Systematic & Applied Acarology 17(2): 191–201. ISSN 1362-1971

Article

A new species, *Aceria neopaederiae* (Acari: Eriophyidae), infesting *Paederia foetida* L. (Rubiaceae) in Thailand, Hong Kong and Singapore

P. KONVIPASRUANG[1], A. CHANDRAPATYA[1*], J. W. AMRINE, JR.[2], R. OCHOA[3], G. BAUCHAN[4] & P. PRATT[5]

[1] *Department of Entomology, Kasetsart University, Chatuchak, Bangkok 10900, Thailand and the Center for Advanced Studies for Agriculture and Food, KU Institute for Advanced Studies, Kasetsart University, Bangkok 10900, Thailand (CASAF, NRU-KU, Thailand)*

[2] *Division of Plant and Soil Sciences, P.O. Box 6108, College of Agriculture and Forestry, West Virginia University, Morgantown, WV 26506-6108, USA*

[3] *Systematic Entomology Laboratory, Agricultural Research Service, U.S. Department of Agriculture, Beltsville, MD 20705, USA*

[4] *Electron and Confocal Microscopy Unit, Agricultural Research Service, U.S. Department of Agriculture, Beltsville, MD 20705, USA*

[5] *Invasive Plant Research Lab, USDA/ARS, 3225 College Ave., Fort Lauderdale FL 33314, USA*

[*] *Corresponding author: E-mail; agramc@ku.ac.th*

Abstract

The new species, *Aceria neopaederiae* infesting leaves of *Paederia foetida* L. (Family Rubiaceae) in Thailand, Hong Kong and Singapore, is described herein. The mite produces small, round to irregular galls, often fused, on both leaf surfaces. The complete descriptions of both males and females, including line drawings and SEM photographs were provided.

Key words: Eriophyidae, Skunkvine, Stinkvine, *Aceria neopaederiae*, *Paederia foetida*

Introduction

Paederia foetida L. (Family Rubiaceae), formerly known as *P. scandens* Lour., *P. chinensis* Hance and *P. tomentosa* Blume, is a wood climbing plant or twining vine-like shrub, native to eastern and southern Asia (Zheng *et al*. 2004; Langeland *et al*. 2008). Several common names were given to this plant such as skunk vine, stinkvine and Chinese fever vine (Langeland *et al*. 2008). This particular plant releases a strong sulfur odor when its leaves or stems were crushed or bruised (Zheng *et al*. 2004).

Since *P. foetida* is a fast-growing shrub and has wide-ranging adaptability to different light, soil, and salt conditions (Langeland *et al*. 2008), hence, it can be found in many countries such as China, Japan, Korea, Taiwan, Bhutan, India, Nepal, Cambodia, Laos, Myanmar, Vietnam, Indonesia, Malaysia, Singapore, Philippines and Thailand (GRIN 2011). *Paederia foetida* can be a severe weed in some countries such as the United States where it was introduced into Florida by the United States Department of Agriculture before 1897 as a potential fiber plant. Unfortunately, by 1916 it was already "a troublesome weed" around the Brooksville Field Station (Morton 1976) and was considered as an economically important weed in 1977 (Reed 1977).

To date, only two eriophyoid species were reported infesting *P. foetida*. *Aceria paederiae* (Nalepa, 1914) was reported forming galls on both leaf surfaces of *P. foetida* leaves in Semarang, Java, Indonesia (Nalepa 1914; Amrine & Stasny 1994; Xue & Zhang 2009). *Vasates scandensi* Huang, 1992 was reported to be vagrant on the same host plant from Taiwan (Huang 1992). This paper provides detailed descriptions of *Aceria neopaederiae n. sp.*, which were collected and recorded for the first time from Thailand, Hong Kong and Singapore. Future research may prove this new species to be a junior synonym of *Aceria paederiae* (Nalepa 1914), when a neotype is eventually described and comparisons can be made with microscopy and DNA analysis. Hence, a future goal is to go to Semarang, Java, Indonesia, to collect galls of *Paederia foetida* L. from the type locality, to redescribe the galls and mites from that location, to do DNA comparisons of all found populations, and to determine the final synonymy.

All field collected specimens were preserved in sorbitol syrup and mounted in modified Belerse's medium (Amrine & Manson 1996). Selected specimens were studied with Low-Temperature Scanning Electron Microscopy (LT-SEM) at the United States Department of Agriculture (USDA), Agricultural Research Service (ARS), Electron and Confocal Microscopy Unit (Beltsville, Maryland, USA) following Ochoa *et al*. (2011) with the following exceptions; observations were performed using an S-4700 field emission SEM (Hitachi High Technologies America, Inc., Pleasanton, CA) equipped with a Quorum CryoPrep PP2000 (Quorum Technologies Ltd., East Sussex, UK)) cryotransfer system. Mites were transferred to 12mm double sided sticky black carbon dots (Ted Pella, Inc. Reading, PA) or leaves with galls were excised and placed on flat specimen holders consisting of 16 x 30mm copper plates that contained a thin layer of Tissue Tek (OCT Compound, Ted Pella, Inc., Redding, CA), which acted as a cyro-adhesive upon freezing. The samples were frozen conductively, in a Styrofoam box, by placing the plates on the surface of a pre-cooled (-196 ^{o} C) brass bar with the lower half submerged in liquid nitrogen (LN_2). After 20–30 sec, the holders containing the frozen samples were transferred to a liquid nitrogen Dewar for future use or cryo-transferred under vacuum to the cold stage in the pre-chamber of the cryo-transfer system. Removal of any surface contamination (condensed water vapor) took place in the cryo-transfer system by etching the frozen specimens for 10–15 min by raising the temperature of the stage to -90^{o}C. Following etching, the temperature was lowered to -130^{o}C, and a magnetron sputter head equipped with a platinum target, was used to coat the specimens with a 10nm layer of platinum. The specimens were transferred to a pre-cooled (-130^{o}C) cryostage in the SEM for observation. An accelerating voltage of 5kV was used to view the specimens. Images were captured using a 4pi Analysis System (Durham, NC).

Nalepa made slides of mites in glycerine solutions; when his descriptions were finished, he discarded the specimens and reused the glass slides. Hence, there are no types set by Nalepa. (Amrine, 1996 and personal communication with Museum of Natural History, Vienna). The specimens we found and studied are very probably identical to Nalepa's *Eriophyes paederiae* Nalepa, 1914.

All measurements are given in micrometers (μm). For females, measurement of the selected mite precedes the corresponding range for other specimen of the same batch. Terminology follows Lindquist (1996). The count of dorsal annuli starts from the rear shield margin; the count of ventral annuli starts from the first lateral annulus at the prodorsal shield margin; the length of each leg is measured from the trochanteral base to the tip of tarsus, excluding empodium. Holotype, paratypes and all other specimens are deposited in the collection of Department of Entomology, Kasetsart University, Bangkok, Thailand.

Aceria neopaederiae **Konvipasruang, Chandrapatya & Amrine**

FEMALE (Fig. 1–4) (n=10). Body vermiform, 187 (163–212) long, 59 (54–64) wide, 54 thick; color in life light yellow. Gnathosoma: projecting slightly downwards, 18 (17–20) long; pedipalp coxal seta *ep* 3 (3–4) long, dorsal pedipalp genual seta *d* 5 (5-6) long, subapical pedipalp tarsal seta *v*2 (2–3) long. Chelicerae 15 (13–18) long, straight. Prodorsal shield: 29 (27–32) long, 43 (40–46) wide, triangular, slightly rounded anteriorly. Scapular setae *sc* 21 (18–30) long, on scapular tubercles 20 (18–21) apart, on rear shield margin, directed divergently to the rear. Shield design rather smooth, consists of few U-shaped lines situated close to rear shield margin, some short lines associated with central U-shaped lines, a few lateral lines appeared on each side of the shield. Frontal lobe absent. Legs: with all setae present. Leg I 32 (30-34) long; femur 10 (8-11) long, ventral basifemoral seta *bv* 7 (5-8) long; genu 5 (4-6) long, antaxial genual seta *l″* 22 (19-25) long; tibia 7 (5-7) long, paraxial tibial seta *l′* 7 (6-9) long; tarsus 9 (6-10) long, with numerous strong striations, antaxial fastigial tarsal seta *ft″* 19 (18–21) long, paraxial fastigial tarsal seta *ft′* 7 (6–8) long, paraxial unguinal tarsal seta *u′* 4 (3-5) long, solenidion almost straight, slightly knobbed, 6 (5–6) long; empodium entire, 5 (4–5) long, 4-rayed. Leg II 30 (28–32) long; femur 10 (8–12) long, ventral basifemoral seta *bv* 8 (7–10) long; genu 5 (4–6) long, antaxial genual seta *l″* 10 (8–13) long; tibia 5 (4–6) long; tarsus 8 (7–9) long,

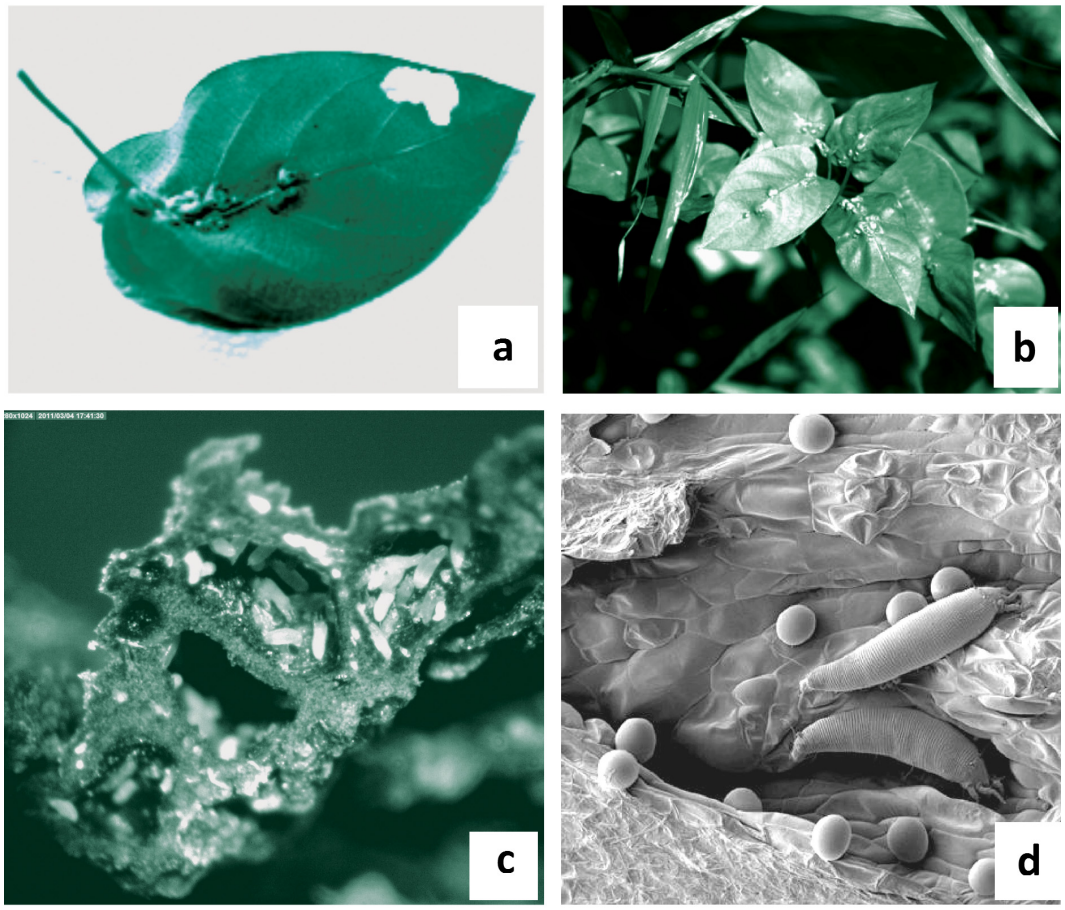

FIGURE 1. *Aceria neopaederiae* n. sp.: a and b) galls on lower and upper leaf surfaces, c and d) mite colonies inside galls.

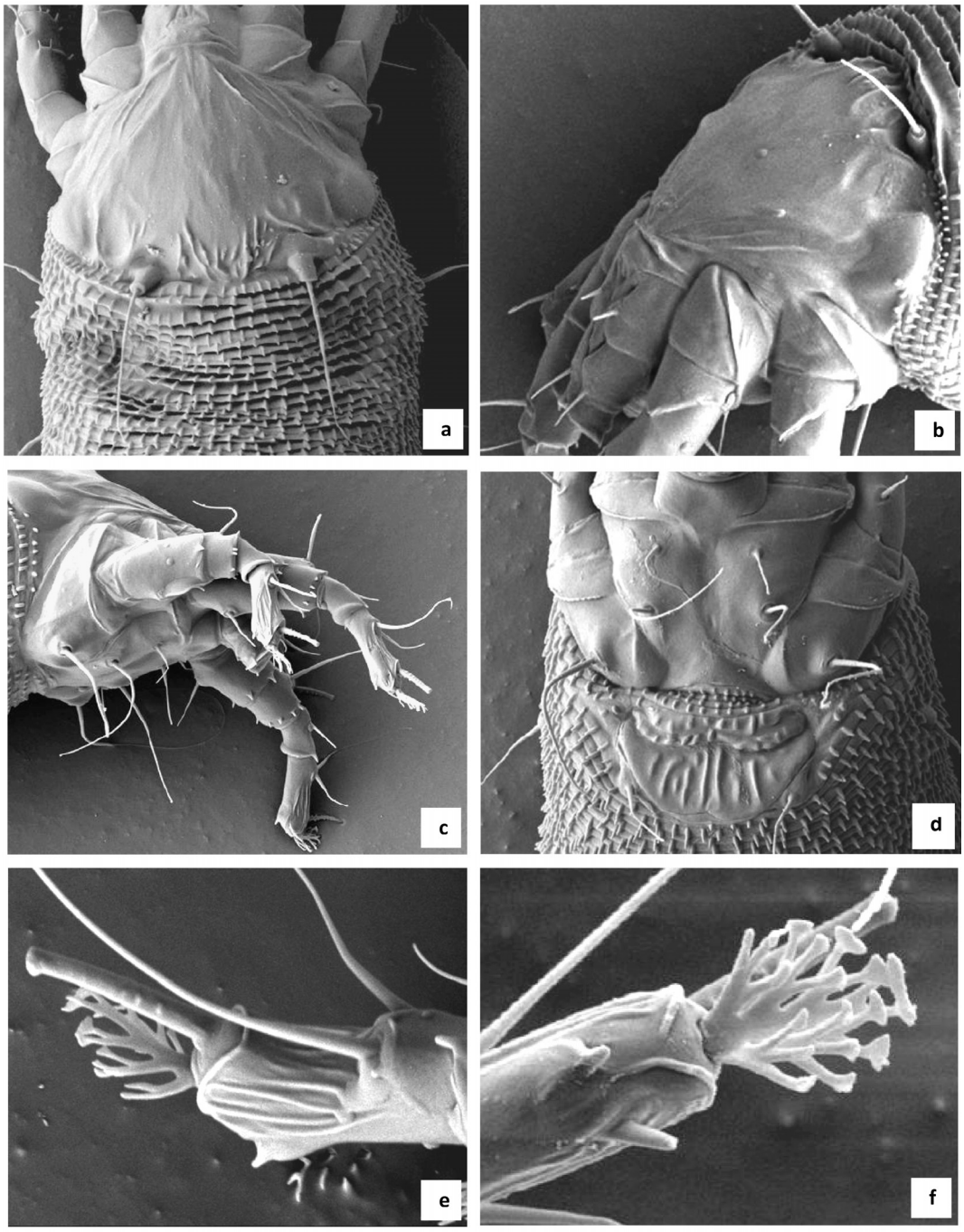

FIGURE 2. *Aceria neopaederiae* n sp.: a and b) dorsal and lateral views of prodorsal shield, c) lateral view of legs I & II, note strong striations on tarsi and transverse ridges on the solenidia; d) coxisterna and female genitalia, e and f) dorsal and ventral views of empodium and solenidion; note strong striations on tarsal surfaces and transverse ridges on the solenidia.

with numerous strong striations, antaxial fastigial tarsal seta *ft″* 19 (15–24) long, paraxial fastigial tarsal seta *ft′* 6 (5–7) long, paraxial unguinal tarsal seta *u′* 3 (3–4) long, solenidion as in leg I, 6 (5–6) long; empodium entire, 5 (5–6) long, 4-rayed. Coxisternal plates: both coxisternal plates smooth.

Internal coxisternal apodeme a line 11 (8–14) long. Anterior seta on coxisternum I *1b* 10 (9–12) long, 10 (9–13) apart; proximal seta on coxisternum I *1a* 21 (18–28) long, 12 (11–14) apart; proximal seta on coxisternum II *2a* 37 (30–41) long, 22 (19–23) apart; distance between setae *1b* and *1a* 6 (4–7) long; coxigenital semiannuli 4 (4–5), microtuberculate. Opisthosoma: with 75 (70–78) dorsal annuli, microtubercles triangular. Ventral opisthosoma with 69 (73–71) annuli, with triangular microtubercles; both dorsal and ventral microtubercles situated slightly ahead of, or on rear margin of each annuli. Microtubercles on dorsal annuli started to fade off after annulus 40 (39–48) to the end of body. Last 28–35 dorsal annuli smooth. Microtubercles slightly elongated on the last 5 ventral annuli. Opisthosoma evenly rounded. Opisthosomal seta *c2* 11 (8–14) long, 56 (50–61) apart, on annulus 11 (10–12); opisthosomal seta *d* 43 (38–50) long, 44 (36–50) apart, on annulus 24 (22–26); opisthosomal seta *e* 9 (8–10) long, 23 (21–26) apart, on annulus 40 (37–47); opisthosomal seta *f* 15 (13–17) long, 18 (14–23) apart, on annulus 64–67 or 6 (6–7) from the rear. Opisthosomal seta h_2 77 (58–85) long; opisthosomal seta h_1 7 (6–8) long. Genital coverflap: 20 (19–22) wide, 14 (12–18) long, with 2 curve lines basally and 10–11 longitudinal ridges distally; proximal seta on coxisternum III *3a* 10 (8–15) long, 16 (14–18) apart.

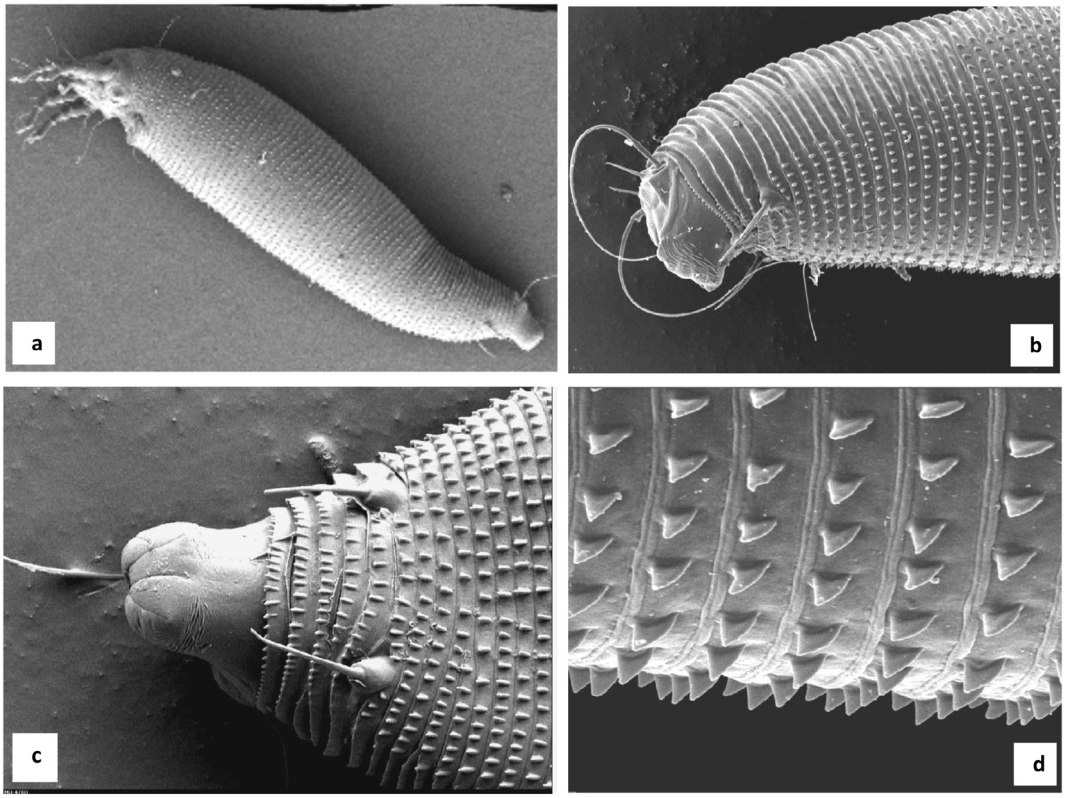

FIGURE 3. *Aceria neopaederiae* n. sp.: a) lateral view of adult female, b) lateral view of posterior opisthosoma; note serrate margins of last two lateral annuli and fine striate sculpture on the caudal lobe, c) ventral view of posterior opisthosoma; note that setae *f* are stout and blade-like and note fine striate sculpture on caudal lobe and d) microtubercles on ventral annuli.

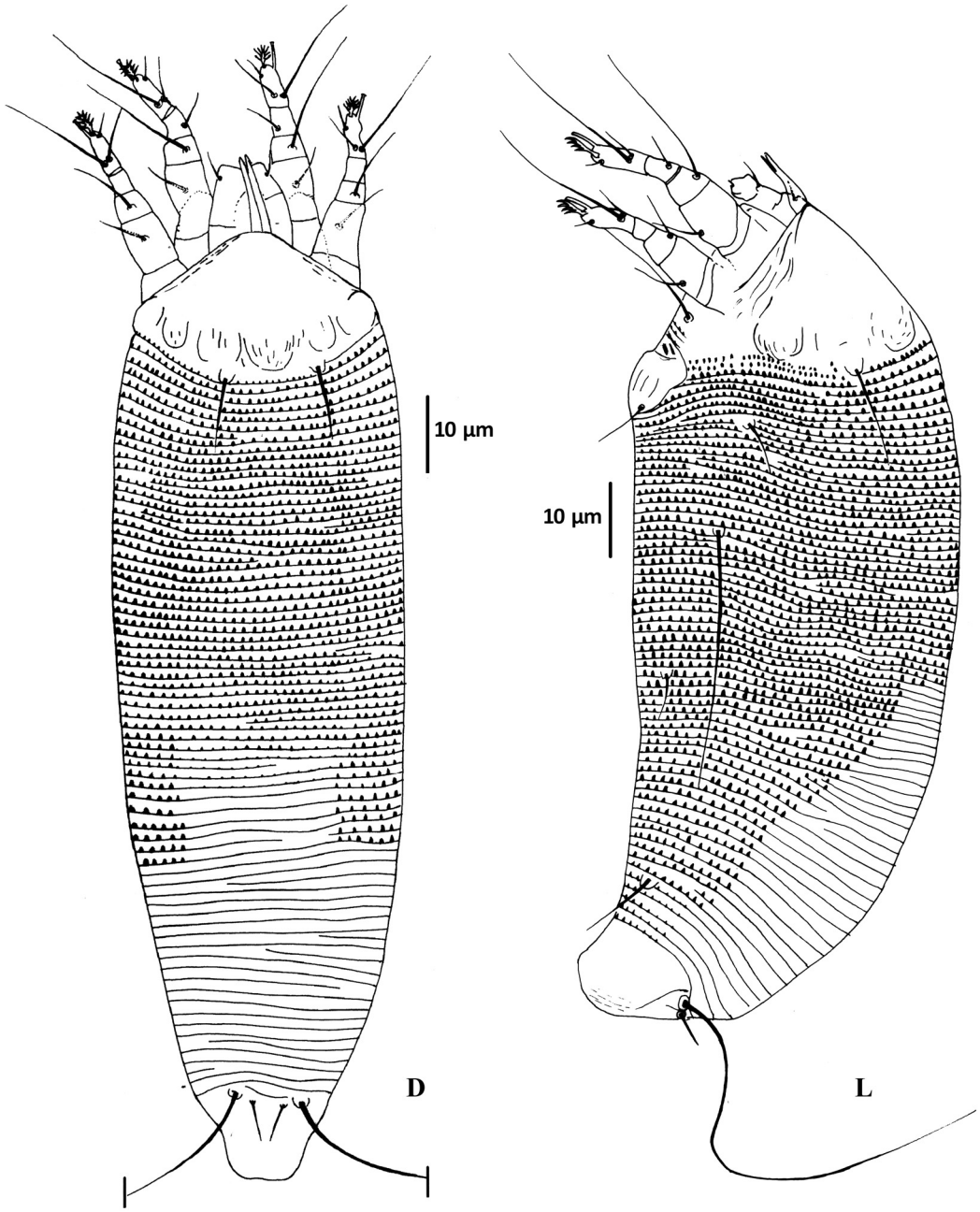

FIGURE 4. *Aceria neopaederiae* n. sp.: D = dorsal view of female, L = lateral view of female.

MALE (n = 2). Smaller than female, 151–154 long, 58–60 wide. Gnathosoma: 17 long; pedipalp coxal seta *ep* 3 long, dorsal pedipalp genual seta *d* 5–6 long, subapical pedipalp tarsal seta *v* 2 long. Chelicerae 15–16 long. Prodorsal shield: 28–32 long, 44–45 wide, similar to female. Scapular setae *sc* 18–19 long, on scapular tubercles 19–22 apart. Frontal lobe absent. Legs: leg I 28 long; femur 8–9 long, ventral basifemoral seta *bv* 7–8 long; genu 4–6 long, antaxial genual seta *l″* 20 long; tibia 5-6 long, paraxial tibial seta *l′* 6–8 long; tarsus 8 long, antaxial fastigial tarsal seta *ft″* 15–17 long, paraxial fastigial tarsal seta *ft′* 7–8 long, paraxial unguinal tarsal seta *u′* 3 long, solenidion

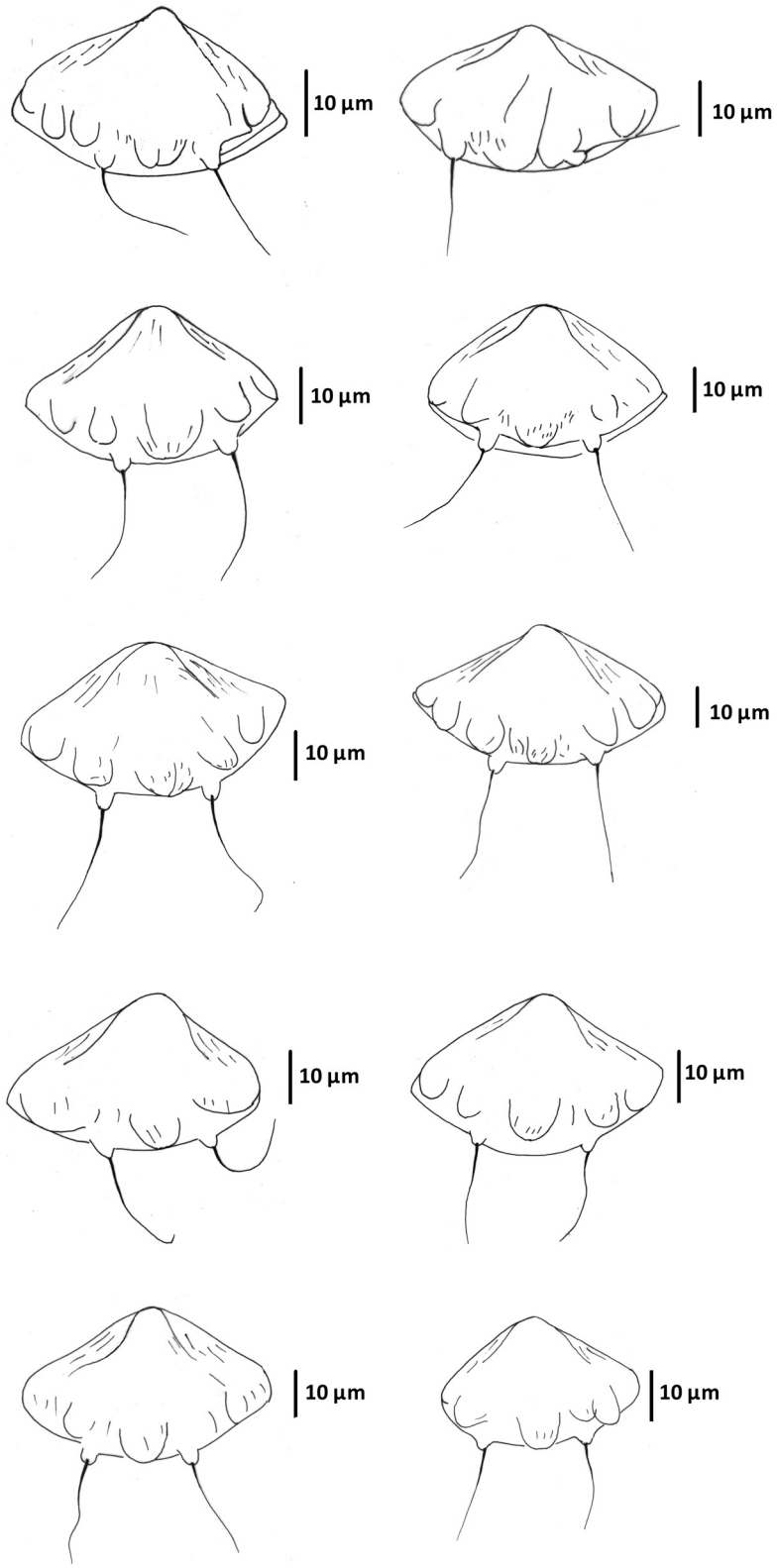

FIGURE 5. Variation of prodorsal shields in *Aceria neopaederiae* n. sp..

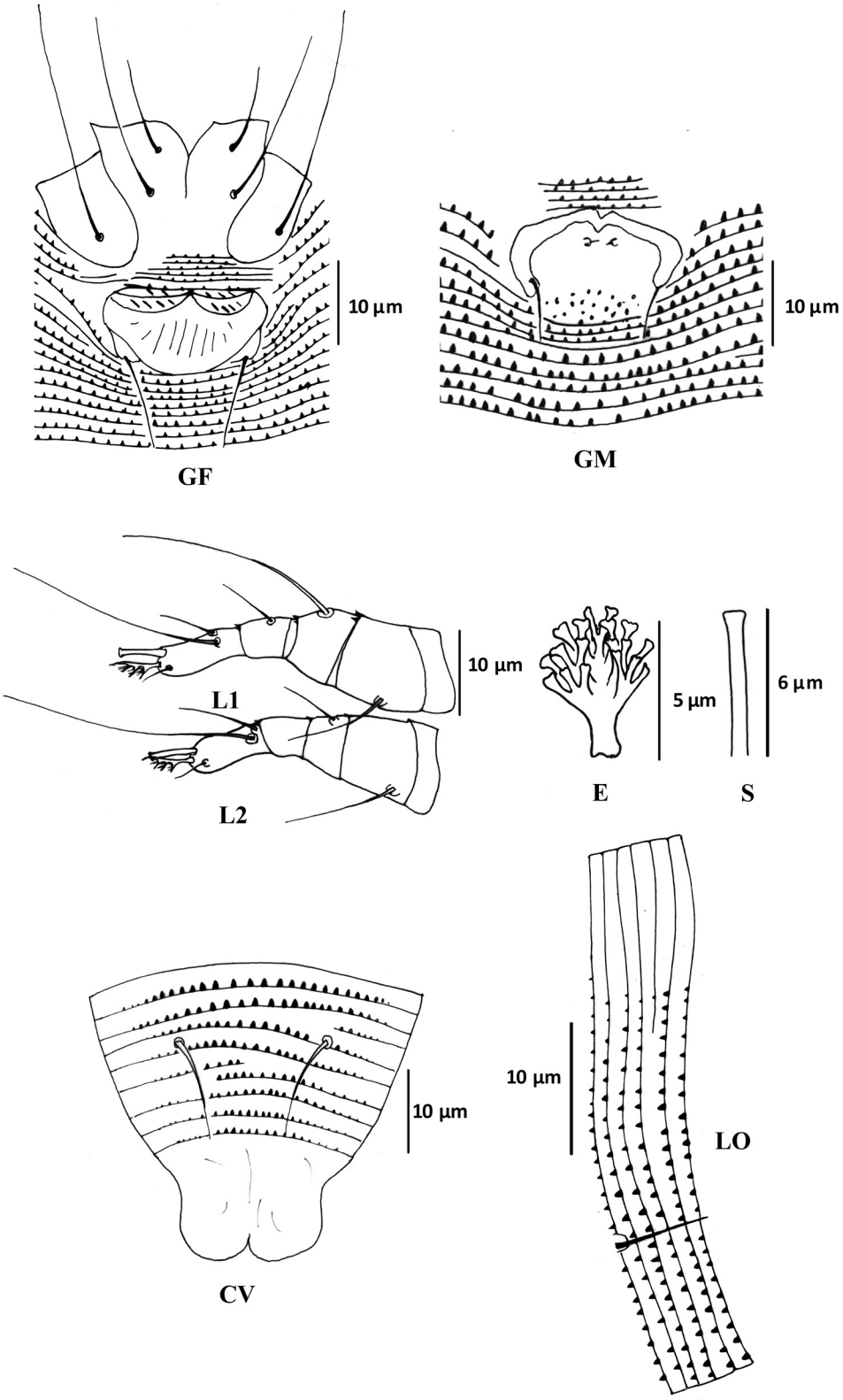

FIGURE 6. *Aceria neopaederiae* n. sp.: GF = female genitalia, GM = male genitalia, L1,L2 = Legs 1 and 2, S = solenidion, E =empodium, CV = ventral view of caudal region, LO = lateral opisthosoma.

almost straight, slightly knobbed, 5–6 long; empodium entire, 5 long, 4-rayed. Leg II 25–27 long; femur 8–9 long, ventral basifemoral seta *bv* 8 long; genu 4-5 long, antaxial genual seta *l″* 9–10 long; tibia 4–5 long; tarsus 7 long, antaxial fastigial tarsal seta *ft″* 18–20 long, paraxial fastigial tarsal seta *ft′* 5–8 long, paraxial unguinal tarsal seta *u′* 3 long, solenidion 5–6 long, almost straight, slightly knobbed; empodium entire, 5 long, 4-rayed. Coxisternal plates: both coxisternal plates smooth. Internal coxisternal apodeme a line 9–10 long. Anterior seta on coxisternum I *1b* 7–8 long, 9–10 apart; proximal seta on coxisternum I *1a* 20 long, 10–12 apart; proximal seta on coxisternum II *2a* 33 long, 19–20 apart, distance between setae *1b* and *1a* 5 long; coxigenital semiannuli 5, microtuberculate. Opisthosoma with 60–66 dorsal annuli, 63–69 ventral annuli. Opisthosomal seta *c2* 10–11 long, 40–51 apart, on annulus 10; opisthosomal seta *d* 33–38 long, 39–40 apart, on annulus 20–21; opisthosomal seta *e* 8–11 long, 22–25 apart, on annulus 33–35; opisthosomal seta *f* 14–15 long, stout and blade-like, 16–20 apart, on annulus 57–63, or 6 from the rear. Opisthosomal seta h_2 56–79 long; opisthosomal seta h_1 5–6 long. Genitalia: 19–20 wide, proximal seta on coxisternum III *3a* 8–11 long, 16 apart.

Materials examined: females and males on 18 slides labeled #3949 and 9 slides labeled #3950. Type Material. Holotype: female collected from galls of *Paederia foetida* L. (Phang Hom), Rubiaceae; Amphoe Mueang, Nakhon Si Thammarat Province, Thailand, 27 February 2010 and 18 May 2010, GPS 08° 31.180’ N, 99° 56.930’ E; coll. A. Winotai and T. Wright, slide labeled#AC20101. Five slides with the same information serve as paratypes.

Paratypes: *Paederia foetida* L. (Phang Hom), Rubiaceae; Mandai Road (post 153), Singapore, 24 February 2011, GPS 1° 24.640’ N, 103° 46.917’ E; coll. T. Wright and B. Brown (three slides, labeled # 2011006); *Paederia foetida* L. (Phang Hom), Rubiaceae; Track 15, off Mandi Lake Road, Singapore zoo, Singapore, 24 February 2011, GPS 1° 24.520’ N, 103° 46.745’ E; coll. T. Wright and B. Brown (18 slides, labeled # 2011007); *Paederia foetida* L. (Phang Hom), Rubiaceae; Wet Market, Sham Tseng, Hong Kong, China, 27 February 2011, GPS 22° 22.057’ N, 114° 03.529’ E; coll. T. Wright, B. Brown and A. Chandrapatya (two slides, labeled # 2011010).

Relation to host: causing isolated or clusters of round to irregular, usually cephaloneon-like, hollow leaf galls, 0.5 to 3 mm diameter, on both leaf surfaces; the inner surfaces of galls are smooth. Leaves often severely deformed.

Etymology: Greek Neo-, new and species designation -*paederiae*, after *Eriophyes paederiae* Nalepa, 1914.

Distribution: Thailand (Nakhon Si Thammarat), China (Hong Kong), Singapore, Indonesia (Java).

Diagnosis: This new species is close to *Aceria paederiae* (Nalepa, 1914) and *A. channabasavannai* Amrine & Stasny, 1994 but it can be distinguished by the appearance of the design on the prodorsal shield, the opisthosoma, coverflap, and number of rays on empodium. Prodorsal shield of *A. paederiae* with three longitudinal lines in midfield, which run close together and merge at the rear margin. In the lateral shield areas, lines extend along the lateral margins. Prodorsal shield of *A. channabasavannai* narrowly truncate anteriorly; shield design with median line on posterior half of prodorsal shield, admedian lines complete, first and second submedial lines on anterior half of prodorsal shield; both sides of prodorsal shield heavily granulate. The new species has rather smooth prodorsal shield, consists of a few U-shaped lines situated close to rear shield margin, some short lines associated with central U-shaped lines, and a few lateral lines on each side of the shield. Opisthosoma of *A. paederiae* with rather fine and dense microtubercles while those of *A. channabasavannai* and *A. neopaederiae* are oval and triangular, respectively. Last 10–15 opisthosomal rings of *A. channabasavannai* with slightly smaller microtubercles while last 25–35 rings of *A. paederiae* and *A. neopaederiae* smooth. Coverflap of *A. paederiae* with relatively indistinct longitudinal ridges while coverflap of both *A. channabasavannai* and *A. neopaederiae*

with 2 curved lines basally and 10–12 longitudinal ridges distally. Both *A. paederiae* and *A. neopaederiae* have a 4-rayed empodium while *A. channabasavannai* with a 5-rayed-empodium. Tarsi of *A. neopaederiae* with many bold striate lines and solenidia with transverse ridges; tarsi and solenidia of the other species are not noted for these features. In addition, specimens from all locations appear to be identical, we do not see any populational differences. The differences between *A. paederiae* and *A. neopaederiae* n. sp. may be the result of modern technology which allows us to see details more easily than microscopes available to Nalepa in 1914.

Author contribution: Ploychompoo Konvipasruang, A. Chandrapatya, J.W. Amrine, Jr. and P. Pratt were responsible for preparation of specimens, manuscript and line drawings while R. Ochoa and G. Bauchan prepared the cold stage specimens and SEM micrographs.

Acknowledgements

Authors wish to thank Dr. Amporn Winotai of the Department of Agriculture, Thailand, Tony Wright of Australia and Bradley Brown, Jeffrey Makinson and Matthew Purcell from the USDA-ARS Australian Biological Control Laboratory (ABCL) for collecting mite samples. ABCL also provided financial support for surveys. A part of this research was partially supported by the Center for Advanced Studies for Agriculture and Food, Institute for Advanced Studies, Kasetsart University under the Higher Education Research Promotion and National Research University Project of Thailand, Office of the Higher Education Commission and Thailand Research Fund (TRF Senior Research Scholar #RTA4880006).

References

Amrine, J.W.Jr. & Manson, D.C.M. (1996) Preparation, mounting and descriptive study of Eriophyoid mites. *In*: Lindquist, E.E., Sabelis, M.W. & Bruin, J. (Eds.), Eriophyoid mites: Their biology, natural enemies and control. Elsevier, Amsterdam., pp. 383–396.

Amrine, J.W.Jr. & Stasny, T.A. (1994) Catalog of the Eriophyoidea (Acarina: Prostigmata) of the world. Indira Publishing House, West Bloomfield, Michigan, USA, 804 pp.

GRIN (Germplasm Resources Information Network). (2011) Taxonomy for plants. [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. USDA, ARS, National Genetic Resources Program http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?26300. (Retrieved August 9, 2011).

Huang K.-W. (1992) Some new eriophyoid mites from Taiwan (Acarina: Eriophyoidea). *Bulletin of the Natural Museum, National Sci*ence, 3, 225–240.

Langeland, K.A., Cherry, H.M. & McCormick, C. (2008) Identification and biology of nonnative plants in Florida's natural areas, 2nd edition. University of Florida-IFAS Pub SP 257. 210 pp.

Lindquist, E.E. 1996. External anatomy and notation of structures. pp. 3–31 *In*: Lindquist, E.E., Sabelis, M.W., Bruin, J. (Eds.), Eriophyoid mites: Their biology, natural enemies and control. Amsterdam, Elsevier Science Publishing. World Crop Pests, 6: xxxii + 790 pp.

Morton, J.F. (1976) Pestiferous spread of many ornamental and fruit species in south Florida. *Proceedings of the Florida State Horticultural Society*, 89, 348–53.

Nalepa, A. (1914) Eriophyiden aus Java (1. Beitrag). *Marcellia*, 13 (2–3), 51–87.

Ochoa, R., Beard, J.J., Bauchan, G.R., Kane, E.C., Dowling, A.P.G., & Erbe, E.F. (2011) Herbivore exploits chink in armor of host. *American Entomologist*, 57(1), 26–29.

Reed, C.F. (1977) Economically important foreign weeds: potential problems in the United States. Washington, D.C. APHIS, USDA. Agriculture Handbook No. 498. 746 pp.

Xue, X.-F. & Zhang, Z.-Q. (2009) Eriophyoid mites (Acari: Prostigmata) in Southeast Asia: a synopsis of 104 genera, with an illustrated key to genera and checklist of species. *Zootaxa*, 2257, 1–128.

Zheng, H., Wu, Y., Ding, J., Binion, D., Fu, W. & Reardon, R. (2004) Invasive plants of Asian origin established in the United States and their natural enemies. Volume 1. United States Department of Agriculture, Forest Service. FHTET-2004-05. Morgantown, WV., 147 pp.

Accepted by Zhi-Qiang Zhang: 15 Apr. 2012; published 25 Jun. 2012