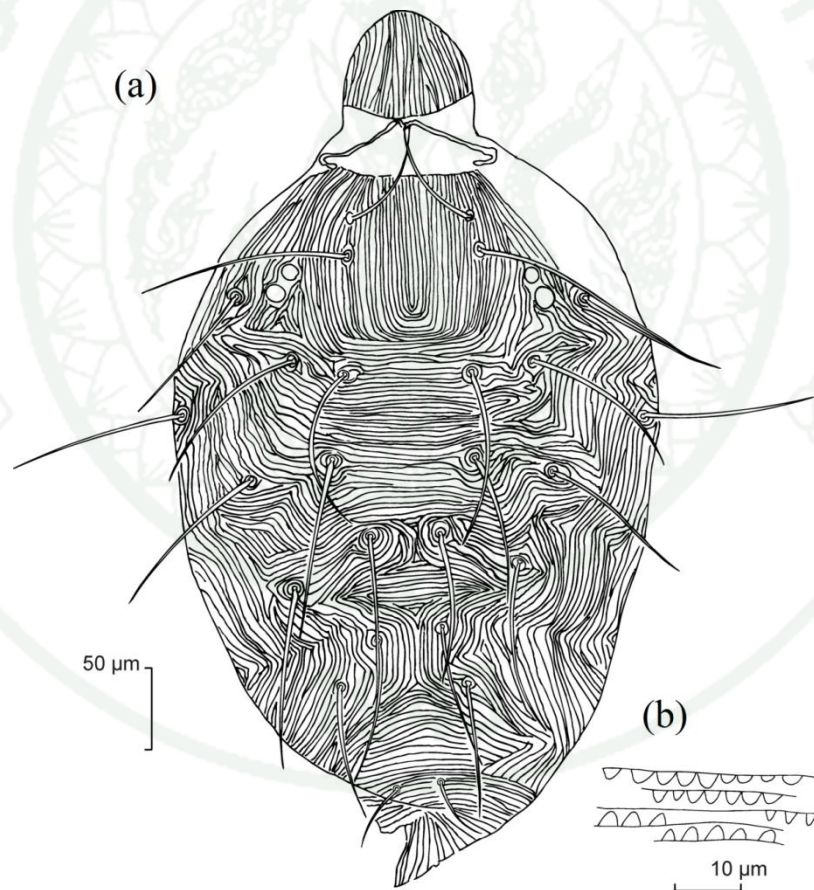


Figure 137 *Tetranychus truncatissimus* sp. nov., female: a) dorsal aspect and b) lobes on dorsal striae.

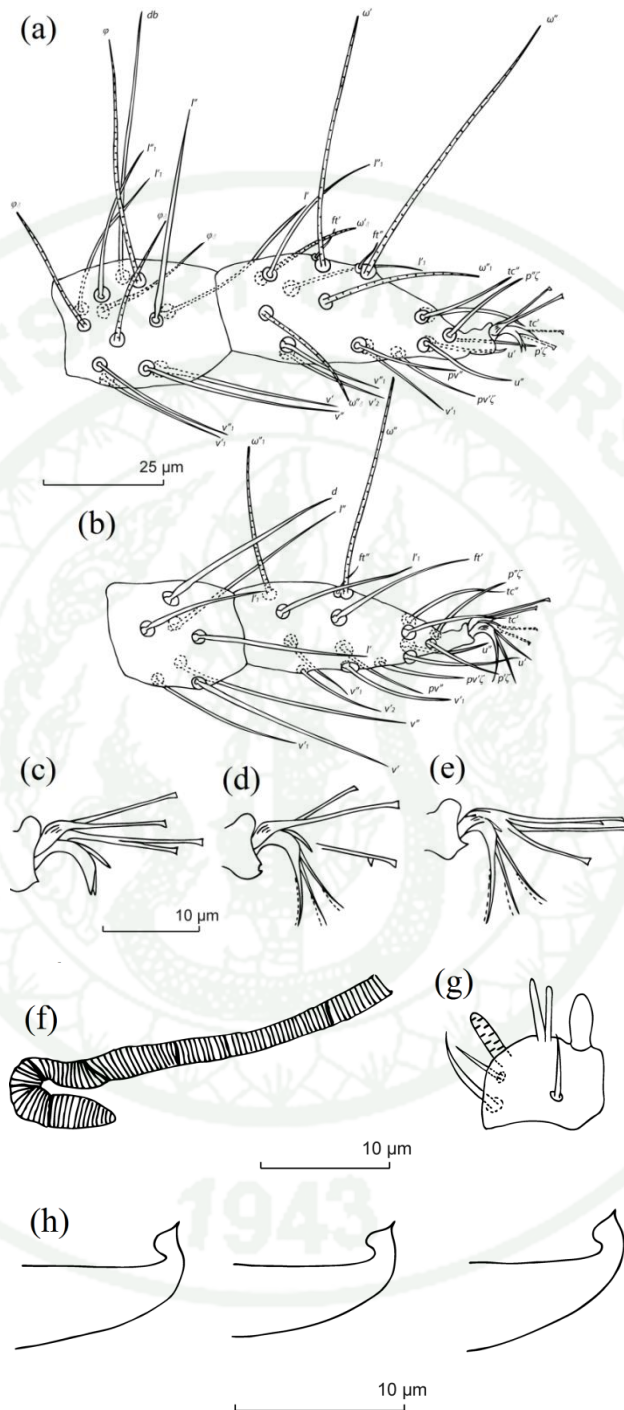


Figure 138 *Tetranychus truncatissimus* sp. nov., male: a) tarsus and tibia I, b) tarsus and tibia II, c) empodium I, d) empodium II, e) empodia III–IV, f) peritreme, g) palptarsus and h) aedeagi (variations).

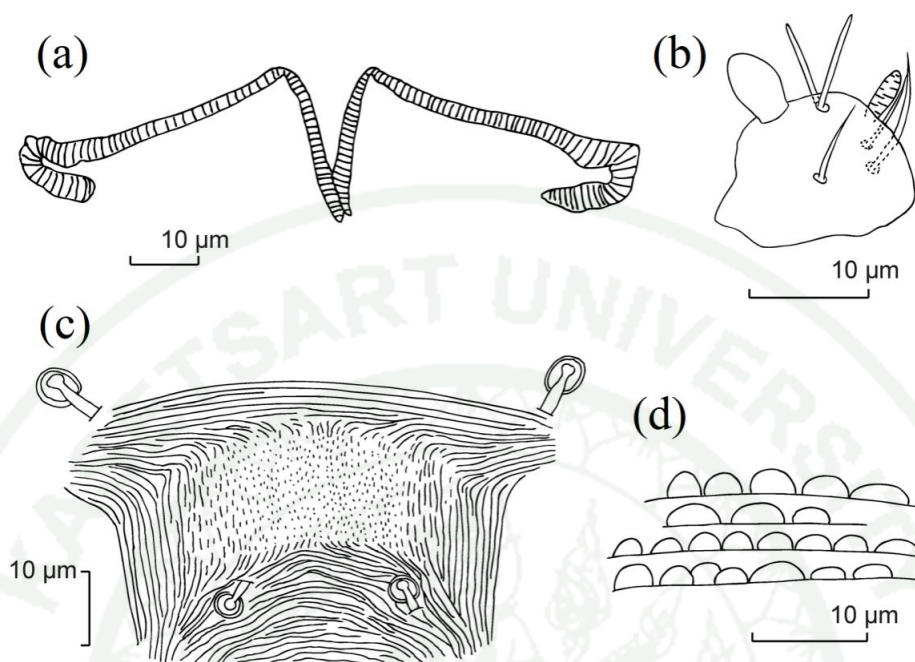


Figure 140 *Tetranychus truncatissimus* sp. nov., female: a) peritreme, b) palptarsus, c) flap and antero-genital area and d) lobes on ventral striation.

- I 2 - 1 - 10 - 5 - 9 + (4) - 13 + (3) + 2 duplexes;
 II 2 - 1 - 6 - 5 - 7 - 13 + (1) + 1 duplex;
 III 1 - 1 - 4 - 4 - 6 - 9 + (1);
 IV 1 - 1 - 4 - 4 - 7 - 10 + 1.

Aedeagus:

Aedeagal shaft bent dorsad at nearly a right angle. Neck very short. Axis of the aedeagal knob forming an angle about 40° with the dorsal margin of the shaft. Aedeagal knob small (1,9 µm in holotype), asymmetrical, with rounded anterior projection and pointed duck-beak like posterior projection posterodorsally directed. Shallow depression present on the dorsal margin of the knob between the two projections.

Female

9 females measured. Idiosoma: length 407-500 μm including gnathosoma, width 240-295 μm .

Dorsum:

Dorsal body setae lanceolate, longer than distances between bases of consecutive setae (variations of 9 paratypes): v_2 64-71; sc_1 114-127; sc_2 79-94; c_1 97-116; c_2 92-112; c_3 90-107; d_1 95-114; d_2 96-115; e_1 88-112; e_2 91-115; f_1 77-97; f_2 70-83; h_1 37-46. Propodosomal striation longitudinal, hysterosomal striation transverse except between the bases of e_1 and f_1 setae (longitudinal) leads to form a diamond-shaped pattern between these setae. Lobes on prodorsal striation rounded, dorsal hysterosomal striae with rounded to triangularly rounded lobes as tall as broad, wider caudally.

Gnathosoma:

Palpus with spinneret about one and a half times as long as broad. Peritreme hooked distally.

Venter:

Genital flap with transverse striation. Area immediately anterior to genital flap with broken longitudinal striae. Rounded lobes present on ventral striation, broader than tall, wider medially.

Legs:

Empodia I-IV each with obvious dorsal spur, more prominent in empodium I (about three quarters the length of proximoventral hairs), smaller in empodium II and

gradually less prominent in empodia III and IV. Empodia I-IV each with proximoventral hairs long and free.

Leg chaetotaxy as follows:

- I 2 – 1 – 10 – 5 – 9 + (1) – 13 + (1) + 2 duplexes;
 II 2 – 1 – 6 – 5 – 7 – 13 + (1) + 1 duplex;
 III 1 – 1 – 4 – 4 – 6 – 9 + (1);
 IV 1 – 1 – 4 – 4 – 7 – 10 + (1).

Tarsus I with 1 tactile setae proximad to proximal duplex setae, 3 tactile setae more or less in line with the proximal duplex, one solenidion at or near the level of proximal duplex.

Etymology:

The name of the species is the Latin superlative of the species name of *T. truncatus*, meaning the most truncate.

Biological observations:

Mites are located on the lower surface of the leaf. The adult females are pale yellow in colour with a pair of dark feeding spots. They produce silk and laid translucent eggs becoming yellowish with age. The males and the juvenile stages are also pale yellow.

Remarks:

This new species can be easily separated from other species belonging to the 6th group of *Tetranychus* (Flechtmann & Knihinicki 2002) by the shape of its aedeagus. However its aedeagus resembles to those of two species that belong to the 8th group and one belonging to the 9th group: *Tetranychus gloveri* Banks, *Tetranychus tumidus* Banks and *Tetranychus merganser* Boudreaux respectively. *Tetranychus*

truncatissimus is easily distinguishable from these species by: 1) its body colour, yellow versus red or carmine, 2) the setal arrangement on the female foretarsus; 3) the size of the female empodial spurs, well developed in *T. truncatissimus* versus absent, tiny or small in the above mentioned species; 4) the aedeageal knob, small, posterodorsally directed with an angle of 45° with the axis of the shaft and with a very short neck. With the exception of the tarsus setal arrangement, the body colour and the development of dorsomedian spurs, *T. truncatissimus* resembles to *Tetranychus truncatus* Ehara by the shape of its aedeagus. However, in *T. truncatissimus* the aedeagal hook is shorter than in *T. truncatus* which was already described as having a hook truncate.

***Tetranychus truncatus* Ehara, 1956 (Figure141)**

Tetranychus truncatus Ehara, 1956; Ehara, 1956: *Journal of the Faculty of Sciences, Hokkaido University, Series VI, Zoology, 12*: 507, figs.28-31.

Tetranychus truncatus Ehara, 1956; Rimando, 1962: *Univ. Philippines Col. Agric. Techn. Bul.*, 11: 31, figs.12

Tetranychus truncatus Ehara, 1956; Ehara, 1963b: : *Japanese Journal of Applied Entomology & Zoology, 7*: 231, figs.16-19.

Tetranychus truncatus Ehara, 1956; Ehara, 1969c: *The Journal of the Faculty of Education, Tottori University, Natural Science, 20*: 99, figs.70.

Tetranychus truncatus Ehara, 1956; Ehara and Wongsiri, 1975: *Mushi* 48: 182, figs.117-119.

Tetranychus truncatus Ehara, 1956; Wang, 1981: *Econ. Insect Fauna China, Science Press, 23*: 118, figs.99e, 101g, h, pl. i, fig. 6.

Diagnosis:

Peritreme hook; dorsal striae forming diamond shape; ventral striae without lobes; tarsus I with sockets of 4 tactile setae proximal to the socket of the proximal

duplex setae; tarsus III with 1 proximal tactile seta, empodium with 6 proximoventral hairs; empodium I-IV each with a minute spur; (Seeman and Beard, 2011).

Description of *Tetranychus truncatus*

Male:

2 males measured, 314–378 μm long (including gnathosoma).

Dorsum:

Dorsal body setae short, subequal in length, sc_1 the longest. With the exception of sc_2 and c_3 setae, dorsal setae widened in their proximal portion, sc_1 and the four pairs of dorsocentral setae the most widened, f_2 and h_1 setae poorly widened proximally: v_2 28 (29-31); sc_1 33 (32-35); sc_2 23 (22-23); c_1 28 (31-32); c_2 22 (23-27); c_3 26 (25); d_1 28 (29-31); d_2 22 (23-27); e_1 25 (26-28); e_2 21 (21-24); f_1 25 (25-28); f_2 23 (21-23); h_1 22 (22-25).

Gnathosoma:

Palptarsus terminal sensillum between two and two and half times as long as broad, 4.7-5 μm long, 1.9-2.5 μm wide. Peritreme hooked distally.

Venter:

Ventral striae without lobes.

Legs:

Leg chaetotaxy are as follows:

I 2 – 1 – 10 [9] – 5[4] – 7 + (2) – 10 + (1) + 2 duplexes;

II 2 – 1 – 6 – 5 – 5 + (1) – 9 + (1) + 1 duplex;

- III 1 – 1 – 2 – 3 – 4 – 7 + (1);
 IV 1 – 1 – 2 – 3/2 – 5 – 7 + (1).

One tactile setae proximal to proximal duplex on tarsus I, one solenidion at or near the level of proximal duplex. One tactile setae and one solenidion proximal to duplex of tarsus II.

Aedeagus:

Bent dorsad at a right angle with dorsal margin of the shaft, abruptly tapering, with acute tip pointing caudad.

Female:

4 females measured. Idiosoma: length 475 – 524 μm (including gnathosoma), width 260 – 285 μm .

Dorsum:

Dorsal body setae widened near the base, tapering distally not well exceeding base of seta next behind but barely reaching base or about as long as longitudinal interval to base of seta next behind (variations of 4 paratypes): v_2 (50-53); sc_1 (48-51); sc_2 (41-44); c_1 (44-49); c_2 (41-45); c_3 (56-58); d_1 (46-49); d_2 (42-45); e_1 (44-48); e_2 (42-44); f_1 (44-46); f_2 (44-46); h_1 (49-52). Setae sc_2 and c_3 not widened proximally, obviously pubescent, h_1 slightly broadened proximally and distally pubescent. Other dorsal setae widened proximally, e_2 and f_2 less widened basally. Distances between setae c_1-c_1 44-49; d_1-d_1 46-49; e_1-e_1 44-48; c_1-d_1 44-48; d_1-e_1 43-49. Hysterosomal striation transverse with rounded to oblong lobes, most of them wider than tall.

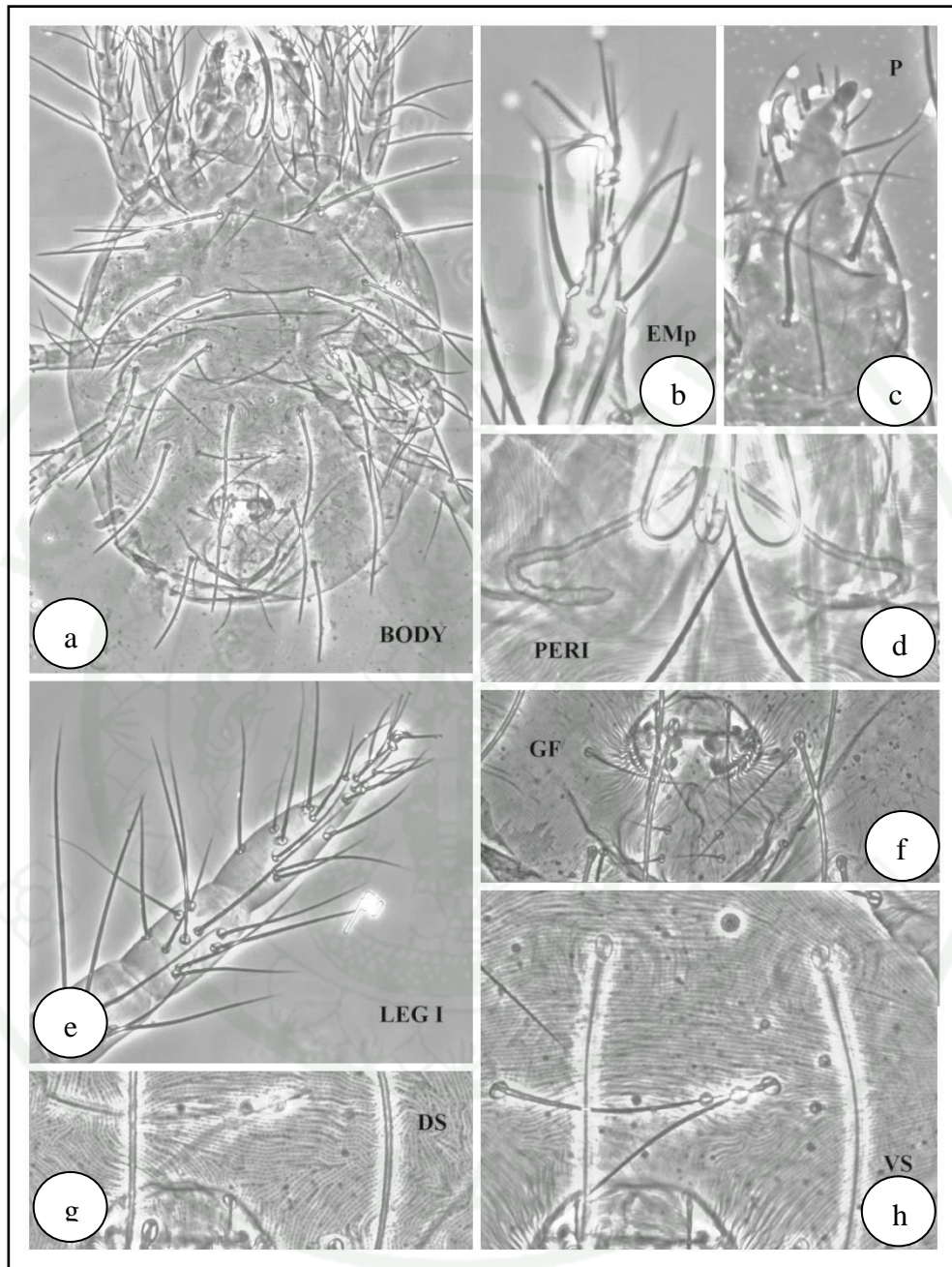


Figure 141 *Tetranychus truncatus* Ehara, 1956: a) dorsum of female, b) empodium, c) palp, d) peritreme, e) leg I, f) genital flap, g) dorsum striation and h) ventral striation.

Gnathosoma:

Palptarsus spinneret about 1.5 as long as broad, 5.2-5.4 μm long, 3.4-3.5 μm wide. Peritreme hooked distally.

Venter:

Ventral striation without lobes, genital flap and area immediately anterior to it bearing transverse striation. Two pairs of para-anal and two pairs of anal setae are present.

Legs:

Empodia I-IV similar, as in male. Leg chaetotaxy as follows:

- I 2 – 1 – 8 [9] – 5 – 7 + (1) – 10 + (1) + 2 duplexes;
 II 2 – 1 – 6 – 5 – 5 – 9 + 1 duplex;
 III 1 – 1 – 2 – 3 – 4 – 7 + (1);
 IV 1 – 1 – 2 – 3 – 5[4] – 7 + (1).

One tactile setae proximal to proximal duplex on tarsus I, one solenidion at or near the level of proximal duplex. One tactile setae proximal to duplex of tarsus II, no solenidion present.

Biological observations:

These mites appear brown to reddish brown in colour in all stages. They occur on the underside of the leaves.

Remarks:

This mite was first described from *Morus alba* in Japan by Ehara (1956c). Baker (1975) reported the present of *T. truncatus* on 18 host plants in 2 provinces of

Thailand. In the same year Ehara and Wongsiri (1975) found this mite feed on 3 host plants in 3 provinces. At present, 80 host plants were reported as host plants for *T. truncatus* but only few of them are reported from Thailand. *Orchidaceae* sp. Charanasri, Saringkapaibul & Kongchuensin (1989).

Host in Thailand:

Achyranthes aspera, *Amaranthus gracilis*, *Carica papaya*, *Cassia fructose*, *Ceiba pentandra*, *Celosia argentea*, *Cucumis* sp., *Glycine max*, *Helianthus annuus*, *Ipomoea batatas*, *Ipomoea reptans*, *Manihot esculenta*, *Melia* sp., *Morus alba*, *Rosa* hybrid, *Ruellia* sp., *Solanum torvum*, *Spathiphyllum cannifolium*, *Zea mays*.

Distribution in Thailand:

Bangkok, Ratchaburi, Nakhon Pathom, Nakhon Ratchasima, Chiangmai, Rayong.

Distribution in other countries:

China, Guam, Indonesia, Japan, Korea, Marianas Islands, Philippines, Taiwan, Vietnam.

Specimens examined:

Three ♀♀ and 6 ♂♂ on black gram(Fabaceae), Khonkaen province, Thailand,8/2/2010, Leg. Dr. Nushiri from NBCRC, Thailand.

***Tetranychus urticae* Koch, 1836 (Figure 142)**

Tetranychus aduncus Flechtmann & Baker, 1967; Flechtmann and Baker, 1967: *Piracicaba, Brasil*: 20.

- Tetranychus aduncus* Flechtmann & Baker, 1967; Flechtmann and Baker, 1970: *Annals of the Entomological Society of America*, 63: 161.
- Epitetranychus aequans* Zacher, 1916; Zacher, 1916: *Mitt. Kais. Biol. Anst. Land-Forst.*, 16: 25.
- Epitetranychus aequans* Zacher, 1916; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 432.
- Epitetranychus alceae* Oudemans, 1928; Oudemans, 1928: *Entomologische Berichten, Amsterdam*, 7: 290.
- Epitetranychus alceae* Oudemans, 1928; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 432.
- Epitetranychus altheae* (von Hanstein, 1901); Zacher, 1916: *Mitt. Kais. Biol. Anst. Land-Forst.*, 16: 23.
- Epitetranychus altheae* (von Hanstein, 1901); Reck, 1950: *Trudy Zoologicheskogo Instituta Akademia Nauk Gruz.S.S.R.*, 9: 127.
- Tetranychus arabicus* Attiah, 1967; Attiah, 1967: *Bulletin de la Societe Entomologique D'Egypte*, 51: 8.
- Tetranychus arabicus* Attiah, 1967; Meyer, 1987: *Entomology Memoir, Department of Agriculture and Water Supply, Republic of South Africa*, 69: 136.
- Tetranychus aratica* Basu, 1963; Basu, 1963: *Proceedings of the Zoological Society of Calcutta*, 16: 223.
- Tetranychus aratica* Basu, 1963; Gupta and Gupta, 1994: *Memoirs of the Zoological Survey of India*, 18: 139.
- Tetranychus aspidistrae* Oudemans, 1931; Oudemans, 1931: *Entomologische Berichten, Amsterdam*, 8: 258.
- Tetranychus aspidistrae* Oudemans, 1931; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 432.
- Tetranychus bimaculatus* Harvey, 1892; Harvey, 1892: *Annual Report Maine Agricultural Experimental Station* : 133.

- Tetranychus bimaculatus* Harvey, 1892; Pritchard and Baker, 1955: Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 432.
- Epitetranychus caldarii* Oudemans, 1931; Oudemans, 1931: *Entomologische Berichten, Amsertdam*, 8: 194.
- Tetranychus (Epitetranychus) caldarii* Oudemans, 1931; Geijskes, 1939: *Mededeelingen van de Landbouwboogeschool, Wageningen*, 42: 40.
- Tetranychus caldarii* (Oudemans, 1931); Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 432.
- Tetranychus choisyae* Oudemans, 1931; Oudemans, 1931: *Entomologische Berichten, Amsertdam*, 8: 274.
- Tetranychus choisyae* Oudemans, 1931; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 432.
- Tetranychus cinnabarinus* (Boisduval, 1867); Boudreaux, 1956: *Annals of the Entomological Society of America*, 49: 46.
- Tetranychus (Tetranychus) cinnabarinus* (Boisduval, 1867); Tuttle and Baker, 1968: *Tuscon, Usa, The University of Arizona Press*: 129.
- Tetranychus cinnabarinus* (Boisduval, 1867); Dupont, 1979: *Entomologia Experimentalis et Applicata*, 25: 302.
- Tetranychus cucumeris* (Boisduval, 1867); Murray, 1877: *London, Chapman and Hall*: 102.
- Tetranychus cucumeris* (Boisduval, 1867); Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 432.
- Eotetranychus cucurbitacearum* Sayed, 1946; Sayed, 1946: 90.
- Tetranychus cucurbitacearum* Sayed, 1946; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 432.
- Tetranychus cucurbitacearum* (Sayed, 1946); Attiah, 1967: 9.

- Tetranychus dahliae* Oudemans, 1937; Oudemans, 1937: 1022.
- Tetranychus dahliae* Oudemans, 1937; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 432.
- Tetranychus dianthica* Dosse, 1952; Mitrofanov, Strunkova and Livshits, 1987: *SSR, I.o.Z.a.P.E.N.P.T., Dushanbe, Donish*: 129.
- Tetranychus dugesii* Cano & Alcacio, 1886; Cano and Alcacio, 1886: *Naturaleza*, 7: 197.
- Tetranychus dugesii* Cano & Alcacio, 1886; Estebanes-Gonzalez and Baker, 1968: *Anales de la Escuela Nacional de Ciencias Biologicas*, 15: 102.
- Tetranychus eriostemi* Murray, 1877; Murray, 1877: Murray, 1877: *London, Chapman and Hall*: 109.
- Tetranychus eriostemi* Murray, 1877; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 432.
- Tetranychus ferrugineus* (Boisduval, 1867); Murray, 1877: *London, Chapman and Hall*: 103.
- Tetranychus ferrugineus* (Boisduval, 1867); Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 432.
- Tetranychus fervidus* Koch, 1841; Koch, 1841: *Arachnida. fasc.*: 21.
- Tetranychus fervidus* Koch, 1841; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 432.
- Tetranychus fici* Murray, 1877; Murray, 1877: Murray, 1877: *London, Chapman and Hall*: 107.
- Tetranychus fici* Murray, 1877; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 432.
- Tetranychus fragariae* Oudemans, 1931; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 432.

- Tetranychus fransseni* Oudemans, 1931; Oudemans, 1931: *Entomologische Berichten, Amsertdam*, 8: 227.
- Tetranychus fransseni* Oudemans, 1931; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 432.
- Epitetranychus hamatus* Zacher, 1916; Zacher, 1916: *Mitt. Kais. Biol. Anst. Land-Forst.*, 16: 25.
- Epitetranychus hamatus* Zacher, 1916; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 432.
- Tetranychus inaequalis* Targioni Tozzetti, 1878; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 432.
- Eotetranychus inexpectatus* Andre, 1933; Andre, 1933: *Bulletin du Museum National d'Histoire Naturelle de Paris (série 2)*, 5: 131.
- Eotetranychus inexpectatus* Andre, 1933; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 432.
- Tetranychus longitarsis* Donnadieu, 1875; Donnadieu, 1875: *Annales de la Société Linnéenne de Lyon (n. sér.)*, 22: 122.
- Tetranychus longitarsus* Donnadieu, 1875; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 432.
- Tetranychus major* Donnadieu, 1875; Donnadieu, 1875: *Annales de la Société Linnéenne de Lyon (n. sér.)*, 22: 120.
- Tetranychus major* Donnadieu, 1875; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 432.
- Tetranychus manihotis* Oudemans, 1931; Oudemans, 1931: *Entomologische Berichten, Amsertdam*, 8: 289.

- Tetranychus manihotis* Oudemans, 1931; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 432.
- Tetranychus minor* Donnadieu, 1875; Donnadieu, 1875: *Annales de la Société Linnéenne de Lyon (n. sér.)*, 22: 121.
- Tetranychus minor* Donnadieu, 1875; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 432.
- Tetranychus multisetis* McGregor, 1950; McGregor, 1950: *American Midland Naturalist*, 44: 294.
- Tetranychus multisetis* McGregor, 1950; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 432.
- Tetranychus piger* Donnadieu, 1875; Donnadieu, 1875: *Annales de la Société Linnéenne de Lyon (n. sér.)*, 22: 121.
- Tetranychus piger* Donnadieu, 1875; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 432.
- Distigmatus pilosus* Donnadieu, 1875; Donnadieu, 1875: *Annales de la Société Linnéenne de Lyon (n. sér.)*, 22: 118.
- Distigmatus pilosus* Donnadieu, 1875; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 432.
- Tetranychus plumistoma* Donnadieu, 1875; Donnadieu, 1875: *Annales de la Société Linnéenne de Lyon (n. sér.)*, 22: 122.
- Tetranychus plumistoma* Donnadieu, 1875; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 432.
- Tetranychus reetalius* Basu, 1963; Basu, 1963: *Proceedings of the Zoological Society of Calcutta*, 16: 221.
- Tetranychus reetalius* Basu, 1963; Gupta and Gupta, 1994: *Memoirs of the Zoological Survey of India*, 18: 139.

- Tetranychus reinwardtia* Oudemans, 1930; Oudemans, 1930:
Entomologische Berichten, Amserdam, 8: 170.
- Epitetranychus reinwardtia* (Oudemans, 1930); Oudemans, 1931:
Entomologische Berichten, Amserdam, 8: 194.
- Tetranychus ricinus* Saba, 1973; Saba, 1973: *Al Awania, 49: 63*
- Tetranychus rosarum* (Boisduval, 1867); Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society, 2: 432.*
- Tetranychus russeolus* Koch, 1838; Koch, 1838: *Ein beitrag zur Deutschen Fauna. fasc: 15.*
- Acarus sambuci* Schrank, 1781; Schrank, 1781: *Beitr. Natur., Augsburg, Germany, 8: 521.*
- Epitetranychus sambuci* (Schrank, 1781); Oudemans, 1931: *Entomologische Berichten, Amserdam, 8: 194.*
- Epitetranychus sambuci* (Schrank, 1781); Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society, 2: 432.*
- Eotetranychus scabrisetus* Ugarov & Nikolskii, 1937; Ugarov and Nikolskii, 1937: *Tr. Sredne-Aziat. Stn. Zash. Rast., 2 : 33.*
- Tetranychus stellariae* Oudemans, 1931; Oudemans, 1931: *Entomologische Berichten, Amserdam, 8: 275.*
- Tetranychus stellariae* Oudemans, 1931; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society, 2: 432.*
- Acarus telarius* Linnaeus, 1758; Linne, 1758: *Stockholm: 616.*
- Tetranychus telarius* (Linnaeus, 1758); Duges, 1834: *Annales des Sciences Naturelles, Paris, 1: 15.*
- Tetranychus telarius* Smith & Baker, 1968; Smith and Baker, 1968:
Cooperative Economic Insect Report, 18 Cooperative Economic Insect Report, 18: 1080.
- Tetranychus telarius haematodes* (Boisduval, 1867); Murray, 1877: *London, Chapman and Hall ; 101.*

- Tetranychus telarius haematodes* (Boisduval, 1867); Pritchard and Baker, 1955: 432.
- Acarus textor* Fourcroy, 1785; Fourcroy, 1785: *Entomologia Parisiensis. Paris, France, 2: 530.*
- Tetranychus textor* (Fourcroy, 1785); Oudemans, 1929: *Kritisch Historisch Overzicht der Acarologie. B2: 276.*
- Tetranychus textor* (Fourcroy, 1785); Pritchard and Baker 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society, 2: 432.*
- Tetranychus urticae* Koch, 1836; Koch, 1836: *Deutsche Crustacea, Myriapoda, Arachnida. fasc. 1: 10.*
- Tetranychus (Tetranychus) urticae* Koch, 1836; Tuttle and Baker , 1968: *Tuscon, Usa, The University of Arizona Press: 129.*
- Tetranychus urticae dianthica* Dosse, 1952; Dosse, 1952: *Pflanzenschutz-Nachrichten Bayer, 5: 250.*
- Tetranychus urticae dianthica* Dosse, 1952; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society, 2: 432.*
- Tetranychus viburni* Koch, 1838; Koch, 1838: *Ein beitrag zur Deutschen Fauna. fasc.: 17.*
- Schizotetranychus viburni* (Koch, 1838); Oudemans, 1937: *Kritisch Historisch Overzicht der Acarologie. 3C: 1061.*
- Schizotetranychus viburni* (Koch, 1838); Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society, 2: 432.*
- Tetranychus violae* Oudemans, 1931; Oudemans, 1931: *Entomologische Berichten, Amserdam, 8: 277.*
- Tetranychus violae* Oudemans, 1931; Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society, 2: 432.*
- Tetranychus vitis* (Boisduval, 1867); Murray, 1877: *London, Chapman and Hall: 103.*

Tetranychus vitis (Boisduval, 1867); Pritchard and Baker, 1955: *Memoirs Series, San Francisco, Pacific Coast Entomological Society*, 2: 432.

Diagnosis:

Empodia with 6 proximoventral hairs; spurs on empodium I – IV absent, peritreme hook; dorsal striae forming diamond shape pattern; dorsal striae with lobes; ventral striae without lobes.

Description of *Tetranychus urticae*

Male:

2 males measured, 314–378 μm long (including gnathosoma).

Gnathosoma:

Palptarsus terminal sensillum between two and two and half times as long as broad, 4.7-5 μm long, 1.9-2.5 μm wide. Peritreme hooked distally.

Venter:

Ventral striae without lobes.

Legs:

Empodia I-IV similar, composed of two claws without appendant hairs. Leg chaetotaxy are as follows:

I 2 – 1 – 10 [9] – 5[4] – 7 + (2) – 10 + (1) + 2 duplexes;

II 2 – 1 – 6 – 5 – 5 + (1) – 9 + (1) + 1 duplex;

III 1 – 1 – 2 – 3 – 4 – 7 + (1);

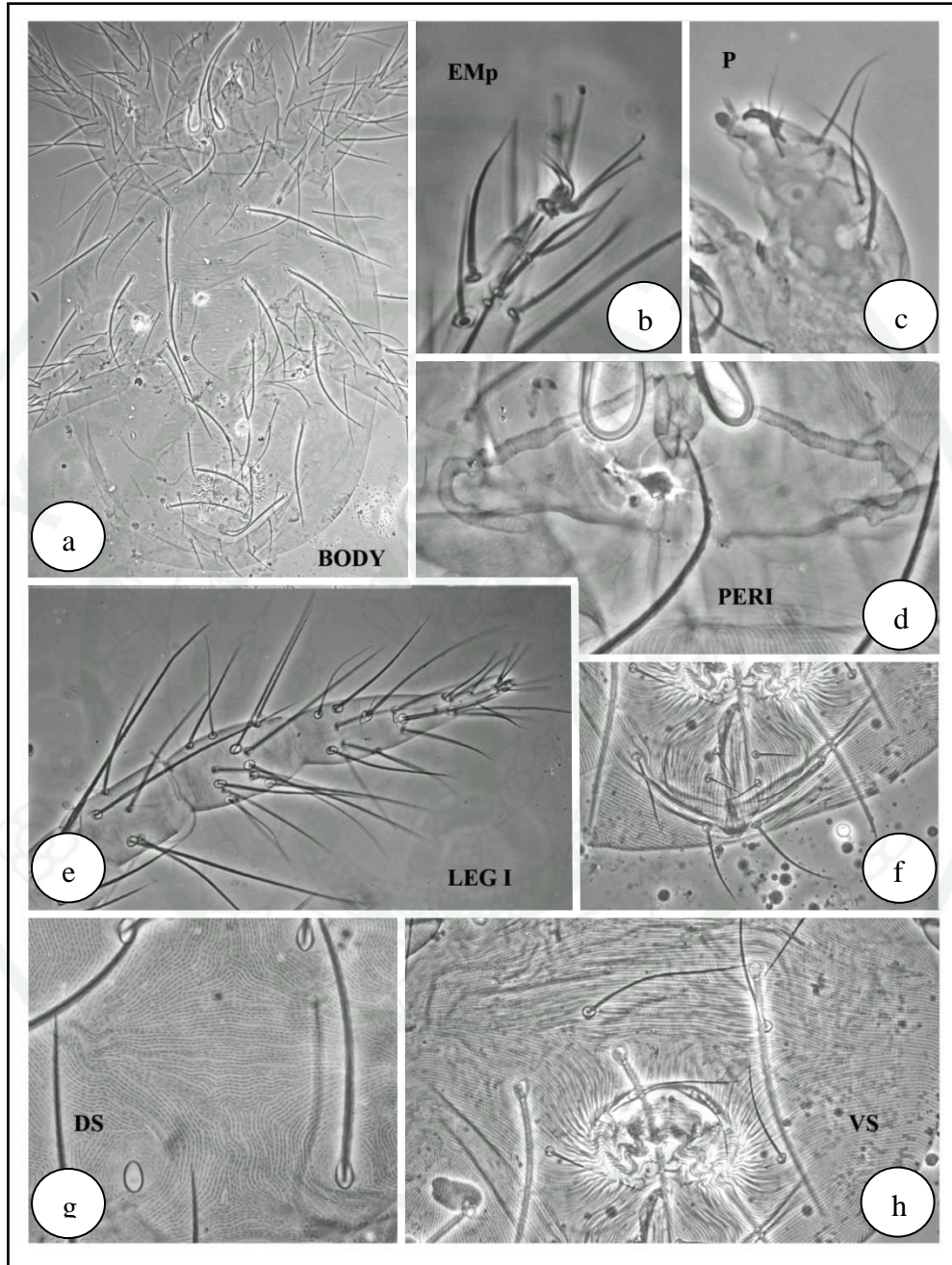


Figure 142 *Tetranychus urticae* Koch, 1836: a) dorsum of female, b) empodium, c) palp, d) peritreme, e) leg I, f) genital flap, g) dorsum striation and h) ventral striation.

IV 1 – 1 – 2 – 3/2 – 5 – 7 + (1).

One tactile setae proximal to proximal duplex on tarsus I, one solenidion at or near the level of proximal duplex. One tactile setae and one solenidion proximal to duplex of tarsus II.

Aedeagus:

Bent dorsad at a right angle with dorsal margin of the shaft, abruptly tapering, with acute tip pointing caudad.

Female:

4 females measured. Idiosoma: length 475 – 524 μm (including gnathosoma), width 260 – 285 μm .

Dorsum:

Dorsal body setae widened near the base, tapering distally not well exceeding base of seta next behind but barely reaching base or about as long as longitudinal interval to base of seta next behind (variations of 4 paratypes): v_2 (50-53); sc_1 (48-51); sc_2 (41-44); c_1 (44-49); c_2 (41-45); c_3 (56-58); d_1 (46-49); d_2 (42-45); e_1 (44-48); e_2 (42-44); f_1 (44-46); f_2 (44-46); h_1 (49-52). Setae sc_2 and c_3 not widened proximally, obviously pubescent, h_1 slightly broadened proximally and distally pubescent. Other dorsal setae widened proximally, e_2 and f_2 less widened basally. Distances between setae: c_1 - c_1 44-49; d_1 - d_1 46-49; e_1 - e_1 44-48; c_1 - d_1 44-48; d_1 - e_1 43-49. Hysterosomal striation transverse with rounded to oblong lobes, most of them wider than tall.

Gnathosoma:

Palptarsus spinneret about 1.5 as long as broad, 5.2-5.4 μm long, 3.4-3.5 μm wide. Peritreme hooked distally.

Venter:

Ventral striation without lobes, genital flap and area immediately anterior to it bearing transverse striation. Two pairs of para-anal and two pairs of anal setae are present.

Legs:

Leg chaetotaxy as follows:

- I 2 – 1 – 8 [9] – 5 – 7 + (1) – 10 + (1) + 2 duplexes;
 II 2 – 1 – 6 – 5 – 5 – 9 + 1 duplex;
 III 1 – 1 – 2 – 3 – 4 – 7 + (1);
 IV 1 – 1 – 2 – 3 – 5[4] – 7 + (1).

One tactile setae proximal to proximal duplex on tarsus I, one solenidion at or near the level of proximal duplex. One tactile setae proximal to duplex of tarsus II, no solenidion present.

Remarks:

Baker (1975) reported *T. urticae* as *T. cinnabarinus* infesting *Helianthus annuus* in Khet Bangkhen, Bangkok. This mite causing severe damage on strawberry plantation in Chiangmai area, later, it spread out to other cash crop, especially cut flower rose and some other vegetable crops. *T. urticae* can feed on numerous hosts where up to 1059 plant species were reported to date. Moreover, it is a cosmopolitan species distributed in more than 200 countries around the world.

Host in Thailand:

Peanut (*Arachis hypogaea* L.), Strawberry, *Fragaria virginiana*, Peach (*Prunus persica* L.)

Distribution in Thailand:

Chiangmai, Khonkaen

Distribution in other countries:

Afghanistan, Algeria, Angola, Argentina, Australia, Austria, Bangladesh, Belgium, Benin, Bolivia, Brazil, Bulgaria, Canada, Canary Is. (Spain), Cape Verde, Chile, China, Columbia, Congo, Costa Rica, Cuba, Cyprus, Czech Republic, Denmark, Egypt, El Salvador, Ethiopia, Fiji, Finland, France, French Polynesia, Germany, Greece, Guadeloupe (France), Guatemala, Guyana, Hawaiian Is., Hungary, India, Indonesia, Iran, Israel, Italy, Ivory Coast, Japan, Jordan, Kazakhstan, Kenya, Korea, Latvia, Lebanon, Libya, Madagascar, Madeira I. (Portugal), Malawi, Malaysia, Mexico, Montserrat (UK), Morocco, Mozambique, Netherlands, New Caledonia (France), New Zealand, Nigeria, Norway, Pakistan, Panama, Paraguay, Peru, Philippines, Poland, Puerto Rico, Reunion (France), Romania, Russia, Sambia, Saudi Arabia, Senegal, Serbia-Montenegro, South Africa, Spain, Sri Lanka, Sudan, Suriname, Swaziland, Sweden, Switzerland, Taiwan, Tasmania (Australia), Tobago, Trinidad, Tunisia, Turkey, Uganda, Ukraine, United Kingdom, United States, Uruguay, Uzbekistan, Venezuela, Vietnam, Yemen, Yugoslavia, Zimbabwe.

Specimens examined:

Four ♀♀ and 4 ♂♂ on Strawberry, *Fragaria virginiana peanut*, (Rosaceae), three ♀♀ and 5 ♂♂ on peach, *Prunus persica* L.(Rosaceae), Chiangmai province, Thailand, 19/4/2011, Leg. H.H. Naing and Dr. Manita's mite working group of DOA, Thailand.

CONCLUSION

Study on the taxonomy of tetranychid mites based on morphological characters is widely used among researchers around the world. The Thailand spider mite fauna was mainly investigated by Baker (1975) and Ehara and Wongsiri (1975). Baker recorded 36 species of 8 genera where as Ehara and Wongsiri found 26 species under 7 genera.

The spider mite species in Thailand were investigated by Thai researchers for several years, but never success in finding any new species of tetranychid mite until *Neotetranychus lek* was described by Flechtmann in 2013. This was almost 15 years far from the last species described in 1988 by Ehara and Tangkanasing.

In this study, three new species of tetranychid mite and one new record were presented. In addition, two new host plants were also reported for *Eotetranychus celtis* and *Tetranychus marianae*.

This indicated that Thailand may have very wide varieties of host plants and more diverse groups of spider mites associated with their host plants. Hence, the efforts should be carried out to find more new species and associated host plants in Thailand.

LITERATURE CITED

- André, M. (1933). Note sur un Tétranyque nuisible au cotonier en Nouvelle-Calédonie. *Bulletin du Museum National d'Histoire Naturelle de Paris (série 2)*, 5: 302-308.
- Auger, P. and C.H.W. Flechtmann. 2003. Two species of a new genus of Tetranychidae (Acari: Prostigmata) from south Tunisia. *International Journal of Acarology*, 29: 75-80.
- Attiah, H.H. (1967). Revision of the Tetranychus telarius complex in the U.A.R., with description of a new species (Acarina: Tetranychidae). *Bulletin de la Societe Entomologique D'Egypte*, 51: 7-10.
- Baker, E.W. 1975. Plant-feeding mites of Thailand (Tetranychidae, Tenuipalpidae, and Tuckerellidae). *Plant Protection Service Technical Bulletin*. Bangkok, Thailand.
- Baker, E.W. and A.E. Pritchard. 1953. A Guide to the spider mites of cotton. *Hilgardia*, 22: 203-234.
- Baker, E.W. and A.E. Pritchard. (1960). The tetranychoid mites of Africa. *Ibid.* 29: 455-574.
- Baker, E.W. and D.M. Tuttle. 1994. A guide to the spider mites (Tetranychidae) of the United States. *West Bloomfield*, USA, Indira Publishing House: 347 p.
- Banks, N. 1900. The red spiders of the United States (Tetranychus and Stigmaeus). *U.S. Dep. Agric. Div. Entomol. Tech. Ser.*, 8: 65-77.
- Banks, N. 1912. New american Mites. *Proceedings of the Entomological Society of Washington*, 14: 96-99.

- Banks, N. 1915. The Acarina or mites. *U.S. Dept. Agric. Bur. Ent. Rep.*, **108**, 153 pp.
- Banks, N. 1917. New Mites, mostly economic (Arach., Acar.). *Entomological News*, **28**: 193-199.
- Basu, B.D. (1963). Studies on two new mites of the family Tetranychidae (genus *Tetranychus*). *Proceedings of the Zoological Society of Calcutta*, **16**: 221-224.
- Beer, R.E. and D.S. Lang. (1958). The Tetranychidae of Mexico. *University of Kansas Scientific Bulletin*, **38**: 1231-1259.
- Berlese, A. 1886. Acari dannosi alle piante coltivati. *Padova, Italia*: 31 p.
- Berlese, A. 1913. Acarotheca Italica. *Firenze*. 221 Pp.
- Boisduval, A. (1867). Essai sur l'entomologie horticole. *Paris, France*: 648 p.
- Bolland, H.R. 2001. Mites (Acari: Tetranychidae and Phytoseiidae) from the Tatra mountains in Slovakia, with special remarks on *Tetranychopsis hystriciformis* Reck. *International Journal of Acarology*, **27**: 225-227.
- Bolland, H.R., J. Gutierrez and C.H.W. Flechtmann. 1998. World catalogue of the spider mite family (Acari: Tetranychidae). *Leiden, Brill Academic Publishers*: 392 p.
- Boudreaux, H.B. 1956. Revision of the two-spotted spider mite (Acarina, Tetranychidae) complex, *Tetranychus telarius* (Linnaeus). *Annals of the Entomological Society of America*, **49**: 43-48.
- Boudreaux, H.B. 1958. *Tetranychus tumidus* Banks versus *Tetranychus gloveri* Banks (Acarina: Tetranychidae). *Ann. Entomol. Soc. Amer.* **51** (2) 174 – 177.

- Charanasri, V., C. Saringkapaibul and M. Kongchuensin. 1989. Mites injurious to orchids in Thailand. *Channabasavanna, G.P. and Viraktamath, C.A., Progress in Acarology*, New Delhi, India, Oxford & Ibh Publishing Co. Pvt. Ltd., 2 2: 201-206.
- Davis, J.J. 1968. Studies of Queensland Tetranychidae. 4. *Eotetranychus lomandrae* sp. n., a spider mite found on mat-rushes. *Queensland Journal of Agricultural & Animal Sciences*, 25: 69-72.
- Davis, J.J. 1968a. *Oligonychus araneum* sp. n. and *Oligonychus digitatus* Davis (Acarina: Tetranychidae) as pests of grasses in eastern Australia. *Journal of the Australian Entomological Society*, 7: 123-126.
- Davis, J.J. 1968b. Studies of Queensland Tetranychidae. 3. Records of the genus *Tetranychus*. *Queensland Journal of Agricultural & Animal Sciences*, 25: 27-67.
- Davis, J.J. 1968c. Studies of Queensland Tetranychidae. 5. Records of the genus *Panonychus* from Queensland, with a note on the occurrence of *Panonychus citri* (McGregor) in New Guinea. *Ibid.* 25: 73-75.
- Davis, J.J. 1968d. Studies of Queensland Tetranychidae. 7. Records of the genus *Eotetranychus* (Acarina: Tetranychidae). *Journal of the Australian Entomological Society*, 7: 127-129.
- Davis, J.J. 1969. Studies of Queensland Tetranychidae (Acarina: Prostigmata). 6. A new genus and five new species of spider mite from native plants. *Memoirs of the Queensland Museum*, 15: 165-183.
- Davis, J.J. 1969a. A new genus and species of the tribe Hystrichonychini (Acarina: Tetranychidae) from Queensland. *Journal of the Australian Entomological Society*, 8: 103-106.

- Davis, J.J. 1969b. A new species of *Schizotetranychus* (Acarina: Tetranychidae) from Queensland. *Ibid.* 8: 107-109.
- Davis, J.J. 1969c. *Neotetranychus victoriae* sp. nov. (Acarina: Tetranychidae), a spider mite found on *Spyridium parvifolium* F. Muell. in Victoria. *Memoirs of the Queensland Museum*, 15: 185-189.
- Davis, J.J. 1969d. A note on cuticular lobes of *Tetranychus marianae* McGregor. *Journal of the Australian Entomological Society*, 8: 112.
- Donnadieu, A.L. 1875. Recherches pour servir à l'histoire des Tétranyques. *Annales de la Société Linnéenne de Lyon (n. sér.)*, 22: 29-136.
- Dosse, G. (1952). The greenhouse spider mite, *Tetranychus urticae* Koch forma *dianthica* and its control. *Pflanzenschutz-Nachrichten Bayer*, 5: 239-267.
- Dugès, A. (1834). Recherches sur l'ordre des Acariens en général et la famille des Trombidiés en particulier. *Annales des Sciences Naturelles, Paris*, 1: 5-46.
- Dufour, L. 1832. Description et figure du *Tetranychus lintearicus*, Arachnide nouvelle de la tribu des Acarides. *Annales des Sciences Naturelles, Paris*, 25: 276.
- Dupont, L.M. (1979). On gene flow between *Tetranychus urticae* Koch, 1836 and *Tetranychus cinnabarinus* (Boisduval) Boudreaux, 1956 (Acari: Tetranychidae): synonymy between the two species. *Entomologia Experimentalis et Applicata*, 25: 297-303.
- Ehara, S. 1956. Notes on some tetranychid mites of Japan (with 37 txt-figures). *Japanese Journal of Applied Zoology*, 21: 139-147.
- Ehara, S. 1956b. Tetranychoid mites of mulberry in Japan. *Journal of the Faculty of Sciences, Hokkaido University, Series VI, Zoology*, 12: 499-510.

- Ehara, S. 1956c. Some spider mites from Northern Japan. *Ibid.* 12: 244-258.
- Ehara, S. 1957. On three spider mites of Schizotetranychus from Japan. *Ibid.* 13: 15-23.
- Ehara, S. 1959. Mites of the subfamily Bryobiinae from Japan (Tetranychidae). *Ibid.* 14: 185-195.
- Ehara, S. 1960. On some Japanese tetranychid mites of economic importance. *Japanese Journal of Applied Entomology & Zoology*, 4: 234-241.
- Ehara, S. 1962. Tetranychoid mites of conifers in Hokkaido. *Journal of the Faculty of Sciences, Hokkaido University, Series VI, Zoology*, 15: 157-175.
- Ehara, S. 1963. A new mite of Oligonychus from rice, with notes on some Japanese spider mites. *Japanese Journal of Applied Entomology & Zoology*, 7: 228-231.
- Ehara, S. 1965. Two new species of Eotetranychus from Shikoku, with notes on *E. kankitus* Ehara (Acarina : Tetranychidae). *Journal of the Faculty of Sciences, Hokkaido University, Series VI, Zoology*, 15: 618-624.
- Ehara, S. 1966. Some mites associated with plants in the State of Sao Paulo, Brazil, with a list of plant mites of South America. *Japanese Journal of Zoology*, 15: 129-150.
- Ehara, S. 1969. Three spider mites of the genus Eotetranychus infesting fruit trees in Japan (Acarina : Tetranychidae). *Applied Entomology & Zoology*, 4: 16-22.
- Ehara, S. 1969a. Spider mites of sugar cane in eastern Asia (Acarina : Tetranychidae). *The Journal of the Faculty of Education, Tottori University, Natural Science*, 20: 19-25.

- Ehara, S. 1969b. The tetranychoid mites of Taiwan (Acarina : Prostigmata). *Ibid.* 20: 79-103.
- Ehara, S. 1970. Four Species of the Carpini Complex of Eotetranychus in Japan (Acarina : Tetranychidae). *Ibid.* 21: 132-141.
- Ehara, S. 1971. Description of a new species of Oligonychus, with notes on Bryobia pritchardi Rimando and Tetranychopsis borealis Ehara and Mori (Acarina : Tetranychidae). *Ibid.* 22: 7-11.
- Ehara, S. 1999. Revision of the spider mite family Tetranychidae of Japan (Acari, Prostigmata). *Species Diversity*, 4: 63-141.
- Ehara, S. and T. Wongsiri. 1975. The spider mites of Thailand (Acarina: Tetranychidae). *Mushi*, 48: 149-185.
- Ehara, S. and Gotoh, T. 1992. Descriptions of two Panonychus spider mites from Japan, with a key to species of the genus in the world (Acari: Tetranychidae). *Applied Entomology & Zoology*, 27: 107-115.
- Ehara, S. and T. Gotoh. 1993. Description of the male of *Panonychus thelytokus* Ehara et Gotoh (Acari, Tetranychidae). *Japanese Journal of Entomology*, 61: 157-160.
- Ehara, S. and T. Gotoh. (1996). Two new species of spider mites occurring in Japan (Acari, Tetranychidae). *Journal of the Acarological Society of Japan*, 5: 17-25.
- Ehara, S. and T. Gotoh. 2007. Two new species of Oligonychus closely related to *O. gotohi* Ehara (Acari: Tetranychidae). *International Journal of Acarology*, 33: 15-20.

- Ehara, S. and M. Masaki. (1989). Notes on two Japanese species of Tetranychus (Acarina : Tetranychidae). *Acta Arachnologica*, 38: 49-54.
- Ehara, S. and Y.P. Tho. 1988. Spider mites of the Malay Peninsula (Acarina : Tetranychidae). *The Journal of the Faculty of Education, Tottori University, Natural Science*, 37: 1-24.
- Ehara, S. and K. Yogi. 1998. Discovery of *Eutetranychus orientalis* (Klein) (Acari: Tetranychidae) from Okinawa Island, Japan. *Plant Protection (Tokyo)*, 52: 530-533.
- Estebanes-Gonzalez, M.L. and E.W. Baker. (1968). Arañas rojas de Mexico (Acarina: Tetranychidae). *Anales de la Escuela Nacional de Ciencias Biologicas*, 15: 61-133.
- Ewing, H.E. 1913. The taxonomic value of characters of the male genital armature in the genus *Tetranychus* Dufour. *Annals of the Entomological Society of America*, 6: 453-460.
- Flechtmann, C.H.W. 1981. The cassava mite complex. II. New records and description of two new species in the genus *Tetranychus* from Asia. *International Journal of Acarology*, 7: 81-86.
- Flechtmann, C.H.W. 1997. Mites (Athropoda: Acari) associated of palms (Arecaceae) in Brazil. III. *Eutetranychus nomurai* n. sp. (Tetranychidae). *Ibid.* 23: 269-273.
- Flechtmann, C.H.W. 2013. A new species of *Neotetranychus* Tragardh (Acari, Prostigmata, Tetranychidae) from Thailand with a key to world species. *Persian Journal of Acarology*, 2: 35-40.

- Flechtmann, C.H.W. and E.W. Baker. (1967). Contribution to knowledge of the mites of plants of some regions of the State of Sao Paulo (as a systematic survey including new species). *Piracicaba, Brasil*: 20 p.
- Flechtmann, C.H.W. and E.W. Baker. 1970. A preliminary report on the Tetranychidae (Acarina) of Brazil. *Annals of the Entomological Society of America*, 63: 156-163.
- Flechtmann, C.H.W. and G.J.d. Moraes. 2001. A new species of Hystrichonychus (Acari: Tetranychidae) from Brazil. *International Journal of Acarology*, 27: 45-47.
- Flechtmann, C.H.W. and D.K. Knihinicki. 2002. New species and new record of Tetranychus Dufour from Australia, with a key to the major groups in this genus based on females (Acari: Prostigmata: Tetranychidae). *Australian Journal of Entomology*, 41: 118-127.
- Flechtmann, C.H.W., S. Kreiter., J. Etienne and G.J.d. Moraes. 1999. Plant mites (Acari) of the French Antilles. 1. Tetranychoida (Prostigmata). *Acarologia*, 40: 137-144.
- Fourcroy, A.F.d. (1785). Entomologia Parisiensis. *Paris, France*, 2: 544 p.
- Geijskes, D.C. (1939). Beiträge zur Kenntnis der europäischen Spinnmilben (Acari, Tetranychidae) mit besonderer Berücksichtigung der niederländischen Arten. *Mededeelingen van de Landbouwoogeschool, Wageningen*, 42: 1-68.
- Goka, K. and A. Takafuji. 1995. Allozyme variations among populations of the two-spotted spider mite, Tetranychus urticae Koch, in Japan. *Applied Entomology & Zoology*, 30: 567-579.

- Gotoh, T., A. Takafuji., and K. Gomi. (1996). Tetranychid mites of Okinawa Island (Acari: Tetranychidae). *Journal of the Acarological Society of Japan*, 5: 89-97.
- Gotoh, T., J. Gutierrez and M. Navajas. 1998. Molecular comparison of the sibling species *Tetranychus pueraricola* Ehara et Gotoh and *T. urticae* Koch (Acari: Tetranychidae). *Entomological Science*, 1: 55-57.
- Gupta, S.K. and Y.N. Gupta. 1994. A taxonomic review of Indian Tetranychidae (Acari: Prostigmata) with description of new species, redescription of known species and keys to genera and species. *Memoirs of the Zoological Survey of India*, 18: 1-196.
- Gutierrez, J. and J. Etienne. 1986. Les Tetranychidae de l'île de la Réunion et quelques-uns de leurs prédateurs. *Agronomie Tropicale*, 41: 84-91.
- Gutierrez, J. and W. Helle. 1971. Deux nouvelles espèces du genre *Eutetranychus* Banks (Acariens : Tetranychidae) vivant sur plantes cultivées à Madagascar. *Entomologische Berichten, Amsertdam*, 31: 45-60.
- Hermann, J.F. 1804. Mémoire aptérologique. *Strasbourg, F. G. Levrault*: 144 p.
- Hirst, S. 1924. LV. On some new species of red spider. *Annals and Magazine of Natural History, (ser. 9)* 14: 522-527.
- Hirst, S. 1926. Descriptions of new mites including four new species of "red spider". *Proceedings of the Zoological Society of London*, 825-841.
- Hotta, M. 1928. A study on a Japanese tea spider mite (in Japanese). *Transactions of the Shizuoka prefectural agricultural Association*, 32: 1-107.

- Jacobi, A. (1905). Eine Spinnmilbe (*Tetranychus ununguis* n. sp.) als Koniferenschädling. *Naturwiss. Z. Land. Forst.*, 3: 269-247.
- Jeppson, L.R., H.H. Keifer., and E.W. Baker. 1975. Mites injurious to economic plants. *Berkeley, University of California Press*: xxiv + 614 p.
- Khodayari, S., K. Kamali., and Y. Fathipour. 2008. A new *Sonotetranychus* (Acari: Tetranychidae) from Iran, with key to the known species. *Systematic & Applied Acarology*, 13: 150-154.
- Kishida, K. 1927. Notes on *Tetranychus kanzawai* n. sp. a new tetranychid mite injurious to leaves of the mulberry tree in Japan. *Zool. Mag.*, 39: 105-107.
- Kishida, K. 1959. An annotated list of animals of Okinawa Islands (Compiled by Y. Okada). 377-384.
- Klein, H.Z. 1936. Contributions to the knowledge of the red spiders in Palestine. I. The Oriental red spider, *Anychus orientalis* Zacher. II. The common red spider, *Epitetranychus althea* v. Hainstein. *Bulletin Israel Agric. Res. Stn. Rehovot*, 21: 3-36, 37-63.
- Knihinicki, D.K. and C.H.W. Flechtmann. 1999. A new species of spider mite, *Oligonychus calicicola* (Acari: Tetranychidae), damaging date fruit, *Phoenix dactylifera* L. (Arecaceae), in Australia. *Australian Journal of Entomology*, 38: 176-178.
- Koch, C.L. (1838). Deutschlands Crustaceen, Myriapoden, und Arachniden. Ein beitrug zur Deutschen Fauna. *fasc. 17*:
- Koch, C.L. (1841). Deutsche Crustacea, Myriapoda, Arachnida. *fasc. 37*:
- Linne, C.v. (1758). Systema Naturae, 10th ed. *Stockholm*: 824 p.

- Lo, P.K.C. and C.C. Ho. 1989. A new species of spider mite from Taiwan (Acarina: Tetranychidae). *Journal of Taiwan Museum*, 42: 55-58.
- Manson, D.C.M. 1963. Mites of the families Tetranychidae and Tenuipalpidae associated with citrus in South East Asia. *Acarologia*, 5: 351-364.
- Manson, D.C.M. (1968). *Panonychus elongatus* Manson (Acarina : Tetranychidae) - a description and comparison with *P.citri* (McG.). *Journal of the Australian Entomological Society*, 7: 6-10.
- Masaki, M., T. Hayase., and S. Miyajima. 1991. Notes on eight species of spider mites and predacious thrips intercepted on squash imported from USA, Mexico, Colombia and New Zealand. *Research Bulletin of the Plant Protection Service Japan*, 27: 107-114.
- McGregor, E.A. (1931). A new spinning mite attacking raspberry in Michigan. *Proceedings of the Entomological Society of Washington*, 33: 193-195.
- McGregor, E.A. (1941). A new spinning mite attacking strawberry on the mid-Atlantic coast. *Proceedings of the Entomological Society of Washington*, 43: 26-28.
- McGregor, E.A. 1942. A new spinning mite attacking sugar cane in Puerto Rico. *Journal of the Agricultural University of Puerto Rico*, 26: 91-94.
- McGregor, E.A. 1950. Mites of the family Tetranychidae. *American Midland Naturalist*, 44: 257-420.
- McGregor, E.A. 1955. Notes on the spider mites of Ecuador. *Revista Ecuat. Entomol. Parasitol.*, 2: 365-377.

- Meyer, M.K.P.S. 1974. A revision of the Tetranychidae of Africa (Acari) with a key to the genera of the world. *Entomology Memoir, Department of Agricultural Technical Services, Republic of South Africa*, 1-291.
- Meyer, M.K.P.S. 1987. African Tetranychidae (Acari: Prostigmata) - with reference to the world genera. *Ibid.* 69: 1-175.
- Meyer, M.K.P.S. and P.A.J. Ryke. 1959. A revision of the spider mites (Acarina : Tetranychidae) of South Africa, with descriptions of a new genus and new species. *Journal of the Entomological Society of Southern Africa*, 22: 330-366.
- Migeon, A. and C.H.W. Flechtmann. 2004. First additions and corrections to the World catalogue of the spider mite family (Acari: Tetranychidae). *International Journal of Acarology*, 30: 143-152.
- Naing, H.H., A. Chandrapatya, M. Navajas., and Auger, P. 2014. New species and new records of Tetranychidae (Acarina, Prostigmata) from Thailand. *Zootaxa* 3802 (2): 257–275.
- Murray, A. (1877). Economic Entomology, Aptera. *London, Chapman and Hall: 433 p.*
- Navajas, M., J. Gutierrez., M. Williams. and T. Gotoh. 2001. Synonymy between two spider mite species, *Tetranychus kanzawai* and *T. hydrangeae* (Acari: Tetranychidae), shown by ribosomal ITS2 sequences and cross-breeding experiments. *Bulletin of Entomological Research*, 91: 117-123.
- Nietner, J. 1861. Observations on the enemies of the coffee tree in Ceylon. *Colombo, Ceylon*: 31 p.

- Oudemans, A.C. (1928). Acarologische Aanteekeningen LXXXIX. *Entomologische Berichten, Amsertdam, 7*: 285-293.
- Oudemans, A.C. (1929). *Kritisch Historisch Overzicht der Acarologie. B2*: 1097 p.
- Oudemans, A.C. (1930). Acarologische Aanteekeningen CV. *Entomologische Berichten, Amsertdam, 8*: 157-172.
- Oudemans, A.C. 1931. Acarologische Aanteekeningen CVI. *Entomologische Berichten, Amsertdam, 8*: 189-204.
- Oudemans, A.C. 1931b. Acarologische Aanteekeningen CVII. *Entomologische Berichten, Amsertdam, 8*: 221-236.
- Oudemans, A.C. 1931c. Acarologische Aanteekeningen CVIII. *Entomologische Berichten, Amsertdam, 8*: 251-263.
- Pritchard, A.E. and E.W. Baker. 1955. A revision of the spider mite family Tetranychidae. *Memoirs Series, San Francisco, Pacific Coast Entomological Society, 2*: 472 p.
- Rahman, K.A. and A.N. Sapra. 1940. Biology of the mite *Paratetranychus indicus* Hirst, a pest of sugar cane in the Punjab. *Indian Journal of Entomology, 2*: 201-212.
- Reck, G.F. (1950). Spider mite fauna from Georgia (Tetranychidae: Acarina). *Trudy Zoologicheskogo Instituta Akademia Nauk Gruz.S.S.R., 9*: 117-134.
- Rimando, L.C. 1962. Four new species of Spider mites of the Genera *Eotetranychus* and *Schizotetranychus* (Tetranychidae, Acarina). *Philippine Agriculturist, 45*: 535-544.

- Rimando, L.C. 1966. A new subfamily of spider mites with the description of a new genus and two species (Acarina : Tetranychidae : Aponychinae). *Philippine Agriculturist*, 50: 105-113.
- Rimando, L.C. 1968. The genus *Aponychus* (Tetranychidae, Acarina). *Philippine Entomologist*, 1: 6-10.
- Sayed, M.T. 1946. Contribution to the knowledge of Acarina of Egypt. V. Five new species of Tetranychidae. *Bulletin de la Societe Entomologique Fouad Ier*, 30: 79-97.
- Seeman, O.D. and J.J. Beard. 2011. Identification of exotic pest and Australian native and naturalised species of *Tetranychus* (Acari: Tetranychidae). *Zootaxa*, 2961: 1-72.
- Smiley, R.L. and E.W. Baker. 1995. A report on some tetranychid mites (Acari: Prostigmata) from Yemen. *International Journal of Acarology*, 21: 135-164.
- Takafuji, A. and N. Hinomoto. 2008. The distribution and geographic variation in diapause capacity among populations of two *Tetranychus* species (Acari: Tetranychidae) in East and Southeast Asia. *Journal of the Acarological Society of Japan*, 17: 1-15.
- Tangkanasing, P. 1988. A new species of *Bakerina Chaudhri* from Thailand (Tetranychidae: Acari). *International Journal of Acarology*, 14: 9-12.
- Targioni Tozzetti, A. 1878. Relazione interno ai lavori della Stazione di entomologia agraria di Firenze per l'anno 1876. **Acaridei.** *Annali di Agricoltura*, 1: 242-275.
- Trägårdh, I. 1915. Bidrag till kännedomen om spinnvalstren (*Tetranychus* Duf.). *Medd. Centralanst. Försöks. Jordbr.*, 109 (*Entomol. Avd.* 20): 1-60.

- Tseng, Y.H. 1990. A monograph of the mite family Tetranychidae (Acarina : Tronbidiformes) from Taiwan. *Taiwan Museum Special Publication Series*, 9: 1-226.
- Tucker, R.W.E. 1926. Some South African mites, mainly Tetranychidae and Eriophyidae. *South African Department of Agricultur Division of Entomology Memories*, 5: 1-15.
- Tuttle, D.M. and E.W. Baker. 1968. Spider mites of southwestern United States and a revision of the family Tetranychidae. *Tuscon, Usa, The University of Arizona Press*: 143 p.
- Tuttle, D.M., E.W. Baker., and M. Abbatiello. 1974. Spider mites from northwestern and north central Mexico (Acarina: Tetranychidae). *Smithsonian Contributions to Zoology*, 171: 1-18.
- Tuttle, D.M., E.W. Baker., and M. Abbatiello. 1976. Spider mites of Mexico (Acarina : Tetranychidae). *International Journal of Acarology*, 2: 1-102.
- Wainstein, B.A. 1960. Tetranychoid mites of Kazakhstan (with revision of the family). *Trudy Nauchno-Issled. Inst. Zashchita Rastenii Kazakh*, 5: 1-276.
- Wainstein, B.A. 1960b. A revision of the tribe Petrobiini (Reck) (Acariformes, Tetranychidae). *Entomologicheskoe Obozrenie*, 39: 214-226.
- Wang, D.S. and E.P. Ma. (1993). New species and records of tetranychid mites from Eastern China. *Acta Entomologica Sinica*, 36: 379-381.
- Wang, H.F. 1981. *Schizotetranychus* from China with a new species (Acarina: Tetranychidae). *Sinozoologica*, 1: 113-116.

- Yokoyama, K. 1929. New textbook of sericultural insect pest. *Tokyo, Japan, Saishin Nippon Sangyo Gaichu Zensho. Meibun - do*: 569 p.
- Zacher, F. 1913. Untersuchungen über Spinnmilben. *Mitt. Kais. Biol. Anst. Land-Forst.*, 14: 37-41.
- Zacher, F. 1916. Zur Kenntnis der Spinnmilben. *Ibid.* 16: 19-25.
- Zaher, M.A. and K.K. Shehata. 1965. *Oligonychus vitis* n. sp. (Acarina : Tetranychidae). *Bulletin de la Societe Entomologique d'Egypte*, 49: 67-69.
- Zaher, M.A., A.A. Soliman., M.A. Hanna., and B.A. Abou-Awad. 1984. Phytophagous mites in Egypt (Nile Valley and Delta). Survey and ecological studies on phytophagous, predaceous and soil mites in Egypt. *Pl. 480 Prog. U.S.A. proj. E G - ARS*, 30: 1-181.
- Zhang, Z.Q., Y.X. Zhang., and J.Z. Lin. 2000. Taxonomic notes on *Stylophoronychus* (Acari: Tetranychidae) with new data for *S. baghensis* infesting moso bamboo in Fujian, China. *Systematic & Applied Acarology Special Publications*, 4: 37-47.

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SCHOLARSHIP: Thailand Research Fund through The Royal Golden Jubilee Ph.D. Program (PHD/0088/2551)**PUBLICATION:** Htar Htar Naing, Angsumarn Chandrapatya, Maria Navajas and Philippe Auger. 2014. New species and new records of Tetranychidae (Acarina, Prostigmata) from Thailand. *Zootaxa*, 3802 (2): 257–275.