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Subscriptions: Year 2020 (Volume 60): 450 €
http://www1.montpellier.inra.fr/CBGP/acarologia/subscribe.php
Previous volumes (2010-2018): 250 € / year (4 issues)
Acarologia, CBGP, CS 30016, 34988 MONTFERRIER-sur-LEZ Cedex, France
ISSN 0044-586X (print), ISSN 2107-7207 (electronic)

The digitalization of Acarologia papers prior to 2000 was supported by Agropolis Fondation under the reference ID 1500-024 through the « Investissements d’avenir » programme (Labex Agro: ANR-10-LABX-0001-01)

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Phytoseiidae of Vietnam (Acari: Mesostigmata) with description of a new species

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Original research

ABSTRACT

Vietnam is a large country of Southeast Asia and a globally recognized hotspot of biodiversity. Until recently, only limited surveys had been carried out on the resident Phytoseiidae fauna and presence of 12 species had been documented, with 11 belonging to the sub-family Amblyseiinae and 1 to the sub-family Typhlodrominae. Here, we present results from 2017 field surveys and add a total of 8 new country records, one of which a newly-described species. At least 5 species (\textit{i.e.}, \textit{Neoseiulus longispinosus}, \textit{Paraphytoseius cracentis}, \textit{P. orientalis}, \textit{Amblyseius cinctus} and \textit{A. herbicolus}) are well-known biological control agents (BCA), while two species (\textit{Euseius ovaloides} and \textit{Gynaeseius liturivorus}) carries ample potential as BCA agents but necessitates further study. In addition to the intrinsic value of phytoseiid mite biodiversity in tropical environments, demonstration of the natural occurrence of efficient BCAs in Southeast Asian countries such as Vietnam is of great agricultural and commercial interest.

Keywords survey; collection; taxonomy; systematics; Vietnam

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Introduction

The Phytoseiidae family is widespread all over the world and consists of about 2,500 valid species dispatched in three sub-families and 94 genera (Demite \textit{et al.} 2014, 2020). Several species in the family are important natural enemies of phytophagous mites, insect eggs and small (or immature) insects in natural habitats, arable field crops and protected crops globally (McMurtry and Croft 1997; McMurtry \textit{et al.} 2013). Despite the extensive faunistic surveys carried out for more than 70 years worldwide, the fauna of certain countries and ecosystems remains little explored (Tixier and Kreiter, 2009; Kreiter \textit{et al.} 2020a). Consequently, it is important to conduct surveys in these poorly-investigated areas and gain more information on resident biodiversity, especially in hotspots of biodiversity. Furthermore, in-country surveys of Phytoseiidae can signal local presence of known biological control agents (BCA) and introduce new potential BCAs, especially in the context of international and country regulations including the Nagoya Protocol on Access and Benefit Sharing (Mason \textit{et al.} 2018).

Most areas of Southeast Asia constitute globally-important hotspots of biodiversity (Myers, 1988). These geographical entities are of immediate importance to biodiversity conservation, regularly hold high endemicity and have been subject to considerable loss of natural habitats.
in recent years (Myers et al. 2000). The characterization of the phytoseiid mite diversity in these areas is thus directly contributing to this general topic of conservation. Though Vietnam is a large area in Southeast Asia, scant information exists on the resident phytoseiid mite fauna restricted to only five species listed in the world Phytoseiidae database (Demite et al. 2020) [Amblyseius matavinikus Schicha & Corpuz-Raros, Graminaseius polisensis (Schicha & Corpuz-Raros), Neoseiulus longispinosus (Evans), Paraphytoseius orientalis (Narayanan, Kaur & Ghai), and Scapulaseius asiaticus (Evans)], based on only one paper (Nguyen et al. 2016) concerning a survey in one city of Vietnam, i.e., Ho Chi Minh City. Actually, 12 species are known from Vietnam, the previous five and 7 additional species: AmblyseiustamatavensisBlommers, Proprioseiulus dahonagnas (Schicha & Corpuz-Raros) and an undetermined Typhlodromus sp., Paraphytoseius cracentis (Corpuz & Rimando), Amblyseius largoensis (Muma), Neoseiulus californicus (McGregor) and Proprioseiopsis lenis (Corpuz & Rimando) (Nguyen & De Clercq, 2018; Nguyen & Dao, 2019; Nguyen et al. 2019a; Nguyen et al. 2019b).

This paper constitutes the sixth contribution to Vietnam’s Phytoseiidae Fauna and reports results of an additional field surveys realised in 2017.

Material and Methods

The survey took place in Yen Bai province, a mountain province located at the northwest part of northern-central Vietnam.

Plant-inhabiting mites were collected in several cultivated plots planted with Manihot esculenta and on surrounding wild plants in two villages of Vietnam (Vinh Kien village: 21.74°N, 105.08°E, Yen Binh district, Yen Bai province and Mau Dong village: 21.91°N, 104.64°E, Van Yen district, Yen Bai province).

Mites were directly collected on leaves with a fine brush.

Collected mite specimens were then transferred with a fine brush into small plastic vials containing 70° ethanol. Next, mites were mounted on slides using Hoyers medium and all identified using a phase contrast and Differential Interference contrast microscope (DMLB, Leica Microsystèmes SAS, Nanterre, France). Characters of specimens were measured using a graduate eyepiece (Leica, see above). Chant and McMurtry’s (1994, 2007) concepts of the taxonomy of the family Phytoseiidae and the world catalogue database of Demite et al. (2014, 2020) were used to identify mite species. In this paper, the setal nomenclature system adopted was that of Lindquist & Evans (1965) and Lindquist (1994), as adapted by Rowell et al. (1978) for the dorsum and by Chant & Yoshida-Shaul (1991) for the venter. The idiosomal setal pattern follows Chant & Yoshida-Shaul (1992). The notation for solenostomes and poroids is based on Athias-Henriot (1975). Numbers of teeth on the fixed and movable cheliceral digits do not include the respective apical tooth. Setae not referred to in the Results section should be considered as absent. All measurements are given in micrometers (µm) in the text and figures and presented as the mean in bold followed by the range in parenthesis. All collected individuals were measured if no precision is given. New measurements added with existing literature records are marked in bold in the tables.

Specimens are deposited in the mite collections of Montpellier SupAgro conserved in UMR CBGP INRA/IRD/CIRAD/SupAgro. All specimens were identified, except for few single males which were not taken into account. The following abbreviations are used in this paper for morphological characters: dsl = dorsal shield length just under j1 to just below J5; dsw = dorsal shield width at the level of s4; Per. ext.: peritreme extension; gd = solenostome; Z4 ser., Z5 ser. = Z4, Z5 serrated (if Z4 and Z5 without ser. = not serrated); Metastern. sh. = presence or absence of metasternal shield; lisl = Largest inguinal sigilla (= “metapodal plate”) length; lisw = Largest inguinal sigilla (= “metapodal plate”) width; sisl = smallest inguinal sigilla (= “metapodal plate”) length; gensl = genital shield length; gensw post. cor. = genital shield width posteriorly; vsl = ventrianal shield length; vsw ZV2 & vsw anus = ventrianal shield width at
**Results and Discussion**

A total of 14 species were found: 11 belonging to Amblyseiinae and to genera *Amblyseius*, *Euseius*, *Graminaseius*, *Gynaeseius*, *Neoseiulus*, *Paraphytoseius* and *Scapulaseius*; Three species are belonging to Phytoseiinae and to genus *Phytoseius*. No species of the sub-family Typhlodrominae has been found.

Thirteen species had been previously described among which 8 are new records for Vietnam, while 1 species is new to science. All results concerning the 14 species are given hereunder.

**Subfamily Amblyseiinae Muma**

*Amblyseiinae Muma*, 1961: 273.

**Genus Neoseiulus Hughes**

*Neoseiulus* Hughes, 1948: 141.

**Neoseiulus longispinosus (Evans)**

*Typhlodromus longispinosus* Evans 1952: 413; Evans 1953: 465; Womersley 1954: 177; Ehara 1958: 55.  
*Typhlodromus (Amblyseius) longispinosus*, Chant 1959: 74.  
*Amblyseius longispinosus*, Corpuz & Rimando 1966: 129; Schicha 1975: 103.  
*Neoseiulus longispinosus*, Moraes et al. 1986: 85; 2000: 245; Chant & McMurtry 2003a: 37; Moraes et al. 2004a: 129; Chant & McMurtry 2007: 29.

**Specimens examined**: Muoi in P4 plot (aasl 66 m, lat. 21°54'41" N, long. 104°38'7" E), 1 ♀ on *Styrax tonkinensis* (Styracaceae), 12/V/2017; in P8 plot (aasl 66 m, lat. 21°54'46" N, long. 104°38'9" E), 1 im. on *Bambusodae* sp. (Poaceae), 17/V/2017; in P1 plot (aasl 66 m, lat. 21°54' N, long. 104°38' E), 1 ♀ an in plot SP5 plot (aasl 66 m, lat. 21°54’ N, long. 104°38’ E), 3 ♀♀, on *Manihot esculenta* (Euphorbiaceae), 17/V/2017; in P11 plot (aasl 66 m, lat. 21°54'30" N, long. 104°38'14" E), 1 im. on *Mallotus canii* (Euphorbiaceae), and 1 ♀ on *Passiflora foetida* (Passifloraceae), 31/V/2017.

**Remarks**: this species is distributed in many countries of the world, mainly in tropical areas (Moraes et al. 2000; Mailloux et al. 2010; Kreiter et al. 2013, 2018 a, c; Demite et al. 2020). It was rarely encountered before in surveys made in Guadeloupe, Martinique and La Réunion but was recently more captured when screening low vegetation constituting companion plants in citrus orchards (Mailloux et al. 2010; Kreiter et al. 2013, 2018c; Le Bellec et al., unpub. data). This species appears to be more common on grasses of the lower vegetation with populations of tetranychid mites. *Neoseiulus longispinosus*, a type II phytoseiid predatory mite like *N. californicus* (McMurtry et al. 2013), is increasingly being considered for the control of *Eutetranychus*, *Oligonychus*, and *Tetranychus* spider mites in Asia (Nusartlert et
### Table 1 Character measurements of adult females of *Neoseiulus longispinosus* collected in this study and those reported in previous studies (localities followed by the number of specimens measured).

| Characters | Vietnam | La Réunion | Comoros | Holotype Indonesia | Sri Lanka | Taiwan | Thailand |
|------------|---------|------------|---------|--------------------|-----------|--------|----------|
| Dsl        | 6, this study | 321 (305 – 350) | 18 | 380 | 332 | 321 (313 – 338) | - | 330 (315 – 340) |
| Dsw at s4 level | 170 (130 – 213) | 183 (150 – 205) | 192 | 173 | 187 (175 – 208) | - | 186 (178 – 195) |
| j1         | 19 (15 – 23) | 18 (15 – 20) | 20 | 14 | 18 (17 – 19) | 17 | 19 (18 – 21) |
| j3         | 57 (50 – 65) | 62 (53 – 73) | 69 | 51 | 62 (61 – 64) | 58 | 61 (56 – 68) |
| j4         | 57 (53 – 60) | 55 (48 – 60) | 70 | 49 | 58 (56 – 60) | 59 | 58 (54 – 62) |
| j5         | 65 (63 – 70) | 66 (58 – 73) | 78 | 59 | 70 (69 – 71) | - | 69 (65 – 72) |
| j6         | 69 (65 – 73) | 73 (65 – 83) | 78 | 64 | 70 (68 – 72) | - | 71 (68 – 73) |
| J2         | 76 (73 – 78) | 74 (68 – 83) | 88 | 66 | 77 (75 – 79) | - | 74 (68 – 81) |
| J5         | 8 | 8 (6 – 10) | 10 | 10 | 8 | - | 9 (7 – 12) |
| r3         | 61 (55 – 65) | 59 (48 – 78) | 75 | 54 | 55 (55 – 56) | - | 61 (50 – 67) |
| R1         | 56 (55 – 58) | 61 (54 – 80) | 70 | 58 | 60 (59 – 62) | - | 63 (55 – 70) |
| s4         | 81 (73 – 83) | 82 (70 – 88) | - | 75 | 82 (80 – 83) | 72 | 81 (76 – 85) |
| S2         | 73 (63 – 80) | 75 (68 – 85) | 88 | 67 | 73 (70 – 79) | 70 | 73 (68 – 80) |
| S4         | 61 (55 – 68) | 56 (43 – 68) | 63 | 49 | 59 (57 – 62) | 58 | 61 (56 – 68) |
| S5         | 18 (15 – 20) | 17 (15 – 18) | 18 | 15 | 21 (19 – 23) | 17 | 20 (18 – 25) |
| z2         | 64 (60 – 73) | 67 (56 – 75) | 75 | 58 | 69 (68 – 70) | 62 | 66 (62 – 70) |
| z4         | 69 (63 – 75) | 73 (65 – 80) | 78 | 58 | 73 (73 – 75) | 65 | 71 (68 – 75) |
| z5         | 31 (28 – 33) | 27 (23 – 33) | 38 | - | 32 (32 – 38) | - | 31 (25 – 36) |
| Z1         | 74 (68 – 78) | 75 (65 – 85) | 83 | 67 | 77 (76 – 78) | - | 75 (71 – 78) |
| Z4         | 70 (60 – 73) | 70 (63 – 75) | 78 | 68 | 72 (71 – 73) | 65 | 71 (65 – 76) |
| Z5         | 76 (63 – 80) | 81 (73 – 88) | 85 | 72 | 80 (80 – 81) | 70 | 78 (72 – 81) |
| st1-st1    | 48 (45 – 48) | 47 (43 – 50) | 48 | - | - | - | - |
| st2-st2    | 57 (55 – 60) | 58 (55 – 60) | 55 | - | 53 (50 – 55) | - | 59 (57 – 60) |
| st3-st3    | 70 (63 – 73) | 71 (68 – 78) | 60 | 77 | - | - | - |
| st1-st3    | 54 (53 – 55) | 57 (55 – 60) | 73 | 62 | 55 (53 – 56) | - | 63 (57 – 85) |
| st4-st4    | 69 (60 – 75) | 71 (63 – 83) | 85 | - | - | - | - |
| Gensl      | 116 (103 – 125) | - | - | - | - | - | - |
| st5-st5    | 56 (50 – 60) | 54 (50 – 58) | 58 | - | 53 (51 – 54) | - | 61 (55 – 64) |
| Gensw post.com. | 75 (70 – 80) | - | - | - | - | - | - |
| Lisl       | 29 (25 – 33) | 25 (20 – 30) | 23 | - | - | - | - |
| Lisw       | 2 | 3 (3 – 6) | 3 | - | - | - | - |
| Sisl       | 14 (13 – 18) | 12 (10 – 18) | 18 | - | - | - | - |
| Vsl        | 110 (95 – 125) | 114 (93 – 125) | 125 | 97 | 106 (103 – 111) | - | 123 (120 – 125) |
| Vsw ZY2    | 91 (75 – 100) | 86 (80 – 95) | 90 | 87 | 91 (89 – 93) | - | 97 (95 – 100) |
| Vsw anus   | 77 (75 – 78) | 69 (67 – 73) | 78 | - | 75 (73 – 77) | - | - |
| JV3        | 59 (50 – 68) | 62 (55 – 70) | 73 | - | - | - | - |
| SIV        | 74 (70 – 75) | 79 (75 – 83) | 75 | 80 – 87 | 68 (68 – 70) | 74 | 74 (72 – 77) |
| Sc1        | 22 (18 – 23) | 24 (13 – 35) | 25 | 30 | 21 (20 – 21) | 17 | 19 (17 – 22) |
| Sew        | 5 (5 – 6) | 4 (3 – 10) | 5 | 4 | - | - | - |
| Fdl        | 23 (20 – 25) | 24 (19 – 28) | 23 | - | 22 (21 – 22) | - | 23 (22 – 25) |
| No teeth Fd | - | 6 | - | - | 5 | - | - |
| Mdl        | 25 | 24 (23 – 30) | 23 | - | 25 (23 – 25) | - | 26 (25 – 27) |
| No teeth Md | - | 2 | - | - | 2 | - | - |

Sources of measurements – La Réunion: Kreiter *et al.* 2020 accepted; Grande Comore Island of Comoros Archipelago: Kreiter *et al.* (2018b) (a mistake remains in the paper, 1 single female measured instead of 8 as indicated); Holotype Indonesia: Schicha (1975); Sri Lanka: Moraes *et al.* (2004b); Taiwan: Tseng (1983); Thailand: Oliveira *et al.* (2012); - : not provided.
al. 2011). Its behaviour, feeding, development, prey consumption, cannibalism and intra-guild predation have been extensively studied by several authors (see for example Luong et al. 2017), with the ultimate aim to enhance its use for biological control. *Neoseiulus longispinosus* is a well-known BCA sold in several countries and commercially-available for management of spider mites. Under controlled laboratory conditions, *N. longispinosus* exhibits potential as a BCA against the citrus red spider mite *P. citri* (Huyen et al., 2017).

This species was already known from Vietnam and reported as a local BCA in earlier survey work (Nguyen et al. 2016) though no measurements were given. Measurements of female specimens collected during this study are given in table 1 and compared with measurements obtained from specimens collected in other countries of Asia and Islands of the Indian Ocean. Measurements match with most of the previous measurements, especially with those obtained on specimens from La Réunion Island. The setal lengths of the present females are longer than those obtained from the holotype, which are in the lower part of the range of data obtained for each seta (probably measurements were obtained from a very small size female).

**Genus Paraphytoseius Swirski & Shechter**

*Paraphytoseius* Swirski & Shechter 1961: 113; Moraes et al. 1986: 104. Chant & McMurtry 2003b: 216; Moraes et al. 2004a: 160; Chant & McMurtry 2007: 49. *Amblyseius* (Paraphytoseius), Ueckermann & Loots 1987: 221. *Amblyseius* (Ptenoseius), Pritchard & Baker 1962: 295. *Proprioseius* (Paraphytoseius), Karg 1983: 302. *Ptenoseius*, Schuster & Pritchard 1963: 198.

**Paraphytoseius cracentis** (Corpuz & Rimando)

*Ptenoseius cracentis* Corpuz & Rimando 1966: 115. *Amblyseius* (Paraphytoseius) *multidentatus*, misidentification (S5 illustrated in figures): Ehara & Bhandhufalck 1977: 79 as mentioned in Ehara et al. 2000: 114. *Paraphytoseius cracentis*, Moraes et al. 1986: 104; Chant & McMurtry 2003b: 220; Moraes et al. 2004a: 160; Chant & McMurtry 2007: 53.

**Specimens examined**: Muoi, in P3 plot (aasl 66 m, lat. 21°54’40” N, long. 104°38’13” E), 1 ♀ + 1 ♂ on *Chromolaena odorata* (Asteraceae) and 1 ♀ on *Rubus alceifolius* (Rosaceae), 11/V/2017; in P5 plot (aasl 66 m, lat. 21°54’56” N, long. 104°38’22” E), 3 ♀♀ + 1 ♂ + 1 im. on *C. odorata* (Asteraceae), 1 ♀ + 1 ♂ on *Ficus hispida* (Moraceae) and 1 ♀ + 1 ♂ on *Artemisa vulgaris* (Asteraceae), 13/V/2017; in P6 plot (aasl 66 m, lat. 21°54’55” N, long. 104°38’22” E), 1 ♀ on *Ficus hispida* (Moraceae) and 1 ♀ on *Curculigo orchioides* (Hypoxidaceae), 15/V/2017; in P7 plot (aasl 66 m, lat. 21°54’51” N, long. 104°38’22” E), 1 ♀ on *F. hispida* (Moraceae) and 2 ♀ + 2 ♂ on *Urena lobata* (Malvaceae), 16/V/2017; in P8 plot (aasl 66 m, lat. 21°54’46” N, long. 104°38’9” E), 2 ♀♀ on *C. odorata* (Asteraceae) and 1 ♀ on *R. alceifolius* (Rosaceae), 16/V/2017; in plot PM1 plot (aasl 66 m, lat. 21°54’ N, long. 104°38’ E), 2 ♀♀ on an unknown host plant, 17/V/2017; in P9 plot (aasl 66 m, lat. 21°54’46” N, long. 104°38’18” E), 1 ♀ on *U. lobata* (Malvaceae) and 6 ♀♀ + 1 ♂ on *C. odorata* (Asteraceae), 18/V/2017; in P10 plot (aasl 66 m, lat. 21°54’46” N, long. 104°38’12” E), 2 ♀♀ + 1 ♂ on *C. odorata* (Asteraceae), 18/V/2017; in P11 plot (aasl 66 m, lat. 21°54’30” N, long. 104°38’14” E), 4 ♀♀ + 1 ♂ on *F. hispida* (Moraceae), 1 ♀ + 1 im. on *Bidens pilosa* (Asteraceae), 4 ♀♀ + 1 ♂ on *C. odorata* (Asteraceae), 1 ♀ on *R. alceifolius* (Rosaceae) and 2 ♀♀ + 1 ♂ on an unknown host plant, 31/V/2017; in P15 plot (aasl 66 m, lat. 21°54’56” N, long. 104°38’46” E), 2 ♀♀ on *F. hispida* (Moraceae), 6 ♀♀ + 2 ♂♂ on *U. lobata* (Malvaceae) and 1 ♀ on *Ch. odorata* (Asteraceae), 03/VI/2019; in P4 plot (aasl 66 m, lat. 21°54’41” N, long. 104°38’7” E), 1 ♀ on *Xanthium strumarium* (Asteraceae), 18/VII/2017; in P5 plot (aasl 66 m, lat. 21°54’56” N, long. 104°38’22” E), 1 ♀ on *U. lobata* (Malvaceae), 19/VII/2017; in P6 plot (aasl 66 m, lat. 21°54’55” N, long. 104°38’22” E), 3 ♀♀ on *X. strumarium* (Asteraceae), 20/VII/2017; in P16
plot (aas 66 mm, lat. 21°54′56″ N, long. 104°38′46″ E), 1 ♀ on Ch. odorata (Asteraceae) and 1 ♀ on U. lobata (Malvaceae), 22/7/2017; in P10 plot (aas 66 mm, lat. 21°54′46″ N, long. 104°38′12″ E), 1 ♀ + 1 ♂ on Tephrosia candida (Fabaceae) and 1 ♀ on Morus alba (Moraceae), 25/7/2017; in P14 plot (aas 66 mm, lat. 21°54′56″ N, long. 104°38′46″ E), 1 ♀ on X. strumarium (Asteraceae), 27/7/2017; in P12 plot (aas 66 mm, lat. 21°54′51″ N, long. 104°38′45″ E), 2 ♀♀ + 1 ♂ on U. lobata (Malvaceae), 29/7/2017.

**Remarks:** The predatory mite *P. cracentis* is a natural enemy of thrips found on vegetables such as green bean, cucumber, green squash, eggplant, and pepper in the Red River Delta in Vietnam. *Paraphytoseius cracentis* is feeding on Frankliniella occidentalis Perigande (Thysanoptera: Thripidae) and *Carpglyphus lactis* (L.) (Acari: Acaridae) (Nguyen and De Clercq 2018, paper in which this species was mentioned for the first time for Vietnam. The intrinsic rate of natural increase of *P. cracentis* fed on *C. lactis* (0.215 female/ female/day) was however significantly higher than that of mites fed on thrips (0.189). Nguyen and De Clercq (2018) conclude that *P. cracentis* can sustain and increase its population when fed on

### Table 2

Character measurements of adult females and males of *Paraphytoseius cracentis* collected in this study and those reported in previous studies (localities followed by the number of specimens measured).

| Characters | Vietnam (12) | Japan | Papua New Guinea | Philippines | Taiwan | Thailand |
|------------|-------------|-------|-------------------|-------------|--------|---------|
|            |            |       |                   |             |        |         |
|            | 12, this study | 2 | 2 | ? | 10 | 3 |
| Dld         | 22.3 (17.7–26.0) | 19.3 (14.8–23.8) | 39.8 (31.1–48.5) | 32.1 (29.5–34.7) | 32.1 (29.5–34.7) | 32.1 (29.5–34.7) |
| Dnw at 50% | 154.3 (100–170) | 154.3 (100–170) | 214.8 (163–265) | 154.3 (100–170) | 154.3 (100–170) | 154.3 (100–170) |
| j5          | 87 (38–91) | 87 (38–91) | 92 (87–99) | 92 (87–99) | 92 (87–99) | 92 (87–99) |
| j6          | 5.4 (4–6) | 5.4 (4–6) | 5.4 (4–6) | 5.4 (4–6) | 5.4 (4–6) | 5.4 (4–6) |
| j5          | 6 (4–7) | 6 (4–7) | 6 (4–7) | 6 (4–7) | 6 (4–7) | 6 (4–7) |
| j6          | 4 (4–5) | 4 (4–5) | 4 (4–5) | 4 (4–5) | 4 (4–5) | 4 (4–5) |
| Zg          | 45 (43–48) | 45 (43–48) | 45 (43–48) | 45 (43–48) | 45 (43–48) | 45 (43–48) |
| Bc          | 123 (121–124) | 123 (121–124) | 123 (121–124) | 123 (121–124) | 123 (121–124) | 123 (121–124) |
| Zt          | 11 (10–11) | 10 (9–10) | 10 (9–10) | 10 (9–10) | 10 (9–10) | 10 (9–10) |
| Zs          | 9 (8–10) | 9 (8–10) | 9 (8–10) | 9 (8–10) | 9 (8–10) | 9 (8–10) |
| Zl          | 59 (54–64) | 59 (54–64) | 59 (54–64) | 59 (54–64) | 59 (54–64) | 59 (54–64) |
| Zs          | 88 (87–89) | 88 (87–89) | 88 (87–89) | 88 (87–89) | 88 (87–89) | 88 (87–89) |
| Zs          | 88 (87–89) | 88 (87–89) | 88 (87–89) | 88 (87–89) | 88 (87–89) | 88 (87–89) |
| Zs          | 88 (87–89) | 88 (87–89) | 88 (87–89) | 88 (87–89) | 88 (87–89) | 88 (87–89) |
| Zs          | 88 (87–89) | 88 (87–89) | 88 (87–89) | 88 (87–89) | 88 (87–89) | 88 (87–89) |
| Zs          | 88 (87–89) | 88 (87–89) | 88 (87–89) | 88 (87–89) | 88 (87–89) | 88 (87–89) |

**Sources of measurements:** For ♀♀: Japan: Ehara et al. (2000); Papua New Guinea: McMurtry & Moraes (1985); Philippines: Schicha & Corpuz-Raros (1985); Taiwan: Ho & Lo (1989); Thailand: Oliveira et al. (2012). For ♂♂: Philippines: Schicha & Corpuz-Raros (1985); Taiwan: Ho & Lo (1989); Thailand 1: (unidentified in *Paraphytoseius* s.l.), unsex 5, overlooked as mentioned by Ehara et al. (2000) Ehara & Bhandhufalck (1977); Thailand 2: Oliveira et al. (2012) – not provided.
F. occidentalis, and that C. lactis can be used for mass-rearing of this predatory mite in the perspective to use it in biological control.

This species was already known from Vietnam and reported locally as a BCA from earlier survey work (Nguyen and De Clercq 2018) though no measurements were provided. Measurements are given here in table 2 for females and males and compared with those obtained from specimens collected in other countries of Asia.

All measurements collected during this study match well with most of the previous measurements, especially with measurements of specimens from Thailand.

**Paraphytoseius horrifer** (Pritchard & Baker)

*Amblyseius* (*Ptenoseius*) *horrifer* Pritchard & Baker, 1962: 295.

*Amblyseius* *horrifer*, Meyer & Rodrigues 1966: 30.

*Proprioseius* (*Paraphytoseius*) *horrifer*, van der Merwe 1968: 169.

*Paraphytoseius* *horrifer*, Moraes et al. 1986: 105; Beard 2001: 84; Chant & McMurtry 2003b: 37; Moraes et al. 2004a: 152; Chant & McMurtry 2007: 53.

**Specimens examined**: Muoi, in P11 plot (aasl 66 m, lat. 21°54′30″ N, long. 104°38′14″ E), 1 ♂ on *Rubus alceifolius* (Rosaceae), 31/V/2017; in P15 plot (aasl 66 m, lat. 21°54′56″ N, long. 104°38′46″ E), 1 ♀ on *Chromolaena odorata* (Asteraceae), 2/VI/2017 and 1 ♀ on *R. alceifolius* (Rosaceae), 3/VI/2017; Ma, in P1 plot (aasl 66 m, lat. 21°45′3″ N, long. 105°1′28″ E), 1 ♀ on *Xanthium stumarium* (Asteraceae) and 1 ♀ on *Blumea eberhardtii* (Asteraceae), 14/VII/2017.

**Remarks**: This species is widely distributed in sub-Saharan Africa and Madagascar. The biology of *P. horrifer* remains totally unknown.

This is the first record of this species from Vietnam and from Asia. Measurements are given in the table 3 for females and males and compared with those obtained from specimens collected in other countries of Africa and Indian Ocean. Measurements obtained during this study agree well with most of the previous measurements obtained, especially with measurements of specimens from La Réunion Island.

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

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

*Paraphytoseius orientalis*, Moraes et al. 1986: 105; Chant & McMurtry 2003b: 220; Moraes et al. 2004a: 162, Chant & McMurtry 2007: 53.

*Amblyseius ipomeai* El-Banhawy 1984: 126 (synonymy according to Chant & McMurtry 2003b: 216).

*Paraphytoseius narayanani* Ehara 1967: 67 (synonymy according to Ehara & Ghai, in Ehara 1967: 77).

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

**Specimens examined**: Muoi, in P4 plot (aasl 66 m, lat. 21°54′41″ N, long. 104°38′7″ E), 1 ♀ on *Styrax tonkinensis* (Styracaceae), 12/V/2017; in P6 plot (aasl 66 m, lat. 21°54′55″ N, long. 104°38′22″ E), 1 ♀ on *Curculigo orchoides* (Hypoxidaceae), 15/V/2017; in P4 plot (aasl 66 m, lat. 21°54′41″ N, long. 104°38′7″ E), 1 ♀ on *Xanthium stumarium* (Asteraceae), 18/VII/2017; in P6 plot (aasl 66 m, lat. 21°54′55″ N, long. 104°38′22″ E), 1 ♀ on *X. stumarium* (Asteraceae), 20/VII/2017.

**Remarks**: This species is widely distributed in tropical and subtropical areas in South America, Africa and Asia. It and other members of the genus belong to the large polyphagous generalist group, type III (McMurtry & Croft 1997; McMurtry et al. 2013). Navasero and Navasero (2016) have studied the life history of *P. orientalis* on the broad mite, *Polyphagotarsonemus latus* (Banks), as prey. The authors reported high predation rates on *P. latus* eggs, suggesting its potential use against this pest.
This species has been collected before in Vietnam by Nguyen et al. (2016). Exact indications of locations were provided in this paper but without providing measurements of collected specimens. Measurements from this study are provided in the table and compared with those obtained from specimens collected in other countries of Asia and Indian Ocean. Measurements obtained with this study agree well with most obtained from female specimens.

### Table 3 Character measurements of adult females and males of *Paraphytoseius horrifer* collected in this study and those reported in previous studies (localities followed by the number of specimens measured).

| Characters | Vietnam 2, this study | Africa 4 | Holotype Zaire 12 | La Réunion 2 | Senegal 2 | South Africa 2 |
|------------|-----------------------|---------|------------------|-----------|---------|-----------------|
| D1l        | 300 – 308             | 300 (294 – 310) | 298              | 295 (265 – 330) | 300 – 304 | 318 – 339 |
| Dow at s4  | 170 – 175             | 158 (149 – 166) | 166              | 153 (128 – 175) | 163 – 170 | 165 – 176 |
| j1         | 35                    | 38 (37 – 40)    | 38               | 33 (25 – 40)   | 35 – 38  | 39 – 42  |
| j3         | 90                    | 85 (80 – 88)    | 84               | 86 (78 – 100)  | 83 – 85  |         |
| j4         | 5                     | 3               | 3                | 5 (3 – 5)      | 3 – 5   |         |
| j5         | 5                     | 3               | 3                | 5 (3 – 5)      | 3 – 5   |         |
| j6         | 5                     | 7 (6 – 8)       | 6                | 8 (5 – 10)     | 5 – 6   |         |
| j7         | 5                     | 4 (3 – 5)       | 3                | 5 (3 – 5)      | 5 – 5   |         |
| r3         | 49 – 50               | 43 (10 – 45)    | 45               | 48 (45 – 58)   | 43 – 45  | 52      |
| R1         | 33 – 35               | 31 (27 – 41)    | 28               | 38 (30 – 45)   | 30 – 32  | 36      |
| s4         | 125                   | 131 (122 – 139) | 138              | 126 (110 – 148) | 118 – 125 | 136 – 141 |
| z2         | 10 – 13               | 11 (10 – 12)    | 11               | 12 (9 – 13)    | 8 – 10  | 14      |
| z4         | 9 – 10                | 8 (6 – 11)      | 6                | 11 (9 – 13)    | 8 – 10  | 9       |
| z5         | 5                     | 5 (4 – 5)       | 5                | 5 (3 – 8)      | 3 – 5   | 5       |
| Z1         | 6 – 8                 | 7 (6 – 8)       | 5                | 7 (5 – 8)      | 7 – 9   | 5       |
| Z4         | 75                    | 80 (77 – 84)    | 84               | 80 (70 – 88)   | 73 – 75 | 85 – 89 |
| Z5         | 108                   | 114 (112 – 118) | 116              | 109 (93 – 133) | 95 – 100 | 122 – 127 |
| s1t-1st1   | 63 – 70               | -               | -                | 68 (55 – 73)   | -       | -       |
| s1t-2st2   | 68 – 70               | 73 (72 – 74)    | 69               | 71 (65 – 80)   | 68 – 69  | 78      |
| s1t-3st3   | 80                    | -               | -                | 79 (73 – 85)   | -       | 68      |
| s1t-3st5   | 70                    | 66 (64 – 69)    | 63               | 68 (58 – 75)   | 68 – 70  | 92      |
| s4t-4st4   | 85 – 93               | -               | -                | 88 (75 – 98)   | -       | -       |
| gensl      | 125                   | -               | -                | -             | -       | -       |
| st5-5st5   | -                     | 83 (82 – 86)    | 84               | 86 (75 – 95)   | 85 – 88  | 87      |
| gensw      | -                     | -               | -                | -             | -       | -       |
| Lisl       | 38                    | -               | -                | 30 (25 – 38)   | -       | -       |
| Lisl       | -                     | -               | -                | -             | -       | -       |
| Sd1        | -                     | -               | 11 (10 – 13)     | -             | -       | -       |
| Ysl        | -                     | 103 (96 – 110)  | 115              | 99 (53 – 118)  | 113 – 115 | 117     |
| Vsl ZV2    | -                     | 68 (62 – 74)    | 75               | 59 (53 – 75)   | 68 – 70  | 70      |
| Vsw annas  | -                     | 62 (59 – 67)    | 63               | 61 (55 – 68)   | 65      | -       |
| jVS        | 73 – 75               | -               | -                | 77 (70 – 85)   | -       | -       |
| SgelI      | 13 – 15               | 12 (11 – 13)    | -                | 15 (13 – 15)   | 13 – 15  | -       |
| SgelIV     | 25 – 30               | 25 (24 – 27)    | 24               | 27 (23 – 45)   | 28 – 30  | 28      |
| SnelV      | 37 – 40               | 37 (35 – 40)    | 34               | 36 (30 – 43)   | 32 – 38  | 47      |
| StIV       | 43                    | 40 (38 – 43)    | 36               | 43 (38 – 47)   | 43 – 45  | 47      |
| StelIV     | 45                    | 41 (39 – 42)    | -                | 45 (43 – 48)   | 33 – 35  | -       |
| Scl        | 2                     | 4 (3 – 5)       | 4                | 3 (3 – 5)      | -       | 25      |
| Sew        | 8                     | 12 (9 – 13)     | -                | 10 (9 – 11)    | -       | 10      |
| Fdl        | 28 – 30               | 29               | -                | 34 (23 – 50)   | -       | -       |
| No teeth Fd| 11                    | 10 – 11         | -                | 11             | -       | -       |
| Mdl        | 33                    | 34 (33 – 34)    | -                | 32 (25 – 38)   | -       | -       |
| No teeth Md| 3                     | 2 – 3           | -                | 2              | -       | -       |
| Shaft      | -                     | -               | -                | -              | -       | -       |
| Toe        | -                     | -               | -                | Not applicable | -       | -       |

Sources of measurements – For ♀♀: Africa (Benin 1♀, Kenya 1♀, Uganda 2♀); Moraes *et al.* (2007); Holotype Zaire: Moraes *et al.* 1989b; La Réunion: Kreiter *et al.* 2020; Senegal: Kade *et al.* (2011); South Africa: van der Merwe (1968). For ♂♂: La Réunion: Kreiter *et al.* 2020; South Africa: van der Merwe (1968); -: not provided.
Table 4 Character measurements of adult females of *Paraphytoseius orientalis* collected in this study and those reported in previous studies (localities followed by the number of specimens measured).

| Characters | Vietnam | Japan | Hong-Kong | La Réunion | Madagascar | Mauritius | Paratype Hong-Kong |
|------------|---------|-------|-----------|------------|------------|-----------|-------------------|
| Dsl        | 288 (280 – 295) | 278 (275 – 281) (8) | 259 – 305 | 266 (260 – 283) | 280 – 295 | 290 | 306 |
| Dsw at s4 level | 128 (123 – 140) | 153 (151 – 155) (8) | - | 150 (145 – 150) | 155 – 160 | - | 165 |
| j1         | 36 (33 – 37) | 36 | 36 (30 – 38) | 31 (28 – 35) | 30 – 36 | 38 | 36 |
| j3         | 78 (75 – 87) | 84 (82 – 85) | 79 (76 – 81) | 83 (81 – 88) | 79 – 89 | 83 | 81 |
| j4         | 4 (3 – 5) | 3 | 4 (3 – 5) | 5 (4 – 5) | < 10 | 5 | 4 |
| j5         | 5 (3 – 5) | 3 | 4 (3 – 5) | 5 (4 – 5) | < 10 | - | 4 |
| j6         | 7 (5 – 8) | 6 | 4 (3 – 5) | 5 (4 – 5) | < 10 | - | 6 |
| J5         | 4 (3 – 5) | 3 (3 – 4) | 4 (3 – 5) | 5 (4 – 5) | < 10 | - | 5 |
| r3         | 45 (43 – 50) | 48 (47 – 49) | 43 (41 – 46) | 38 (35 – 40) | 36 – 48 | 55 | 45 |
| R1         | 26 (25 – 28) | 26 (25 – 27) | 26 (20 – 33) | 34 (33 – 35) | 23 – 35 | 33 | 25 |
| s4         | 121 (118 – 125) | 121 (118 – 123) | 117 (107 – 124) | 120 (113 – 123) | 118 – 130 | 125 | 117 |
| z2         | 10 (9 – 10) | 8 (7 – 8) | 8 (5 – 11) | 11 (10 – 15) | < 10 | 8 | 9 |
| z4         | 9 (7 – 10) | 9 (9 – 10) | 10 (8 – 13) | 10 (5 – 10) | < 10 | 10 | 11 |
| z5         | 5 (3 – 5) | 5 | 4 (3 – 5) | 6 (6 – 8) | < 10 | - | 3 |
| Z1         | 8 (7 – 8) | 7 | 8 (8 – 10) | 9 (6 – 9) | < 10 | 8 | 8 |
| Z4         | 72 (65 – 78) | 74 (73 – 75) | 74 (69 – 81) | 80 (70 – 80) | 68 – 80 | 70 | 71 |
| Z5         | 94 (88 – 100) | 100 (99 – 101) | 82 (76 – 91) | 105 (99 – 107) | 96 – 116 | 93 | 94 |
| st1-st1    | 65 (60 – 68) | - | - | - | - | - | - |
| st2-st2    | 66 (65 – 68) | - | - | - | 68 (65 – 68) | - | 66 |
| st3-st3    | 74 (73 – 75) | - | - | - | 75 (75 – 78) | - | - |
| st1-st3    | 62 (60 – 63) | - | - | - | 65 (64 – 65) | - | 65 |
| st4-st4    | 85 (78 – 93) | - | - | - | 85 (85 – 93) | - | - |
| Gensl      | 107 (105 – 108) | - | - | - | - | - | - |
| st5-st5    | 84 (80 – 93) | - | - | 85 | - | - | 79 |
| Gensw      | 90 (88 – 93) | - | - | - | - | - | - |
| Lisl       | 30 | - | - | 18 | - | - | - |
| Lisw       | 3 | - | - | 2 | - | - | - |
| Vsl        | 96 (88 – 100) | - | 93 (84 – 102) | 80 | 102 – 108 | 113 | 97 |
| Vsw ZV2    | 64 (63 – 65) | - | 53 | 65 | 59 – 63 | - | 52 |
| Vsw anus   | 54 (53 – 55) | - | 53 – 55 | 63 | - | - | 55 |
| JV5        | 71 (63 – 78) | 71 (70 – 72) | 69 (64 – 76) | 66 (65 – 75) | 63 – 82 | - | - |
| Sgel       | 9 (8 – 10) | 9 (8 – 9) | - | - | - | 8 | 6 |
| SgeII      | 13 (10 – 15) | 14 (14 – 15) | - | 13 | Present | 13 | 13 |
| SgelV      | 27 (25 – 29) | 28 (27 – 28) | 28 (25 – 33) | 23 (21 – 28) | 22 – 27 | 30 | 25 |
| StlV       | 34 (31 – 37) | 34 (34 – 35) | 35 (33 – 38) | 38 (30 – 38) | 28 – 38 | 38 | 35 |
| StlV       | 46 (45 – 48) | 49 (48 – 49) | 44 (41 – 46) | 41 (38 – 42) | 38 – 45 | 45 | 43 |
| StIV       | 38 (35 – 40) | 35 (38 – 39) | 33 (30 – 36) | 33 (33 – 45) | 34 – 42 | 48 | 36 |
| Sel        | 3 | - | 3 (3 – 5) | 20 | 4 | - | - |
| Sew        | 10 | - | 10 (8 – 11) | 7 | 6 | - | - |
| Fdl        | 25 (25 – 28) | - | 25 | 27 (27 – 30) | - | 25 | - |
| No teeth Fd | 8 | - | 7 | 7 – 8 | 8 | 7 | - |
| Mdl        | 29 (28 – 30) | - | 29 (28 – 30) | 35 (31 – 35) | - | 28 | - |
| No teeth Md | 3 | - | 2 | 2 | 3 | 2 | - |

Sources of measurements – Japan: (identified as *Paraphytoseius multidentatus*, synonymized by Mathysse & Denmark 1981): Ehara et al. (2000); Hong-Kong: Swirski & Shechter (1961); La Réunion: Kreiter et al. 2020; Madagascar (identified as *Paraphytoseius multidentatus*, synonymized by Mathysse & Denmark 1981): Blommers (1976); Mauritius: Kreiter et al. (2018a); Paratype Hong-Kong: Moraes et al. (2007); - : not provided.
collected in other countries, especially with measurements of specimens from Hong Kong and La Réunion Island.

**Genus Scapulaseius Karg & Oomen-Kalsbeek**

*Scapulaseius* Karg & Oomen-Kalsbeek 1987: 132.

*Amblyseius* (*Scapulaseius*) Karg & Oomen-Kalsbeek 1987: 132.

*newsami* group of *Typhlodromus* (*Amblyseius*), Chant 1959: 95.

*markwelli* species group of *Amblyseius*, Schicha 1987: 2.

*japonicus* species group of *Amblyseius*, Schicha 1987: 26.

*oguroi* species group of *Amblyseius*, Wu & Ou 1999: 103.

*Scapulaseius*, Chant & McMurtry 2005b: 331; 2007: 65.

**Scapulaseius asiaticus (Evans)**

*Typhlodromus asiaticus* Evans 1953: 461.

*Typhlodromus* (*Amblyseius*) *asiaticus*, Chant 1959: 80.

*Amblyseius* (*Typhlodromopsis*) *asiaticus*, Muma 1961: 289.

*Amblyseius* (*Amblyseius*) *asiaticus*, Ehara 1966: 20; Ehara & Bhandhufalck, 1977: 58.

*Amblyseius asiaticus*, Carmona 1968: 280; Gupta, 1975: 32.

*Amblyseius* (*Neoseiulus*) *asiaticus*, Ehara 2002: 127.

*Typhlodromips asiaticus*, Moraes et al. 2004a: 207.

*Scapulaseius asiaticus*, Chant & McMurtry 2005b: 335; 2007: 67.

*Scapulaseius linearis* Corpuz-Raros & Rimando 1966:125 (synonymy according to Schicha & Corpuz-Raros 1992: 60).

*Scapulaseius siaki* Ehara & Lee 1971: 64 (synonymy according to Ehara & Bhandhufalck 1977: 58).

**Specimens examined**: Ma, in P1 plot (aasl 63 m, lat. 21°45′53″ N, long. 105°1′28″ E), 1 ♀ on *Chromolaena odorata* (Asteraceae), 9/V/2017; Muoi, in P7 plot (aasl 66 m, lat. 21°54′51″ N, long. 104°38′22″ E), 1 ♀ on *Crassecephalum crepidioides* (Asteraceae), 16/V/2017; in P9 plot (aasl 66 m, lat. 21°54′46″ N, long. 104°38′18″ E), 1 ♀ on an unknown plant support, 18/V/2017; in P11 plot (aasl 66 m, lat. 21°54′30″ N, long. 104°38′14″ E), 1 im. on *C. odorata* (Asteraceae), 31/V/2017; in P15 plot (aasl 66 m, lat. 21°54′56″ N, long. 104°38′46″ E), 1 ♀ on *C. odorata* (Asteraceae), 31/V/2017; in P8 plot (aasl 66 m, lat. 21°54′46″ N, long. 104°38′9″ E), 2 ♀♀ + 1 im. on *Xanthium strumarium* (Asteraceae), 2/VI/2017; in P13 plot (aasl 66 m, lat. 21°54′50″ N, long. 104°38′46″ E), 1 ♀ on *X. strumarium* (Asteraceae), 29/VII/2017.

**Remarks**: Species of this genus are supposed to be of type III (McMurtry and Croft 1997; McMurtry et al. 2013), i.e. a polyphagous generalist predator. However, the biology of *S. asiaticus* remains totally unknown.

This species was already known from Vietnam from results of a previous survey (Nguyen et al. 2016). Exact indications of locations were provided in this paper without providing any morphological data on the collected specimens. Measurements of collected specimens during this study are provided in table 5 and compared with those obtained from specimens collected in other countries of Asia and Indian Ocean. Measurements obtained match with most of previous measurements, especially with measurements of specimens from Thailand.

**Scapulaseius okinawanus (Ehara)**

*Amblyseius* (*Amblyseius*) *okinawanus* Ehara 1967: 72; Ehara & Bhandhufalck 1977: 58.

*Amblyseius okinawanus*, Lo 1970: 56.

*Neoseiulus okinawanus*, Moraes et al. 1986: 91.

*Amblyseius* (*Neoseiulus*) *okinawanus*, Ehara & Amano 1998: 37; Ehara & Amano 2002: 321.

*Amblyseius okinawanus*, Jung et al. 2003: 189.

*Typhlodromips okinawanus*, Moraes et al. 1986: 137; 2004a: 220.

*Scapulaseius okinawanus*, Chant & McMurtry 2005b: 335; 2007: 67.
Table 5 Character measurements of adult females of *Scapulaseius asiaticus* collected in this study and those reported in previous studies (localities followed by the number of specimens measured).

| Characters | Vietnam | Indonesia | Mauritius | Sri Lanka | Thailand 1 | Thailand 2 |
|------------|---------|-----------|-----------|-----------|------------|------------|
| Dsl        | 306     | 300 – 325 | 311 (304 – 325) | 287 | 330 | 301 (283 – 318) |
| Dsw at s4 level | 179 | 180 - 195 | 191 (182 – 199) | 182 | 230 | 200 (181 – 222) |
| j1         | 21      | 16 – 18   | 22 (20 – 24)  | 19 | 20 | 21 (19 – 23) |
| j3         | 14      | 16 – 18   | 17 (15 – 20)  | 13 | 18 | 15 (10 – 16) |
| j4         | 8       | 8 – 9     | 5           | 8 | 7 | 8 (7 – 10) |
| j5         | 8 (6 – 8) | 8 – 9     | 5           | 8 | 7 | 8 (6 – 10) |
| j6         | 9 (8 – 10) | 8 – 9     | 8 (7 – 9)  | 9 | 8 | 10 (9 – 12) |
| J2         | 9 (8 – 10) | 8 – 9     | 9 (7 – 9)  | 9 | 9 | 11 (10 – 12) |
| J5         | 8 (8 – 9) | 8 – 9     | 8 (7 – 8)  | 6 | 6 | 8 (7 – 8) |
| r3         | 13 (13 – 15) | 16 – 18   | 15 (13 – 16) | 12 | 14 | 13 (11 – 15) |
| R1         | 10      | 9 – 13    | 18 (16 – 19) | 14 | 16 | 16 (14 – 17) |
| s4         | 18      | 16 – 18   | 23 (22 – 25) | 17 | 21 | 21 (18 – 23) |
| S2         | 15      | 16 – 18   | 18 (15 – 20) | 13 | 15 | 16 (13 – 18) |
| S4         | 12      | 10 – 13   | 15 (13 – 17) | 12 | 13 | 14 (11 – 15) |
| S5         | 13      | 10 – 15   | 16 (13 – 15) | 11 | 13 | 14 (12 – 19) |
| z2         | 12      | 10 – 15   | -           | 11 | 13 | 14 (13 – 15) |
| z4         | 13      | 10 – 15   | -           | 11 | 11 | 11 (7 – 13) |
| z5         | 8 (7 – 10) | -         | 7 (6 – 9)  | 7 | 9 | 9 (8 – 11) |
| Z1         | 10      | 7 – 13    | -           | 9 (8 – 9) | - | 11 (10 – 12) |
| Z4         | 50      | 47 (55)   | 44 (44 – 52) | 45 | 51 | 52 (49 – 58) |
| Z5         | 77      | 75 (80)   | 73 (65 – 77) | 68 | 73 | 74 (70 – 83) |
| st1-stl    | 50      | -         | -           | - | - | - |
| st2-stl2   | 58      | -         | 57 (55 – 60) | 52 | - | 59 (57 – 61) |
| st3-stl3   | 61      | -         | -           | - | - | - |
| stl-stl3   | 53      | -         | 53 (52 – 54) | 48 | - | 54 (50 – 58) |
| st4-stl4   | 65      | -         | -           | - | - | - |
| Gensl      | 101     | -         | -           | - | - | - |
| st5-stl5   | 59      | -         | 61 (55 – 65) | 54 | - | 61 (58 – 64) |
| GenSw post. corn. | 69 | 65 (80) | 71 (60 – 74) | - | - | - |
| Lisl       | 16      | 13 (18)   | -           | - | - | - |
| Lisw       | 3       | 2 – 5     | -           | - | - | - |
| Sisl       | 10      | -         | -           | - | - | - |
| Vsl        | 102     | 95 (110)  | 99 (95 – 101) | 97 | - | 103 (97 – 110) |
| Vsw ZV2    | 82      | 78 (90)   | 81 (77 – 84) | 79 | - | 84 (80 – 87) |
| Vsw anus   | 64      | 50 (73)   | 67 (61 – 74) | 65 | - | - |
| JV3        | 23      | 20 (25)   | -           | 26 (22 – 28) | - | 19 |
| Sgel       | 16      | 15 (20)   | -           | 18 (16 – 19) | - | 17 (15 – 20) |
| SgelII     | 12      | 10 (15)   | -           | 12 (10 – 13) | - | 11 (8 – 13) |
| SgelIII    | 17      | 15 (19)   | -           | 15 (13 – 17) | 14 | - | 17 (15 – 18) |
| StiIII     | 15      | 13 (18)   | -           | - | - | 15 |
| SgelIV     | 28      | 25 (30)   | -           | 26 (24 – 29) | 22 | 27 | 27 (24 – 30) |
| StiIV      | 22      | 20 (24)   | -           | 20 (18 – 23) | 18 | 22 | 22 (18 – 26) |
| StiV       | 50      | 48 (50)   | -           | 49 (44 – 53) | 45 | 50 | 49 (44 – 52) |
| ScI        | 30      | 28 (35)   | -           | 33 (29 – 34) | 27 | - | 35 (29 – 40) |
| Scw        | 5       | 4 – 6     | -           | - | - | - |
| Fdl, No teeth | 25  | 23 – 28, 9 | 26 (24 – 27) | 9 | - | 22 (21 – 23) |
| Mdl, No teeth | 25  | 23 – 28, 3 | 27 (25 – 29) | 3 | - | 25 (23 – 25) |

Sources of measurements – Mauritius: Ferragut & Baumann (2019); Sri Lanka: Moraes et al. (2004b); Thailand 1: Ehara & Bhandhufalck (1977); Thailand 2: Oliveira et al. (2012); -: not provided.
Specimens examined: Muoi, in PM1 plot (aasl 66 m, lat. 21°54’ N, long. 104°38’ E), 2 ♂♂ on an unknown host plant, 17/V/2017; in P9 plot (aasl 66 m, lat. 21°54’46” N, long. 104°38’18” E), 2 ♀♀ on *Crassocephalum crepidioides* (Asteraceae), 17/V/2017; in P15 plot (aasl 66 m, lat. 21°54’56” N, long. 104°38’46” E), 1 ♀ on *Rubus alceifolius* (Rosaceae), 17/V/2017; in P11 plot (aasl 66 m, lat. 21°54’30” N, long. 104°38’14” E), 3 ♀♀ on *Xanthium strumarium* (Asteraceae), 26/VII/2017.

Remarks: The biology of *S. okinawanus* remains totally unknown. This is the first mention of this species in Vietnam. Measurements of specimens collected during this study are provided in table 6 for females and males and compared with measurements obtained from specimens collected in other countries of Asia. Measurements obtained agree well with most of those previously obtained, except setae *j6, J2*, and *z5*, and macrosetae *SgeI* and *SgeII* in female specimens and shorter setae of the *j-J, S* series and *Z1* of male specimens.

**Genus Amblyseius Berlese**

*Amblyseius* Berlese, 1914: 143; Garman, 1948: 16; Muma, 1955: 263; Chant, 1957: 528; Kennet, 1958: 474; Muma, 1961: 287; Gonzalez & Schuster, 1962: 8; Pritchard & Baker, 1962: 235; van der Merwe & Ryke, 1963: 89; Corpuz & Rimando, 1966: 116; van der Merwe, 1968: 109; Zack, 1969: 71; Muma and Denmark, 1970: 62; Chant & Hansell, 1971: 703; Denmark & Muma, 1972: 19; Tseng, 1976: 104; Chaudhari *et al.*, 1979: 68; Karg, 1982: 193, Schicha, 1987: 19, Schicha & Corpuz-Raros, 1992: 12; Denmark & Muma, 1989: 4; Chant & McMurtry, 2004a: 188; 2007: 73. *Amblyseius* (Amblyseius), Karg, 1983: 313. *Amblyseius* (Amblyseialus), Karg, 1983: 313. *Amblyseius* (Amblyseius) section *Amblyseius*, Wainstein, 1962: 15. *Amblyseius* (Amblyseius) section *Italoseius* Wainstein, 1962: 15.

*Amblyseius cinctus* Corpuz & Rimando

*Amblyseius cinctus* Corpuz & Rimando 1966: 119. *Amblyseius* (Amblyseius) *cinctus*, Ehara & Bhandhufalck 1977: 70. *Amblyseius* (Multiseius) *cinctus*, Denmark & Muma 1989: 103. *Amblyseius cinctus*, Moraes *et al.* 1986: 10; 2004a: 20; Chant & McMurtry 2004a: 203; 2007: 78.

Specimens examined: Muoi in P1 plot (aasl 66 m, lat. 21°54’ N, long. 104°38’ E), 10 ♀ + 1 im. on *Manihot esculenta* (Euphorbiaceae), 17/V/2017; in P5 plot (aasl 66 m, lat. 21°54’56” N, long. 104°38’22” E), 1 ♀ on *Urena lobata* (Malvaceae), 19/VII/2017.

Remarks: This species was described from specimens collected in the Philippines on *Panicum* sp. and *Streblus asper*. Life history of *A. cinctus* has been evaluated on *Polyphagotarsonemus latus* (Banks), an important pest of several cultivated (crop) plants worldwide (Vichitbandha and Chandrapatya 2009) and this species can be considered as a potential BCA of *P. latus*.

This is the first mention of this species in Vietnam. Measurements of specimens collected during this study are provided in table 7 and compared with measurements obtained from specimens collected in other countries of South-East Asia. Measurements obtained during this study agree well with those obtained from female specimens collected in other countries.

*Amblyseius herbicolus* (Chant)

*Typhlodromus* (Amblyseius) *herbicolus* Chant 1959: 84. *Amblyseius* (Amblyseius) *herbicolus*, Muma 1961: 287. *Typhlodromus herbicolus*, Hirschmann 1962: 23.
### Table 6 Character measurements of adult females and males of *Scapulaseius okinawanus* collected in this study and those reported in previous studies (localities followed by the number of specimens measured).

| Characters                  | Vietnam 6, this study | Japan 9 | Korea 7 | New Hebrides 1? | Vietnam 2, this study | Japan 3 | Korea 4 |
|-----------------------------|-----------------------|---------|---------|-----------------|-----------------------|---------|---------|
| Dsl                         | 324 (310 – 328)       | 340     | 306     | 314             | 243 – 250             | 250     | -       |
| Dsw at s4 level             | 201 (180 – 210)       | 190 – 250 | 205 | 173             | 125 – 128             | 180     | -       |
| j1                          | 20 (18 – 22)          | 21      | 20      | -               | 18                    | 18      | 18      |
| j3                          | 15 (13 – 15)          | 16      | 16      | -               | 13 – 14               | 19      | 19      |
| j4                          | 9 (8 – 10)            | 10      | 9       | -               | 6 – 8                 | 10      | 9       |
| j5                          | 8 (5 – 10)            | 10      | 9       | -               | 6 – 8                 | 9       | 9       |
| j6                          | 8 (8 – 10)            | 12      | 12      | -               | 8                    | 11      | 10      |
| J2                          | 10 (9 – 10)           | 15      | 15      | -               | 8 – 10                | 12      | 11      |
| J3                          | 9 (8 – 9)             | 8       | 9       | -               | 7 – 8                 | 8       | 7       |
| r3                          | 13 (10 – 15)          | 14      | 13      | -               | 12 – 14               | 12      | 10      |
| R1                          | 10 (8 – 13)           | 11      | 11      | -               | 11 – 12               | 11      | 10      |
| s4                          | 20 (19 – 21)          | 22      | 20      | -               | 18 – 19               | 19      | 18      |
| S2                          | 19 (18 – 20)          | 17      | 18      | -               | 13 – 16               | 17      | 18      |
| S4                          | 16 (15 – 18)          | 16      | 17      | -               | 13                    | 17      | 16      |
| S5                          | 16 (14 – 18)          | 15      | 18      | -               | 11 – 12               | 15      | 17      |
| z2                          | 14 (13 – 15)          | 15      | 14      | -               | 13                    | 14      | 14      |
| z4                          | 15 (13 – 16)          | 16      | 15      | -               | 15 – 18               | 15      | 15      |
| z5                          | 9 (8 – 10)            | 11      | 10      | -               | 6 – 8                 | 10      | 9       |
| Z1                          | 12 (10 – 13)          | 14      | 14      | -               | 5 – 7                 | 12      | 12      |
| Z4                          | 35 (33 – 37)          | 35      | 33      | -               | 30 – 34               | 30      | 27      |
| Z5                          | 82 (80 – 88)          | 78      | 80      | -               | 53 – 58               | 57      | 56      |
| st1-st1                     | 49 (48 – 51)          | -       | -       | -               | 38 – 43               | -       | -       |
| st2-st2                     | 58 (55 – 63)          | -       | -       | 65              | 48 – 51               | -       | -       |
| st3-st3                     | 64 (63 – 68)          | -       | -       | -               | 47 – 48               | -       | -       |
| st1-st3                       | 55 (53 – 58)          | -       | -       | 55              | 93 – 95               | -       | -       |
| st4-st4                     | 70 (60 – 83)          | -       | -       | -               | 35 – 36               | -       | -       |
| Gensl                       | 104 (103 – 105)       | -       | -       | Not applicable  | 33 – 34               | -       | -       |
| Gensw post. corn.           | 72 (68 – 75)          | -       | -       | -               | Not applicable        | -       | -       |
| Lisl                        | 16 (15 – 18)          | -       | -       | 18              | -                    | -       | -       |
| Lisw                        | 5 (3 – 7)             | -       | -       | -               | -                    | -       | -       |
| Sisl                        | 10 (8 – 13)           | -       | -       | 10              | -                    | -       | -       |
| Vsl                         | 104 (98 – 108)        | -       | -       | 115             | 97 – 105              | -       | -       |
| Vsw ZV2                     | 88 (83 – 90)          | -       | -       | 92              | 100 – 115             | -       | -       |
| Vsw anus                    | 79 (78 – 80)          | -       | -       | -               | 58 – 68               | -       | -       |
| Dist. solen. vas            | 24 (23 – 25)          | -       | -       | -               | 18                    | 20      | 22      |
| JV5                         | 29 (25 – 30)          | 28      | 28      | -               | 18                    | -       | -       |
| Sged                        | 10 (9 – 13), knob.    | -       | -       | 19 – 20 knob.   | 10                    | -       | -       |
| SgedII                     | 9 (8 – 9), knob.      | -       | -       | 15 – 16 knob.   | 13                    | -       | -       |
| SgedIII                    | 19 (18 – 20), knob.   | -       | -       | 21 – 23 knob.   | 10                    | -       | -       |
| StiIII                     | 17 (13 – 19)          | -       | -       | 18              | 23                    | 20      | 21      |
| SgedIV                     | 27 (25 – 30), knob.   | 29      | 25      | 31 knob.        | 15                    | 20      | 22      |
| StiIV                      | 24 (20 – 25)          | 24      | 25      | 25              | 43                    | 42      | 48      |
| StiV                       | 53 (53 – 54), knob.   | 54      | 56      | 55 knob.        | Not applicable        | -       | -       |
| Scl                         | 11 (10 – 13)          | -       | -       | 8               | -                    | -       | -       |
| Scw                         | 7 (5 – 8)             | -       | -       | -               | -                    | -       | -       |
| Fdl, No teeth               | 25 (23 – 25)          | -       | -       | -               | 23                    | -       | -       |
| No teeth Fd                 | 7                    | -       | -       | -               | 7                     | -       | -       |
| Mdl, No teeth               | 27 (25 – 28)          | -       | -       | -               | 23                    | -       | -       |
| No teeth Md                 | 3                    | -       | -       | -               | 1                     | -       | -       |
| Shaft                       | Not applicable        | -       | -       | -               | -                    | -       | -       |
| Toe                         | 13 – 15               | -       | -       | -               | 5                     | -       | -       |

Sources of measurements – For ♀♀: Japan: Ehara (1967); Korea: Ryu & Lee (1992); New Hebrides: Schicha (1982). For ♂♂: Japan Ehara (1967); Korea: Ryu & Lee (1992). - : not provided.
Amblyseius herbicola, Moraes et al. 1986: 14; 1989a: 79; Chant & McMurtry 2004: 208; Moraes et al. 2004a: 27; Chant & McMurtry 2007: 78.
Amblyseius deleoni Muma & Denmark 1970: 68 (synonymy according to Daneshvar & Denmark 1982; Denmark & Muma 1989).
Amblyseius giganteus Gupta 1981: 33 (synonymy according to Gupta 1986).
Amblyseius impactus Chaudhri 1968: 553 (synonymy according to Daneshvar & Denmark 1982).
Amblyseius (Amblyseius) thermophilus Karg 1991: 12 (synonymy according to El-Banawy & Knapp 2011).
Typhlodromus (Amblyseius) amitae Bhattacharyya 1968: 677 (synonymy according to Denmark & Muma 1989).

Specimens examined: Muoi in P8 plot (aasl 66 m, lat. 21°54′46″ N, long. 104°38′9″ E), 1 ♀ on Paspalum sp. (Poaceae), 17/V/2017.

Remarks: Amblyseius herbicola is widespread in all tropical and subtropical regions of the world. It is the second most abundant phytoseiid mite on Coffea arabica in Brazil, and is deemed to be an efficient predator of Brevipalpus phoenicis (Geijskes), vector of the coffee ring spot virus (Reis et al. 2007). Amblyseius herbicola is also found in association with the broad mite, Polyphagotarsonemus latus Banks in crops such as chili pepper (Capsicum annum) in Brazil and has good potential for controlling the latter. Rodriguez-Cruz et al. (2013) have demonstrated that A. herbicola was able to develop on broad mites, castor bean pollen (Ricinus communis) and sunn hemp pollen (Crotalaria juncea). Provision of pollen can enhance populations of this predator and increase biological control (Duarte et al. 2015).

### Table 7 Character measurements of adult females of Amblyseius cinctus collected in this study and those reported in previous studies (localities followed by the number of specimens measured).

| Characters | Vietnam 11, this study | Philippines | Thailand 1 | Thailand 2 |
|------------|-------------------------|-------------|------------|------------|
| Dsl        | 337 (308 – 363)         | 314         | 350        | 326 (312 – 341) |
| Dow at s4 level | 196 (188 – 207)     | 175         | 240        | 223 (218 – 227) |
| j1         | 25 (23 – 30)            | 24 – 26     | 25         | 25 (24 – 25)  |
| j3         | 44 (40 – 48)            | 42 – 44     | 44         | 45 (44 – 46)  |
| j4         | 5 (4 – 6)               | 5           | 5          | 5 (5 – 6)     |
| j5         | 5 (4 – 5)               | 4           | 4          | 4            |
| j6         | 5 (5 – 7)               | 5           | 5          | 6 (5 – 7)     |
| J2         | 6 (5 – 7)               | 5           | 5          | 6 (6 – 7)     |
| J3         | 5 (5 – 7)               | 8           | 6          | 6            |
| jz         | 13 (10 – 15)            | 10          | 13         | 13 (13 – 14)  |
| R1         | 8 (6 – 8)               | 9           | 7          | 7 (7 – 8)     |
| s4         | 73 (63 – 82)            | 68 – 73     | 69         | 70 (68 – 77)  |
| S2         | 7 (5 – 8)               | 6           | 7          | 8 (7 – 8)     |
| S4         | 5 (5 – 6)               | 6           | 7          | 6 (7 – 6)     |
| S3         | 5 (5 – 6)               | 9           | 6          | 6 (5 – 7)     |
| z2         | 10 (8 – 13)             | 7           | 9          | 10 (9 – 10)   |
| z4         | 8 (6 – 9)               | 8           | 7          | 7 (6 – 7)     |
| s5         | 5 (4 – 5)               | 4           | 4          | 4            |
| Z1         | 6 (5 – 8)               | 6           | 6          | 7 (7 – 8)     |
| Z4         | 88 (83 – 95)            | 72 – 90     | 86         | 95 (88 – 106) |
| Z5         | 178 (166 – 188)         | 200         | 169        | 172 (168 – 182) |
| s1-s2      | 59 (55 – 64)            | -           | -          | -            |
| s2-s2a2    | 66 (63 – 68)            | 60          | -          | 66 (65 – 67)  |
| s3-s3a3    | 74 (70 – 77)            | 79          | -          | -            |
| s1-s3a3    | 55 (53 – 58)            | -           | -          | 56 (55 – 58)  |
| s1a-s4     | 76 (68 – 105)           | -           | -          | -            |

| Characters | Vietnam 11, this study | Philippines | Thailand 1 | Thailand 2 |
|------------|-------------------------|-------------|------------|------------|
| Gensl      | 114 (105 – 125)         | -           | -          | -          |
| s5-sa5     | 66 (62 – 69)            | 74          | -          | 68 (66 – 70) |
| Genw. post. corn. | 77 (70 – 85) | -          | -          | -          |
| Lisl       | 16 (13 – 18)            | 16          | -          | -          |
| Lisw       | 5 (3 – 6)               | -           | -          | -          |
| St      | 9 (7 – 10)              | 8           | -          | -          |
| Vol        | 109 (100 – 115)         | 82          | -          | 114 (110 – 118) |
| Vsw Z1/2   | 81 (75 – 88)            | -           | -          | 80 (78 – 84) |
| Vsw unus   | 73 (63 – 78)            | -           | -          | -          |
| Dist. Solen. proa | 21 (20 – 23) | -          | -          | -          |
| J/5        | 59 (55 – 65)            | 52 – 70     | 57         | -          |
| Sgel       | 32 (28 – 35)            | 33          | -          | 34 (32 – 35) |
| SgelII     | 30 (25 – 33)            | 32          | -          | 33 (32 – 34) |
| SgelIII    | 42 (38 – 48)            | 45          | -          | 44 (42 – 46) |
| StIII      | 30 (28 – 33)            | 34          | -          | 31 (28 – 32) |
| SgelIV     | 85 (80 – 91)            | 84          | 79         | 84 (80 – 86) |
| StIV       | 49 (45 – 55)            | 36          | 53         | 47          |
| StIV      | 62 (53 – 65)            | 56          | 60         | 60          |
| Scw        | 3 (3 – 4)               | -           | -          | -          |
| Fdl, No teeth | 29 (25 – 33), 9 – 10 | 27, 9 – 10  | -          | -          |
| Mdl, No teeth | 30 (28 – 33), 3 – 4   | 31, 3 – 4   | -          | -          |

Sources of measurements - Philippines: Corpuz & Rimando (1966) and Schicha & Corpuz-Raros (1992); Thailand 1: Ehara & Bhandhufalck (1977); Thailand 2: Oliveira et al. (2012); - : not provided.
Table 8. Character measurements of adult females of *Amblyseius herbicolus* collected in this study and those reported in previous studies (localities followed by the number of specimens measured).

| Characters | Vietnam 1, this study | Africa 8 | Grande Comore 2 | Holotype Portugal, 1 | Kenya 46 | La Réunion 15 | Senegal 2 | Thailand 1 | Turkey 3 |
|------------|-----------------------|---------|-----------------|---------------------|--------|---------|--------|--------|--------|
| Dsl        | 388                   | 352 (325–368) | 385–428 | 369 | 335 | 359 (343–390) | 360–365 | 360 | 313–352 |
| Dsw at s4  | 182                   | 256 (240–274) | 263–275 | 236 | 190 | 240 (225–265) | 250–268 | 194 | 196–221 |
| j1         | 38                    | 37 (34–40) | 40–43 | 38 | 32 | 35 (33–38) | 35–38 | 37 | 33–38  |
| j3         | 43                    | 49 (38–58) | 53–55 | 42 | 37 | 40 (38–45) | 38–45 | 38 | 32–39  |
| j4         | 8                     | 6 (5–8)  | 6 | 9 | 4–6 | 7 (5–8) | 6–8 | 6 | 8–9    |
| j5         | 5                     | 4 (3–5)  | 5 | 7 | 4–6 | 5 (5–5) | 4 | 5 | 7–8    |
| j6         | 8                     | 7 (5–8)  | 5–6 | 11 | 4–6 | 7 (5–8) | 8 | 8 | 6–7    |
| J2         | 10                    | 10 (8–11)| 8–10 | 12 | 4–6 | 8 (8–10) | 8–9 | 9 | 8–9    |
| J5         | 10                    | 8 (6–10) | 10 | 9 | 4–6 | 8 (8–10) | 8–10 | 7 | 9–10   |
| r3         | 13                    | 14 (11–16)| 8–15 | 15 | 10 | 12 (10–13) | 10–11 | 13 | 10–16  |
| R1         | 10                    | 9 (8–10) | 10–13 | 8 | 10 | 10 (10–13) | 9–10 | 9 | 8–9    |
| s4         | 105                   | 113 (98–130)| 120–125 | 100 | 92 | 98 (95–108) | 123–135 | 95 | 86–96  |
| S2         | 8                     | 12 (8–14)| 13 | 11 | 10 | 12 (10–13) | 13–15 | 10 | 10–12  |
| S4         | 8                     | 11 (8–13)| 13 | 11 | 10 | 11 (8–13) | 8–10 | 11 | 9–11   |
| S5         | 8                     | 9 (8–10) | 13 | 11 | 10 | 9 (8–10) | 8–10 | 9 | 9–10   |
| z2         | 10                    | 11 (8–16)| 6–8 | 13 | 6 | 13 (8–18) | 8–9 | 13 | 9–12   |
| z4         | 10                    | 8 (8–10) | 8 | 9 | 6 | 10 (8–13) | 10–11 | 10 | 8–12   |
| z5         | 8                     | 6 (5–6)  | 5 | 6 | 6 | 5 (5–8) | 7–9 | 7 | 6–7    |
| Z1         | 10                    | 8 (10–13)| 8 | 9 | 10 | 12 (10–13) | 8–10 | 13 | 9–12   |
| Z4         | 105                   | 126 (101–152)| 133–135 | 110 | 90 | 99 (93–108) | 163–172 | 94 | 91–99  |
| Z5         | 288                   | 281 (251–306)| 288–300 | 236 | 232 | 255 (248–273) | 310–345 | 270 | 220–251 |
| st1-st1    | 65                    | -       | 68 | - | - | 66 (63–68) | - | - | -     |
| st2-st2    | 70                    | 71 (66–75) | 73–75 | - | 69 | 73 (65–78) | 75–78 | 73 | 70–73  |
| st3-st3    | 75                    | -       | 63–65 | - | - | 77 (73–83) | - | - | -     |
| st1-st3    | 65                    | 65 (58–70) | 73–75 | - | 62 | 69 (68–73) | 63–65 | 67 | 64–69  |
| st4-st4    | 75                    | -       | 78–83 | - | - | 76 (73–80) | - | - | -     |
| Gensl      | Gensl                 | -       | - | - | - | - | - | - | -     |
| st5-st5    | 63                    | 71 (67–75) | 70–78 | - | 65 | 65 (63–70) | 65–70 | 68 | 58–64  |

Sources of measurements – Africa (Benin 1♀, Burundi 1♀, Democratic Republic of Congo 1♀, Ghana 1♀, Kenya 3♀, Rwanda 1♀): Zannou et al. (2007); Grande Comore Island of the Comoros Archipelago: Kreiter et al. (2018b); Portugal (holotype): Denmark & Muma (1989); Kenya: El-Banawy & Knapp (2011); La Réunion: Kreiter et al. 2020; Senegal: Kade et al. (2011); Thailand: Oliveira et al. (2012); Turkey: Akyazi et al. (2016); - : not provided.
especially with cattail pollen (Typha latifolia), chilli pepper pollen and bee-collected pollen. *Amblyseius herbicolus* was collected recently in Comoros archipelago (Kreiter et al. 2018b). This is the first record of that species in Vietnam.

Measurements of the single specimen collected during this study are provided in table 8 and compared with measurements obtained from specimens collected in other countries of Africa, Asia and Indian Ocean. These measurements match with those obtained previously. The dorsal shield width is less important in the single Vietnam specimen than all order widths of the table, probably because the single female was a small one, all other dimensions being quite similar.

**Genus Graminaseius**

*Graminaseius* Chant & McMurtry 2004a: 215; 2007: 83.

### *Graminaseius polisensis* (Schicha & Corpus-Raros)

*Graminaseius polisensis* Schicha & Corpus-Raros 1992: 39; Moraes et al. 2004a: 47. *Graminaseius polisensis*, Chant & McMurtry 2004a: 219; 2007: 85.

**Specimens examined:** Muoi in P6 plot (aasl 66 m, lat. 21°54′55″ N, long. 104°38′22″ E), 1 ♀ + 1 ♂ on Xanthium strumarium (Asteraceae), 20/VII/2017.

**Remarks:** This species was described from several specimens collected on various plants in Philippines. The biology of *G. polisensis* remains totally unknown and even the life type of this species and of species of *Graminaseius* are unknown.

| Characters | Vietnam, 1, this study | Holotype, Philippines, 1 | Vietnam, 1, this study | Paratype, Philippines, 1 |
|------------|------------------------|--------------------------|------------------------|--------------------------|
| Dsl        | 325                    | 380                      | 250                    | 299                      |
| j1         | 15                     | 19                       | 15                     | 16                       |
| j3         | Broken                 | 32                       | 23                     | 25                       |
| j4         | 10                     | 14                       | 10                     | 12                       |
| j5         | 10                     | 14                       | 10                     | 12                       |
| j6         | Broken                 | 18                       | 10                     | 12                       |
| j2         | Broken                 | 18                       | 10                     | 15                       |
| j5         | Broken                 | 10                       | 8                      | 8                        |
| r3         | 15                     | 16                       | Broken                 | -                        |
| R1         | 14                     | 14                       | 10                     | -                        |
| s4         | Broken                 | 51                       | Broken                 | 37                       |
| S2         | Broken                 | 10                       | 18                     | 19                       |
| S4         | Broken                 | 10                       | 13                     | 13                       |
| S5         | Broken                 | 10                       | 13                     | 13                       |
| z2         | 15                     | 19                       | 13                     | 16                       |
| z4         | 13                     | 19                       | 13                     | 16                       |
| z5         | 8                      | 11                       | Broken                 | 12                       |
| Z1         | 15                     | 19                       | 10                     | 12                       |
| Z4         | Broken                 | 62                       | Broken                 | 50                       |
| Z5         | 58                     | 57                       | 35                     | 39                       |
| st1-st3    | -                      | -                        | -                      | -                        |
| st2-st2    | 63                     | 82                       | 53                     | 82                       |
| st3-st4    | 70                     | -                        | -                      | -                        |

**Table 9** Character measurements of one adult female and one adult male of *Graminaseius polisensis* collected in this study and those reported in previous studies (localities followed by the number of specimens measured).

Sources of measurements – For ♀♀: Philippines: Schicha & Corpuz-Raros (1992), probably measurements of the holotype female. For ♂♂: Philippines: Schicha & Corpuz-Raros (1992), probably measurements of the paratype male; - : not provided.
This species was already known from Vietnam from a previous survey (Nguyen et al. 2016). Details of locations were provided in this paper though no measurements were provided on the collected specimens. Measurements of specimens collected in this study are provided in table 9 for the single female and the single male and compared with measurements obtained from specimens collected in the Philippines, i.e., country of the original description. Measurements obtained for Vietnamese specimens (both damaged) collected during this study agree well with most obtained from female and male type material from Philippines, most of the setae being shorter in Vietnamese specimens.

**Genus Gynaeseius Wainstein**

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

*Indoseiulus* Ghai & Menon 1969: 347.

*Amblyseius (Indoseiulus)* Ehara 1982: 42.

*Indoseiulus*, Denmark & Kolodochka 1993: 249; Moraes et al. 1986: 59; 2004a: 89.

*Macmurtryseius* Kolodochka & Denmark 1995: 20.

.irregularis group* Chant 1959: 70.

*Gynaeseius*, Chant & McMurtry 2006: 22; 2007: 107.

**Gynaeseius liturivorus (Ehara)**

*Amblyseius (Indoseiulus) liturivorus* Ehara 1982: 43; McMurtry & Moraes 1984: 29; Ehara 1985: 120.

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

*Indoseiulus liturivorus*, Moraes et al. 1986: 60; Denmark and Kolodochka 1993: 253; Ehara et al. 1994: 139; Ehara & Amano 1998: 48; Moraes et al.: 2004a: 89.

*Amblyseius armellae* Schicha and Gutierrez 1985: 175 (synonymy according to Denmark & Kolodochka 1993).

Re-description of the adult female of *Gynaeseius liturivorus* (Ehara)

n = 19 (Figs. 1a – b, 2 a – c)

**Dorsum** — (Fig. 1a) Dorsal shield 361 (333 – 375) long and 223 (188 – 250) wide at level of s4, smooth, with seven solenostomes (gd1, gd2, gd4, gd5, gd6, gd8, gd9), 21 pairs of poroids, 16 pairs of dorsal setae and two pairs of sub-lateral setae off the dorsal shield: j1 18 (15 – 20), j3 19 (18 – 20), j4 14 (12 – 15), j5 13 (11 – 15), j6 15 (13 – 18), J2 18 (15 – 20), J5 8 (7 – 8), z2 16 (15 – 18), z4 18 (15 – 20), z5 13 (10 – 15), Z1 19 (18 – 20), Z4 18 (15 – 20), Z5 28 (25 – 30), s4 20 (18 – 23), S2 19 (15 – 23), S5 19 (18 – 20), r3 16 (15 – 18), RI 19 (17 – 20). All setae minute and smooth.

**Peritreme** — (Fig. 1a) Extending to a level between j1 to j3, closer to j3.

**Venter** — (Fig. 1b) All shields smooth. Sternal shield with three pairs of setae and two pairs of lyrifissures; one pair of sternal setae on metasternal shields with a pair of pores; posterior margin with a projection very difficult to see. Distances between st1-stl 64 (60 – 68), st2-st2 70 (63 – 78), st3-st3 81 (75 – 88), st1-st3 74 (68 – 78), st4-st4 93 (79 – 106). Genital shield length 130 (115 – 140), width at the level of st5 84 (78 – 90), width at the level of the posterior corners 95 (83 – 100). Two pairs of inguinal sigilla of “metapodal shields” 26 (23 – 28) long and 4 (3 – 5) wide for the primary and 14 (13 – 15) long for the secondary shield. Ventrianal shield with three pairs of preanal setae ( JV1, JV2, and ZV2), small oblong pre-anal pores. Membrane surrounding ventrianal shield with four pairs of setae ( ZV1, ZV3, JV4 and JV5), and six pairs of round to oblong poroids; ventrianal shield 109 (91 – 135) long, 66 (63 – 70) wide at level of ZV2, and 54 (50 – 60) wide at level of anus. One pair of pore distant to 24 (20 – 33). JV5 23 (20 – 25) long, smooth.

**Chelicera** — (Fig. 2a) Chelicerae are visible by the side with digits open. Consequently, they are drawn. Fixed digit 30 (28 – 33) long with 11 teeth; and movable digit 34 (33 – 36) long with 3 small teeth.
Figure 1. Female of *Gynaecia liturivora* (Ehara). a – Dorsal shield and peritreme; b – Ventral shields.
Figure 2 Female of Gynaeseius liturivorus (Ehara). a – Insemination apparatus; b – Chelicera; c – Genus; tibia and basitarsus of the leg IV.

**Spermatheca** — (Fig. 2b) Spermatheca with a long, slender tubular calyx 38 (33 – 47) long and 4 (2 – 7) wide, an atrium slightly swollen bifurcate. Ductus minor and ductus major visible in some specimens.

**Legs** — (Fig. 2c) Macrosetae on all legs, all pointed except on legs IV with macrosetae slightly bulbous; one on genua of legs I, II and III, and three on genu, tibia and basitarsus of leg IV: SgeI 35 (30 – 38), SgeII 15 (13 – 20), SgeIII 29 (25 – 30), StII 30 (28 – 35), SgeIV 42 (37 – 47), StIV 54 (50 – 55), StIV 48 (43 – 53). Genu II and III with 7 setae each, chaetotactic formula of genu II: 2-2/0, 2/0-1; genu III: 1-2/1, 2/0-1. A pair of erected setae on femora IV: 30 (28 – 32).

First description of the deutonymphs of Gynaeseius liturivorus (Ehara)

n = 4 (Figs 3 a – b)

**Dorsum** — (Fig. 3a) Dorsal shield 301 (250 – 338) long and 169 (155 – 188) wide at level of s4 with no solenostomes and no poroids visible. The dorsal shield bears 14 pairs of dorsal setae and 2 pairs of sub-lateral setae: j1 28 (25 – 33), j3 31 (28 – 35), j4 4 (3 – 6), j5 4 (3 – 6), j6 6 (5 – 8), J2 9 (8 – 10), J5 5 (4 – 5), z2 5 (4 – 7), z4 6 (5 – 8), z5 4 (3 – 6), Z4 12 (10 – 13), Z5 31 (28 – 35), x4 17 (15 – 18), S2 9 (7 – 10), r3 8 (6 – 8), R1 6 (5 – 8). All setae smooth.

**Peritreme** — (Fig. 3a) Extending to a level between z4 and z2, closer to z2.

**Venter** — All ventral shields very smooth not reticulated with margins not visible and so no drawings possible. Distances between st1 – st1 44 (40 – 47), st2 – st2 64 (63 – 65), st3 – st3 59 (55 – 63), st1 – st3 80, st4 – st4 53 (50 – 55), st5 – st5 49 (47 – 50). Ventrianal shield with three pairs of pre-anal setae, JV1, JV2, and ZV2, and a pair of small oblong pores 21 (20 – 23) apart. Membrane surrounding ventrianal shield with one pair of setae JV5 smooth; ventrianal shield 94 (90 – 100) long, 54 (53 – 55) wide at anterior corners and 52 (50 – 53) wide at level of anus. JV5 15 long, smooth.
**Chelicera** — (Fig. 3b) Fixed digit 23 (22–25) long, with 9 strong teeth and movable digit 25 (23–28) long, with 2 small teeth.

**Legs** — Legs and macrosetae like in females but with different dimensions: Sgel 33 (28–35), Sgel II 30 (28–35), Sgel III 33 (30–35), StiIII 34 (30–35), Sgel IV 49 (48–50), StiIV 51 (45–55), and StiV 54 (53–55). Chaetotactic formula of genu II and III similar to that of females.

**Specimens examined** — Muoi in all experimental plots (aasl 66 m, lat. 21°54’ N, long. 104°38’ E), 19 ♀♀ + 4 deutonymphs on *Manihot esculenta* (Euphorbiaceae), 20/VII/2017.

**Voucher specimens** — 19 ♀♀ + 4 deutonymphs in 2 different slides deposited in CBGP, in Montpellier SupAgro Acarology collection, France.

**Remarks** — This species was found on *Manihot esculenta* in Vietnam. It is a type-III predator and is considered of interest for thrips control on grape infested with *Scirtothrips dorsalis* Hood (Shibao et al. 2004) and on various plants with *Frankliniella occidentalis* (Pergande) and *Thrips palmi* Karny (Mochizuki 2009). *Gynaeseius liturivorus* fed on the larvae of these thrips species. Females consumed an average of 7.4 - 19.4 first-stadium larvae of these
### Table 10
Character measurements of adult females of *Gynaesus litturivorus* collected in this study and those reported in previous studies (localities followed by the number of specimens measured).

| Characters | Vietnam | Indonesia | Japan | Papua-New Guinea | Philippines | Taiwan | Thailand |
|------------|---------|-----------|-------|-------------------|-------------|--------|---------|
|            | 19, this study | 10 | 17 | ? | 2 | 2 |
| Dsl        | 361 (333 – 375) | 347 (341 – 353) | 342 | 353 | 313 | 323 (317 – 326) | 368 (362 – 375) |
| Dsw at sd level | 223 (188 – 250) | 235 (231 – 239) | 236 | 194 | 187 | 219 (211 – 226) | 239 (237 – 242) |
| j1         | 18 (15 – 20) | 25 (25 – 26) | 15 (15 – 16) | 27 | 14 – 20 | 17 | 16 (16 – 17) |
| j3         | 19 (18 – 20) | 26 (19 – 21) | 19 (18 – 20) | 24 | 14 – 20 | 19 | 18 (17 – 19) |
| j4         | 14 (12 – 15) | 17 (16 – 17) | 13 (13 – 14) | 17 – 19 | 14 – 20 | 12 | 17 (16 – 18) |
| j5         | 13 (11 – 15) | 18 (18 – 19) | 14 (13 – 15) | 17 – 19 | 14 – 20 | 11 | 15 (15 – 16) |
| j6         | 15 (13 – 18) | 17 (16 – 18) | 15 (14 – 15) | 17 – 19 | 14 – 20 | 12 | 13 |
| J2         | 18 (15 – 20) | 19 (18 19) | 16 (16 – 17) | 17 – 19 | 14 – 20 | 14 | 15 |
| J5         | 8 (7 – 8) | 9 | 7 (6 – 7) | 8 | 14 – 20 | 12 | 9 (8 – 10) |
| r3         | 16 (15 – 18) | 19 (18 20) | 15 (15 – 16) | 21 | 14 – 20 | - | 12 (12 – 13) |
| R1         | 19 (17 – 20) | 20 (19 – 20) | 18 (16 – 18) | - | 14 – 20 | - | 17 (17 – 18) |
| s4         | 20 (18 – 23) | 22 (21 – 22) | 20 (20 – 21) | 23 | 14 – 20 | 17 | 16 |
| S2         | 19 (15 – 23) | 23 (22 – 23) | 21 (21 – 22) | 23 | 14 – 20 | 16 | 20 (20 – 21) |
| S5         | 19 (18 – 20) | 23 (22 – 23) | 18 (18 – 19) | 24 | 14 – 20 | 17 | 19 (18 – 20) |
| z2         | 16 (15 – 18) | 19 (19 – 20) | 16 (15 – 16) | 20 | 14 – 20 | 12 | 16 (16 – 17) |
| z4         | 18 (15 – 20) | 20 (19 – 20) | 16 (16 – 17) | 19 | 14 – 20 | 16 | 18 (17 – 19) |
| z5         | 13 (10 – 15) | 18 (17 – 18) | 15 (14 – 15) | 17 | 14 – 20 | 11 | 14 (13 – 16) |
| Z1         | 19 (18 – 20) | 22 (22 – 23) | 19 (18 – 20) | 25 | 14 – 20 | 16 | 20 |
| Z4         | 18 (15 – 20) | 20 (19 – 20) | 17 | 23 | 14 – 20 | 11 | 19 (18 – 20) |
| Z5         | 28 (25 – 30) | 30 (29 – 31) | 23 (23 – 24) | 31 | 27 | 24 | 30 |
| st1-st1    | 64 (60 – 68) | - | - | - | - | - |
| st2-st2    | 70 (63 – 78) | - | - | - | - | - | 69 (69 – 70) |
| st3-st3    | 81 (75 – 88) | - | - | 81 | - | - |
| st1-st3    | 74 (68 – 78) | - | - | 72 | - | - | 69 (68 – 70) |
| st4-st4    | 93 (79 – 106) | - | - | - | - |
| Gensl      | 130 (115 – 140) | - | - | - | - |
| st5-st5    | 84 (78 – 90) | - | - | - | - | 84 (81 – 92) |
| Gensw post.cor. | 95 (83 – 100) | - | - | 97 | - | 77 |
| Lisl       | 26 (23 – 28) | - | - | - | - |
| Lisw       | 4 (3 – 5) | - | - | - | - |
| Sisl       | 14 (13 – 15) | - | - | - | - |
| Val        | 109 (91 – 135) | - | - | - | - | 91 | 105 |
| Vsw JV2    | 66 (63 – 70) | - | - | - | - | 65 | 70 |
| Vsw anus   | 54 (50 – 60) | - | - | - | - | - | 65 |
| Dist. solen. vas | 24 (20 – 33) | - | - | - | - |
| JV5        | 23 (20 – 25) | - | 24 (23 – 24) | - | - | - |
| Sgel       | 35 (30 – 38) | - | - | - | - | - | 35 |
| SgelII     | 15 (13 – 20) | - | - | - | - | - | 14 |
| SgelIII    | 29 (25 – 30) | - | - | - | - | 24 | 30 |
| StIII      | 30 (28 – 35) | - | - | - | 27 | - | 35 |
| SgelIV     | 42 (37 – 47) | - | 34 (33 – 34) | 37 | 34 | 34 | 37 |
| StIV       | 54 (50 – 55) | - | 46 (45 – 46) | 48 | 41 | 43 | 50 (49 – 52) |
| StIV       | 48 (43 – 53) | - | 45 (45 – 46) | 42 | 37 | 43 | 48 (47 – 50) |
| Scf        | 38 (33 – 47) | - | - | 28 | - | - | 25 |
| Scw        | 4 (2 – 7) | - | - | - | - |
| Fdl        | 30 (28 – 33) | - | - | - | - |
| No teeth Fd | 11 | - | - | 12 – 13 | 12 | 11 |
| Mdl        | 34 (33 – 36) | - | - | - | - |
| No teeth Md | 3 | 3 | 3 | 1 – 2 | 3 | 2 |

Sources of measurements – Indonesia: Ehrara (2005) (but identified under the name *Indoseiulus armellae*, synonymized by Denmark & Kolodochka, 1993); Japan: Ehrara (1982); Papua New Guinea: Schicha & Gutierrez (1985) (but identified under the name *Indoseiulus armellae*, synonymized by Denmark & Kolodochka, 1993); Philippines: Corpuz-Raros (2005); Taiwan: Tseng (1983); Thailand: Moraes et al. (2004b); - : not provided.
thrips within the first 24 hrs and laid an average number of 1.6 - 6.8 eggs within 24-48 hrs. These data suggest that *G. liturivorus* would be a promising BCA against thrips (Mochizuki 2009).

All measurements obtained on female specimens collected during this study (Table 10) agree well with measurements obtained from female specimens collected in other countries, especially with type specimens from Japan and Thailand. Specimens of Taiwan have shorter setae whereas specimens of Indonesia and Papua New Guinea have longer setae.

It is interesting to notice that in deutonymph specimens some setae are longer than those of female specimens, especially *j1*, *j3*, *Z5*, *SgeI*, *SgeIV*, *StIV*, shorter peritremes and chelicerae and a lower number of teeth than female specimens on both digits of chelicerae.

**Genus Euseius Wainstein**

*Amblyseius (Amblyseius) section Euseius*, Wainstein, 1962: 15; *Euseius De Leon*, 1967: 86.

**Euseius ovaloides** (Blommers)

*Amblyseius (Amblyseius) ovaloides* Blommers 1974: 147.

*Euseius ovaloides* Moraes *et al.* 1986: 51; 2004b: 78; Chant & McMurtry 2005a: 215; 2007: 121.

**Specimens examined:** Muoi in P6 plot (aasl 66 m, lat. 21°54'55" N, long. 104°38'22" E), 1 ♀ + 1 ♂ (in too bad state for doing measurements) on *Vernicia montana* (Euphorbiaceae), 20/VII/2017.

### Table 11

Character measurements of adult females of *Euseius ovaloides* collected in this study and those reported in previous studies (localities followed by the number of specimens measured).

| Characters | Vietnam (1) 1, this study | Guadeloupe 4 | La Réunion 2 | Madagascar 1? |
|------------|-----------------------------|--------------|-------------|--------------|
| Dsl        | 343                         | 351 (341 – 360) | 324 – 340 | 335          |
| Dsw at s4 level | 235                     | 243 (236 – 253) | 227 – 258 | 200          |
| j1         | 33                          | 32 (31 – 33)  | 28 – 34     | 27 – 30      |
| j3         | 10                          | 9 (8 – 9)     | 9           | 8            |
| j4         | 5                           | 6             | 6           | 5            |
| j5         | 5                           | 6 (5 – 6)     | 6           | 5            |
| j6         | 7                           | 7 (6 – 7)     | -           | 6            |
| J2         | 7                           | 8 (8 – 9)     | 6 – 9       | 7            |
| J5         | 5                           | 6             | 6           | 5            |
| r3         | 10                          | 10 (9 – 11)   | 9           | 8            |
| R1         | 8                           | 6 (6 – 7)     | 8 – 9       | 8            |
| s4         | 12                          | 11 (11 – 12)  | 13          | 9 – 12       |
| S2         | 10                          | 7 (6 – 8)     | 8 – 9       | 8            |
| S4         | 11                          | 8 (7 – 8)     | 8 – 9       | 8            |
| S5         | 10                          | 6 (6 – 7)     | 6 – 8       | 7            |
| z2         | 10                          | 8 (7 – 9)     | 8 – 9       | 7            |
| z4         | 8                           | 8 (7 – 9)     | 8 – 9       | 8            |
| z5         | 5                           | 6             | 6           | 7            |
| Z1         | 8                           | 7 (6 – 8)     | 8 – 9       | 8            |
| Z4         | 9                           | 7 (6 – 8)     | 6 – 9       | 8            |
| Z5         | 48                          | 53 (52 – 54)  | 50 – 54     | 44 – 48     |
| st1-st1    | 58                          | -             | -           | -            |
| st2-st2    | 53                          | 68 (66 – 68)  | 61 – 63     | -            |
| st3-st3    | 75                          | -             | -           | -            |
| st4-st4    | 95                          | -             | -           | -            |

| Characters | Vietnam (1) 1, this study | Guadeloupe 4 | La Réunion 2 | Madagascar 1? |
|------------|-----------------------------|--------------|-------------|--------------|
| Gensl      | 123                         |              |             |              |
| Sgst-sgst | 70                          | 79 (76 – 82) | 63 – 69     | -            |
| Gensw post.cor. | 105                     |              |             |              |
| Lisl       | 23                          | -            | -           | -            |
| Lisw       | 5                           | -            | -           | -            |
| Sisl       | 13                          | -            | -           | -            |
| Vsl        | 100                         | 98 (93 – 105)| 98 – 104   | 100          |
| Vsw ZV2    | 40                          | 44 (42 – 47) | 44 – 50     | -            |
| Vsw anus   | 63                          | 74 (71 – 78) | 71 – 74     | 72           |
| JV5        | 25                          | -            | -           | 22           |
| SgelI      | 19                          | 14 (12 – 16) | -           | -            |
| SgelII     | 15                          | 15 (12 – 17) | -           | -            |
| SgelIII    | 25                          | 26 (25 – 27) | 22 – 28     | 25           |
| StIII      | 23                          | 16 (14 – 19) | 19 – 22     | 20           |
| SgelIV     | 35                          | 40 (37 – 42) | 38 – 39     | 36 – 40      |
| StIV       | 33                          | 36 (34 – 38) | 35          | 29 – 34      |
| StV        | 55                          | 62 (59 – 66) | 47 – 60     | 52 – 57      |
| Sel        | 14                          | 14 (14 – 15) | 9 – 13      | 11           |
| Sew        | 2                           | -            | -           | 1            |
| Fdl        | 23                          | 29 (27 – 31) | 25          | 28           |
| Mdl        | 23                          | 30 (27 – 32) | 25          | 26           |
| No teeth Fd | -                           | -            | 2           | 1            |
| No teeth Md | -                           | -            | 1           | 1            |

Sources of measurements – Guadeloupe: Moraes *et al.* (2000); La Réunion: Moraes *et al.* (2012); Madagascar: Blommers (1976); - : not provided.
Remarks: All measurements obtained on the single female specimen collected during this study agree well with measurements obtained from female specimens collected in other countries.

_Euseius ovaloides_ was described by Blommers (1974) from specimens collected on _Citrus hystrix_ and _Persea americana_ in Madagascar. Like all _Euseius_ species, this species belongs to the type IV (polliniphagous generalist predators) of McMurtry and Croft (1997) and McMurtry _et al._ (2013). The species has been occasionally recorded from Madagascar (Blommers, 1974), Papua-New Guinea (Schicha and Gutierrez 1985), Seychelles (Schicha, 1987), Reunion Island, (Quilici et al., 1997, 2000), Guadeloupe, Martinique and Marie-Galante (Moraes _et al._, 2000; Kreiter _et al._, 2006) on various plants, though its biology remains unknown. It is suspected to be a poor predator of tetranychid mites (Gutierrez and Etienne, 1986) but can be considered as a potentially good predator of thrips and of whiteflies. This is one of the more common species on La Réunion Island.

This is the first mention of that species in Vietnam.

Measurements of the single female specimen collected during this study are provided in table 1 and compared with measurements obtained from specimens collected in other countries of Indian Ocean and the Caribbean.

**Subfamily Phytoseiinae Berlese**

Phytoseiini Berlese 1913: 3; Phytoseiinae, Vitzthum 1941: 768.

**Genus Phytoseius Ribaga**

*Phytoseius* Ribaga, 1904: 177.

*Phytoseius coheni* Swirski & Shechter

*Phytoseius* (Dubininellus) macropiliscoheni Swirski & Shechter 1961: 104.

*Phytoseius* (Phytoseius) macropiliscoheni, Ebara 1966: 26.

*Phytoseius* (Dubininellus) coheni, Swirski & Golan 1967: 226; Wu 1997: 153.

*Phytoseius* (Phytoseius) coheni, Moraes _et al._ 1986: 219.

*Phytoseius coheni*, Moraes _et al._ 2004a: 235; Chant & McMurtry 2007: 129.

*Phytoseius hawaiiensis* Prasad 1968: 1460 (synonymy according to Denmark & Evans 2011: 301).

*Phytoseius huangii* Ebara 1970: 62 (synonymy according to Ebara 2002: 40).

*Phytoseius jianfengensis* Chen, Chu & Zhou 1980: 15 (synonymy according to Wu 1997: 153).

**Specimens examined**: Muoi in PM1 plot (aasl 66 m, lat. 21°54' N, long. 104°38' E), 1 ♀ on an unknown plant support, 17/V/2017; in P7 plot (aasl 66 m, lat. 21°54'51" N, long. 104°38'22" E), 1 ♀ on an unknown plant support, 21/VII/2017; in P16 plot (aasl 66 m, lat. 21°54'56" N, long. 104°38'46" E), 1 ♀ on _Tephrosia candida_ (Fabaceae), 22/VII/2017.

**Remarks**: This species was described from Hong-Kong by Swirski and Shechter (1961) collected on a wide range of plants and very common on citrus.

Although species of the genus _Phytoseius_ are considered to belong to the type III (polyphagous generalist predators) of McMurtry and Croft (1997) and McMurtry _et al._ (2013), its specific biology is totally unknown.

This is the first mention of that species in Vietnam.

Measurements of specimens collected during this study are provided in table 1 and compared with measurements obtained from specimens collected in other countries of Asia and Indian Ocean. Measurements obtained during this study agree well with most obtained from female specimens collected in other countries.
Table 12 Character measurements of adult females of *Phytoseius coheni* collected in this study and those reported in previous studies (localities followed by the number of specimens measured).

| Characters | Vietnam | Type material Hong-Kong | Mauritius | Philippines | Taiwan | Thailand |
|------------|---------|-------------------------|-----------|-------------|--------|----------|
| Dsl        | 293 (275 – 310) | 269 – 292 | 293 (289 – 297) | 279 | 295 – 314 | 280 |
| Dsw at s4 level | 157 (138 – 175) | 142 | 157 (153 – 160) | 160 | 180 – 249 | 170 |
| j1         | 26 (25 – 28) | 29 | 26 (24 – 28) | 26–31 | 28 – 29 | 26 |
| j3         | 20 (18 – 20) | 18 – 23 | 20 (19 – 21) | 20 – 23 | 23 – 25 | 22 |
| j4         | 9 (8 – 10) | 8 | 10 (9 – 10) | 7 – 12 | 7 – 8 | 9 |
| j5         | 8 | 8 | 9 | 7 – 13 | 6 – 8 | 8 |
| j6         | 10 | 8 | 9 | 8 – 13 | 8 – 9 | 9 |
| J5         | 9 (8 – 10) | 13 | 8 (7 – 8) | 8 – 13 | 8 | 6 |
| r3         | 37 (33 – 40) | 32 | 38 (36 – 39) | 34 – 39 | 30 – 41 | 36 |
| s4         | 82 (75 – 93) | 66 – 81 | 74 (72 – 76) | 78 – 86 | 90 – 95 | 80 |
| s6         | 65 (63 – 70) | 58 – 74 | 60 (57 – 63) | 65 – 73 | 82 – 90 | 67 |
| z2         | 12 (10 – 13) | 13 | 12 | 13 – 14 | 14 – 15 | 13 |
| z3         | 26 (25 – 28) | 27 | 27 (24 – 29) | 26 – 28 | 29 – 30 | 28 |
| z4         | 12 (11 – 13) | 13 | 13 | 12 – 14 | 15 | 13 |
| z5         | 10 | 10 | 10 (9 – 10) | 10 – 13 | 8 | 10 |
| Z4         | 54 (50 – 58) | 51 – 64 | 55 (50 – 59) | 54 – 59 | 56 – 65 | 53 |
| Z5         | 63 (55 – 70) | 58 – 71 | 63 (59 – 66) | 70 – 73 | 70 – 78 | 61 |
| st1-st1    | 52 | 50 – 55 | - | - | - | - |
| st2-st2    | 59 | 55 – 63 | - | 60 (59 – 60) | - | - |
| st3-st3    | 73 | 65 – 80 | - | - | - | - |
| st1-st3    | 54 | 53 – 55 | - | 59 (58 – 59) | - | - |
| st4-st4    | 80 | 63 – 98 | - | - | - | - |
| gensl      | 98 | 95 – 100 | - | 97 | - | - |
| st5-st5    | 62 | 60 – 63 | - | 72 (69 – 74) | - | - |
| gensw post. cor. | 73 | 70 – 75 | - | - | - | - |
| Lisl       | 27 | 25 – 28 | - | 28 (27 – 29) | - | 16 |
| Lisw       | 2 | - | - | - | 3 | - |
| Val        | 94 | 80 – 103 | 86 – 99 | 98 (95 – 101) | 99 | 98 |
| Vs w ZV2   | 44 | 38 – 50 | 41 – 48 | 45 (41 – 49) | 44 | 85 |
| Vs w amus  | 49 | 43 – 53 | 48 – 53 | 53 (52 – 53) | 51 | - |
| JV5        | 44 | 43 – 45 | 38 – 46 | 41 (39 – 43) | 47 – 52 | 53 |
| Sc1        | 11 | 10 – 13 | - | 15 (14 – 16) | - | 6 |
| Scw        | 5 | - | - | - | - | - |
| SgelIV     | 24 | 23 – 25 | 18 – 23 | 20 (19 – 20) | 20 – 24 | 15 – 16 |
| StIIV      | 44 | 40 – 50 | 38 – 51 | 42 (40 – 43) | 42 – 44 | 45 – 48 |
| SIV        | 24 | 23 – 25 | 20 – 25 | 25 (23 – 26) | 23 – 27 | 23 – 40 |
| StIIV      | 20 | 18 – 25 | 21 (20 – 21) | 20 | 30 | 21 |
| Fdl        | 24 | 23 – 25 | 23 – 25 | - | - | - |
| No teeth Fd | 3 | 3 | - | - | - | - |
| Mdl        | 24 | 23 – 25 | 23 – 25 | - | - | - |
| No teeth Md | 1 | 1 | - | - | - | - |

Sources of measurements – Type material Hong-Kong: Swirski & Shechter (1961), Denmark (1966); Mauritius: Ferragut & Baumann (2019); Philippines: Swirski & Golan (1967) and (identified as *Phytoseius hawaiensis*) Corpuz-Raros & Garcia (1994); Taiwan: Lo (1970) & Tseng (1976); Thailand: (identified as *Phytoseius hawaiensis*) Ebara & Bhandhufalck (1977); - : not provided.
Phytoseius hongkongensis Swirski & Shechter

Phytoseius (Phytoseius) hongkongensis Swirski & Shechter 1961: 99; Amitai & Swirski 1966: 22.
Phytoseius (Pennaseius) hongkongensis Ehara 1966: 25; Ehara 1972: 169; Moraes et al. 1986: 211.
Phytoseius hongkongensis Moraes et al. 2004a: 240; Chant & McMurtry 2007: 129.

Specimens examined: MuoiinP16plot(aasl66m,lat. 21°54’46”N,long. 104°38’18”E), 2♀♀on Chromolaena odorata (Asteraceae), 18/V/2017; in P11 plot (aasl 66 m, lat. 21°54’30” N, long. 104°38’14” E), 1♀on Mallotus canii (Euphorbiaceae), 31/V/2017; in P14 plot (aasl 66 m, lat. 21°54’56” N, long. 104°38’45” E), 2♂♂on C. odorata (Asteraceae) and 1♂inan unknown host plant, 2/VI/2017; in P15 plot (aasl 66 m, lat. 21°54’56” N, long. 104°38’46” E), 1♀on C. odorata (Asteraceae), 2/VI/2017and 1♀+1♂on Rubus alceifolius (Rosaceae), 3/VI/2017.

Remarks: This species was described from specimens collected on Heterosmilax gaudichaudiana and Urena lobata in Victoria Mount Forest, Hong Kong Island, Hong Kong.

Although species of the genus Phytoseius are considered to belong to the type III (polyphagous generalist predators) of McMurtry and Croft (1997) and McMurtry et al. (2013), its specific biology is totally unknown.

This is the first mention of that species in Vietnam.

Measurements of specimens collected during this study are provided in table 13 for females and males and compared with measurements obtained from specimens collected in other countries of Asia and Africa.

Measurements obtained agree well with most of those obtained previously, with slightly shorter dimensions, especially in male specimens.

Phytoseius tixierae Kreiter n. sp.

Zoobank: 7B2DE1ED-FE36-488E-87B2-969ADB09507

Figs. 4a–d, 5a–b, 6a–c

Diagnose — Phytoseius tixierae Kreiter n. sp. lacks setae J2 and R1 and consequently belongs to the horridus species group. This species is unique by the following characters: z2 and Z4 smooth, s6 only slightly serrated, setae j4, j5, j6, J5 also smooth, setae s6, Z4 and Z5 subequal, s6 being the longest seta, four macrosetae on leg IV spatulate, SgeIV being the shortest and StiIV being the longest, with StIV and SttIV being intermediate and subequal, setae j1 and j3 almost equal, setae JV5 very short, < 20, peritreme reaching the level of setae j1.

Description of the adult female of Phytoseius tixierae Kreiter n. sp.

n = 4 (Figs. 4 a – b, Figs. 5 a – b)

(in bold, average measurements)

Dorsum — (Fig. 4a) Dorsal shield rugose 271 (250 – 280) long and 130 (125 – 140) wide, smooth, with no visible solenostome, 8 pairs of poorly visible poroids, 14 pairs of dorsal setae and one pair of sub-lateral setae on the dorsal shield: j1 23 (21 – 23), j3 18 (15 – 23), j4 10 (10 – 11), j5 10 (10 – 11), j6 11 (10 – 13), J5 9 (8 – 9), z2 12 (10 – 13), z3 20 (18 – 25), z4 19 (18 – 23), z5 12 (9 – 13), Z4 57 (48 – 63), Z5 53 (48 – 55), s4 44 (43 – 45), s6 59 (55 – 63), r3 30 (28 – 30). Setae z2, j4, j5, j6, z5 and Z4 smooth, setae s6 very slightly serrated at the distal third of setae, setae j1, j3, z3, z4, r3, s4 and Z5 serrated.

Peritreme — (Fig. 4a) Extending to the level of setae j1.

Venter — (Fig. 4b) All shields smooth.

Sternal shield with three pairs of setae and two pairs of lyrifissures; one pair of sternal setae on metasternal shields with a pair of pores; posterior margin straight. Distances between st1-st1 46 (43 – 50), st2-st2 53 (50 – 55), st3-st3 59 (43 – 68), st1-st3 58 (55 – 60), st4-st4 62 (50 – 75).

Genital shield length 101 (98 – 105), st5-St5 56 (50 – 60), width at the level of the posterior corners of the genital shield 80 (78 – 82).

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Table 13 Character measurements of adult females and males of *Phytoseius hongkongensis* collected in this study and those reported in previous studies (localities followed by the number of specimens measured).

| Characters | Vietnam (♀) this study | Africa | Type material | Taiwan | Thailand | Vietnam (♂) | Hong-Kong (♂) this study |
|------------|------------------------|--------|---------------|---------|----------|-------------|--------------------------|
| **Dsl**    | 285 (260 – 300)        | 4      | 5              | 304     | 274 (264 – 294) | 217 (210 – 228) | 1                          |
| **Dsw at st1** level | 125 (115 – 130) | 138 (133 – 145) | 134 – 140 | 196 | 145 (135 – 150) | 115 (110 – 123) | 19 (19 – 20) |
| **jl**     | 25 (23 – 25)           | 24 (22 – 26) | 25 – 28       | 30     | 28 (25 – 30) | 45 (45 – 46) | 53                          |
| **j3**     | 65 (63 – 68)           | 67 (59 – 71) | 64 – 69       | 70     | 72 (70 – 75) | 4            | 4 – 8                      |
| **j4**     | 5                      | 5 (5 – 6)   | 3 – 8         | 9      | 5 (4 – 5)   | 4            | 4 – 8                      |
| **j5**     | 5                      | 5 (5 – 6)   | 3 – 8         | 9      | 6 (5 – 6)   | 4            | 4 – 8                      |
| **j6**     | 5                      | 6 (5 – 7)   | 3 – 8         | 9      | 6 (5 – 6)   | 4            | 4 – 8                      |
| **J2**     | 9 (8 – 10)             | 9 (8 – 10)  | 9 – 12        | 9      | 7 (7 – 10)  | -            | 5                          |
| **J5**     | 6 (5 – 8)              | 7 (6 – 8)   | 6 – 9         | -      | 6 (6 – 7)   | 5            | 4 – 8                      |
| **r3**     | 35 (30 – 40)           | 42 (40 – 43) | 36 – 44       | 45      | 45 (43 – 47) | 30 (29 – 30) | 36                          |
| **R1**     | 13 (10 – 15)           | 16 (14 – 17) | 13 – 18       | 9      | 16 (15 – 17) | 9            | 8 – 10                     |
| **s4**     | 95 (90 – 98)           | 96 (90 – 105) | 91 – 102       | 95     | 103 (102 – 106) | 65 (63 – 68) | 76                          |
| **s6**     | 75 (75 – 78)           | 81 (77 – 86) | 75 – 77       | 91     | 84 (80 – 90) | 45 (43 – 45) | 51                          |
| **z2**     | 13 (13 – 15)           | 12 (10 – 13) | 10 – 15       | 13     | 17 (16 – 18) | 13 (11 – 14) | 10                          |
| **z3**     | 44 (43 – 45)           | 45 (45 – 46) | 38 – 40       | 58      | 44 (39 – 47) | 32 (30 – 33) | 36                          |
| **z4**     | 10 (8 – 10)            | 8         | 10 – 13       | 18      | 10 (8 – 12)  | 10 (9 – 10)  | 9                           |
| **z5**     | 5                      | 4 (3 – 5)   | 3 – 8         | -      | 4          | 3            | 4 – 8                      |
| **Z4**     | 72 (68 – 75)           | 74 (67 – 82) | 76 – 90       | 75     | 79 (75 – 82) | 39 (37 – 40) | 53                          |
| **Z5**     | 69 (67 – 70)           | 74 (67 – 85) | 55 – 75       | 83      | 80 (75 – 84) | 32 (30 – 33) | 36                          |
| st1-st1    | 61 (57 – 63)           | -        | -            | -      | -          | 50 (48 – 53) | -                           |
| st2-st2    | 68 (65 – 70)           | -        | -            | -      | 69 (66 – 70) | 55 (55 – 56) | -                           |
| st3-st3    | 73 (70 – 75)           | -        | -            | -      | -          | 63 (63 – 64) | -                           |
| st1-st3 ♀ / st1-st5 ♂ | 59 (58 – 60) | 60 (58 – 63) | -            | -      | 61 (60 – 62) | 103 (100 – 108) | -                          |
| st4-st4    | 80 (73 – 83)           | -        | -            | -      | -          | 54 (53 – 57) | -                           |
| Gensl      | 113 (110 – 115)        |          |              | -      | -          | 41 (38 – 43) | -                           |
| st5-st5    | 61 (58 – 63)           | 60 (58 – 62) | -            | -      | 64 (63 – 66) | -                           | Not applicable |
| Gensw post. corn. | 64 (60 – 68) |          |              | -      | -          | Not applicable | -                           |
| Lisl       | 19 (18 – 20)           | -        | -            | 50     | -          | -                           | Not applicable |
| Lisw       | 2                      | -        | -            | 2      | -          | -                           | Not applicable |
| Vsl        | 92 (83 – 100)          | 89 (85 – 93) | -            | 93     | 97 (95 – 100) | -                          | 82 (78 – 90) |
| Vsw ZV2    | 50 (49 – 50)           | 53 (50 – 60) | -            | 53      | 55 (52 – 58) | 128 (125 – 130) | -                        |
| Vsw anus   | 46 (43 – 48)           | 44 (43 – 45) | -            | -      | 46 (44 – 49) | 52 (50 – 55) | -                           |
| JV5        | 48 (45 – 50)           | -        | 46 – 61       | 63     | -          | 19 (15 – 23) | 25                          |
| Scl        | 15 (13 – 18)           | 12 (10 – 18) | -            | 10     | 10 (9 – 12)  | 18 (18 – 19) | 23                          |
| Sco        | 14 (10 – 18)           | -        | -            | -      | -          | 19 (18 – 20) | 23                          |
| SgeIV      | 26 (25 – 28)           | 25 (24 – 26) | 26 – 33       | 30     | 29 (28 – 31) | 23                         | 29                          |
| SliIV      | 30                      | 31 (29 – 32) | 29 – 33       | 30     | 32 (31 – 32) | 25                         | -                           |
| StiIV      | 25 (23 – 25)           | 24 (22 – 24) | 21 – 25       | 30     | 26 (24 – 28) | -                          | Not applicable |
| Fdl        | 27 (25 – 30)           | 25         | -            | -      | 26 (25 – 27) | 17 (15 – 18) | -                           |
| No teeth Fdl | 2                      | 2        | -            | -      | -          | 2                           | -                           |
| Mdl        | 28 (25 – 30)           | 26         | -            | -      | 29 (29 – 30) | 19 (18 – 20) | -                           |
| No teeth Mdl | 1                      | 1        | -            | -      | -          | -                           | 1                           |
| Shaft      | Not applicable         |          |              | -      | -          | 14 (13 – 15) | -                           |
| Toe        | Not applicable         |          |              | -      | -          | 6 (4 – 8)      | -                           |

Sources of measurements – For ♀: Africa (Benin: 1♀, Kenya: 2♀, Malawi: 1♀); Ueckermann et al. (2007); Hong-Kong: Swirski & Shechter (1961), Denmark (1966) & Ehara & Lee (1971); Taiwan: Tseng (1976). For ♂: Hong-Kong: Swirski & Shechter (1961). - : not provided.
One pair of narrow metapodal shields 24 (20 – 28) long and 2 wide.

Ventral shield with three pairs of preanal setae (JV1, JV2 and ZV2) and a pair of pores. Membrane surrounding ventrianal shield with two pairs of setae (ZV3 and JV5), and no visible poroids in our specimens; ventrianal shield 92 (85 – 98) long, 51 (50 – 53) wide at level of anterior corners (ZV2), and 44 (43 – 45) wide at level of anus.

JV5 short, 19 (15 – 20) long, and serrated.

Chelicera — Chelicerae not clearly visible and therefore not drawn. Fixed digit 17 (14 – 20) long with apparently 2 teeth; and movable digit 18 (15 – 20) long with apparently 1 tooth.

Spermatheca — (Fig. 5a) Spermatheca with calyx pocular (Denmark and Evans 2011), 10 long and 5 wide, and a small atrium. Ductus minor not visible but large ductus major well visible in all specimens.

Legs — (Fig. 5b) Four macrosetae on leg IV, all spatulate: SgeIV 10, StiIV 39 (38 –
40), SttIV 21 (20 – 23), SttIV 19 (18 – 20). Genu II with 7 setae and Genu III with 6 setae, chaetotactic formula of genu II: 2-2/0, 2/0-1; genu III: 1-2/0, 2/0-1.

Description of the adult male of *Phytoseius tixierae* Kreiter n. sp. 

n = 1 (Figs 6 a – c) 

**Dorsum** — (Fig. 6a) Dorsal shield rugose 200 long and 113 wide, with no visible solenostome. The dorsal shield bears 14 pairs of dorsal setae and 1 pair of sub-lateral setae situated on the dorsal shield: j1 20, j3 16, j4 10, j5 8, j6 9, j5 6, z2 10, z3 18, z4 18, z5 10, Z4 30, Z5 28, s4 35, s6 35, r3 25. Setae z2, j4, j5, j6, z5 and Z4 smooth, setae s6 very slightly serrated, setae j1, j3, z3, z4, r3, s4 and Z5 serrated, like in the female.

**Peritreme** — (Fig. 6a) Extending to the level of setae j1.

**Venter** — (Fig. 6b) Sternal shield smooth. Distances between st1 – st1 43, st2 – st2 48, st3 – st3 50, st1 – st5 90, st4 – st4 43, st5 – st5 35. Ventral shield with three pairs of pre-anal setae, JV1, JV2 and ZV2. Pre-anal pores absent. Membrane surrounding ventral shield with one pair of setae JV3; ventral shield 75 long, 90 wide at anterior corners and 50 wide at level of paranal setae. Short setae JV5 serrated, 10 long.

**Chelicera** – Fixed digit 15 long, with 2 teeth visible and movable digit 15 long with 1 tooth visible. Spermatodactyl circumflex accent shaped, shaft (Fig. 6c) 11, toe 9.

**Legs** — Legs IV with four spatulate macrosetae like in the female: SgeIV 5, SttIV 10, StIV 15, SttIV 15. Chaetotactic formula of genu II and III similar to that of females.

**Specimens examined** — Muoi in P4 experimental plot (aasl 66 m, lat. 21°54’41” N, long. 104°38’7” E), 1 ♀ + 1 ♂, 12/05/2017 and in P12-P13 plots (aasl 66 m, lat. 21°54’20” N, long. 104°38’45” E), 3 ♀ on *Bambusodae* sp. (Poaceae).

**Type material** — The holotype female, 3 paratype females, and 1 paratype male on 3 slides deposited in CBGP, in Montpellier SupAgro Acarology collection, France.

**Etymology** — The name “tixierae” refers to our colleague Professor-Dr Marie-Stéphane Tixier (Montpellier SupAgro) to whom this species is dedicated for her huge contribution to...
the knowledge of mites and especially to the taxonomy of Phytoseiidae and her great assistance with this paper.

**Remarks** — Measurements of specimens collected during this study are provided in table 14 for females and for the single male and compared with measurements obtained from specimens of the closest described species.

Females of *Phytoseius tixierae* Kreiter *n. sp.* (Table 14) resembles that of *P. huaxiensis* Xin, Liang and Ke but differs in having *s6* only slightly serrated, shorter *s4*, *s6*, *Z4*, *Z5* and *JV5*. It also resembles *P. indicus* Bhattacharyya but differs in having *s6* only slightly serrated, shorter
s4, s6, Z4, JV5, Z4 not serrated but z4 serrated and longer. It is also related to P. kazusanus Ehara but differs in having s6 only slightly serrated, z4 serrated, longer Z5, JV5 and ShV and Z4 not serrated. It is also very close to P. longchuanensis Wu but differs from this species by having longer setae except s4 and Z4, s6 only slightly serrated, z4 serrated, longer JV5 and 4 macrosetae on the leg IV instead of zero. It is also very similar to P. rimandoi Corpuz but differs from this species in having shorter s6, Z4 smooth. Finally, the closest species is P. nudus Wu and Li but the new species differs from this species in having z4 strongly serrated (only slightly serrated in the former), and the dorsal shield rugose (smooth in the former).

Males of *Phytoseius tixierae* Kreiter n. sp. (Table 14) also resembles to the males of *P. huaxiensis* and *P. kazusanus* that are the only species for which males have been described. But males of the new species differ from males of the former species in having s6 only slightly

| Table 14 | Character measurements of adult females and one adult male of *Phytoseius tixierae* Kreiter n. sp. collected in this study and close species reported in previous studies (localities followed by the number of specimens measured). |
|----------|-------------------------------------------------------------|
| Characters | Phytoseius tixierae Kreiter n. sp. | Phytoseius huaxiensis Xin, Liang & Ke | Phytoseius kazusanus Ehara | Phytoseius indicus Wu | Phytoseius longchuanensis Wu | Phytoseius neglectus Wu & Li | Phytoseius rimandoi Corpuz-Raroz | Phytoseius tixierae Kreiter n. sp. | Phytoseius huaxiensis Xin, Liang & Ke | Phytoseius kazusanus Ehara |
| Dwl | 271 (250 – 280) | 260 – 299 | 284 | 268 | 285 | 332 | 200 | 222 | 228 |
| Dow at s4 level | 130 (125 – 140) | 136 – 145 | 155 | 196 | 143 | 186 | 113 | 118 | 144 |
| Ds | rugose | rugose | rugose | rugose | rugose | smooth | rugose | smooth | ? |
| j1 | 23 (21 – 23) | 28 | 20 – 27 | 25 (25 – 26) | 17 | 23 | 26 | 20 | 21 | 19 |
| j2 | 18 (15 – 23) | 20 | 22 – 27 | 19 (18 – 19) | 17 | 18 | 16 | 16 | 21 | 17 |
| j4 | 10 (10 – 11) | 8 | 9 | 7 | 13 | 8 to 12 | 10 | 9 | 8 |
| j5 | 10 (10 – 11) | 8 | 6 – 12 | 8 (8 – 9) | 7 | 13 | 8 to 12 | 10 | 9 | 8 |
| j6 | 11 (10 – 13) | 11 | 9 – 12 | 10 | 7 | 13 | 8 to 12 | 9 | 10 | 8 |
| J5 | 9 (8 – 9) | 9 | 8 – 9 | 9 (8 – 9) | 7 | 9 | 8 to 12 | 6 | 7 | 7 |
| r3 | 30 (28 – 30) | 36 | 30 – 36 | 31 (31 – 32) | 24 | 33 | 36 | 25 | 28 | 26 |
| s4 | 44 (43 – 45) | 57 | 60 – 72 | 48 (47 – 49) | 55 | 43 | 48 | 35 | 43 | 37 |
| s6 | 59 (55 – 63) | 60 | 60 – 72 | 59 (58 – 61) | 58 | 61 | 58 | 35 | 48 | 36 |
| s2 | 12 (10 – 13) | 13 | 10 – 12 | 14 (13 – 14) | 14 | 11 | 12 | 10 | 11 | 13 |
| s3 | 20 (18 – 25) | 35 | 26 – 29 | 29 (28 – 29) | 34 | 20 | 24 | 18 | 31 | 23 |
| s4 | 19 (18 – 23) | 17 | 10 | 10 | 16 (16 – 17) | 10 | 20 | 24 | 18 | 19 | 14 |
| z5 | 12 (9 – 13) | 11 | 8 – 9 | 11 (10 – 11) | 7 | 13 | 8 to 12 | 10 | 10 | 9 |
| Z4 | 57 (48 – 63) | 72 | 48 – 52 | 63 (62 – 64) | 69 | 53 | 56 | 28 | 37 | 35 |
| s1 – s4 | 53 (48 – 55) | 69 | 52 – 65 | 62 (61 – 62) | 38 | 41 | 56 | 43 | - | - |
| s1 – s3 | 46 (43 – 50) | - | - | - | - | - | - | - | - | - |
| s2 – s2 | 53 (50 – 55) | - | - | - | - | - | - | 48 | - | - |
| s3 – s3 | 59 (43 – 68) | - | - | - | - | - | - | 50 | - | - |
| s1 – s4 / s1 – a5 | 58 (55 – 60) | - | - | - | - | - | - | 90 | - | - |
| s6 – a4 | 62 (50 – 75) | - | - | - | - | - | - | 43 | - | - |
| Genid | 101 (98 – 105) | - | - | - | - | - | - | Not applicable | - | - |
| s1 – s5 | 56 (50 – 60) | - | - | - | - | - | - | 35 | - | - |
| Genos post. corn. | 80 (78 – 82) | - | - | - | - | - | - | Not applicable | - | - |
| Lsl | 24 (20 – 28) | - | - | - | - | - | - | Not applicable | - | - |
| Lsl | 2 | - | - | - | - | - | - | - | - | - |
| Vsl | 42 (85 – 98) | - | - | - | - | - | - | 75 | - | - |
| Vws Z7’ | 51 (50 – 53) | - | - | - | - | - | - | 90 | - | - |
| Vws anns | 44 (43 – 45) | - | - | - | - | - | - | 50 | - | - |
| JVS | 19 (15 – 29) | 44 | 36 | 41 (40 – 41) | 10 | 20 | - | 10 | 19 | 16 |
| SpdV | 19 spat. | - | 12 – 20 spat. | 10 (9 – 10) | 14 sp. | 6 spat. | 5 | - | 8 |
| SpdF | 30 (38 – 43) | 32 – 40 spat. | 31 (31 – 32) | 43 sp. | 42 spat. | 7 | - | 11 |
| ShV | 20 (20 – 23) | 20 | 20 – 23 | 26 (26 – 27) | 21 sp. | 24 spat. | 13 | - | 19 |
| ShF | 19 (18 – 20) | 22 | 22 spat. | 21 (20 – 21) | 21 sp. | 24 spat. | 15 | - | 16 |
| Scl | 10 | - | - | - | - | - | - | Not applicable | - | - |
| Scw | 5 | - | - | - | - | - | - | - | - | - |
| Fd | 14 (14 – 20) | - | - | - | - | - | - | 15 | - | - |
| No teeth Fd | 2 | - | - | - | - | - | - | 2 | - | - |
| Md | 18 (15 – 20) | - | - | - | - | - | - | 15 | - | - |
| No teeth Md | 1 | - | - | - | - | - | - | 1 | - | - |
| Shaft | 2 | - | - | - | - | - | - | 11 | - | - |

Sources of measurements – For *Phytoseius huaxiensis*: Xin et al. (1982); *P. indicus* (= *P. neglectus* Gupta): Bhattacharyya (1968) and Gupta (1969); *P. kazusanus*: Ehara in Ehara et al. (1994); *P. longchuanensis*: Wu (1997); *P. nudus*: Wu & Li (1984); *P. rimandoi*: Corpuz (1966). For Receiv.: *Phytoxiius* Xin et al. (1982); *P. kazusanus*: Ehara in Ehara et al. (1994). - : not provided.
serrated, and shorter s4, s6, z3, Z4, Z5 and JV5. Males of the new species differ from males of *P. kazusanus* in having s6 only slightly serrated, shorter Z4, Z5 and JV5, z4 serrated and longer and Z4 not serrated.

**Conclusion**

The fauna of Phytoseiidae of Vietnam is now composed of 20 species, 12 already known from previous studies and 8 added in this paper. As this number of species is still far below the anticipated real number of phytoseiid species present in this tropical biodiversity hotspot, follow-up survey work is urgently needed.

**Acknowledgements**

We are very grateful to Nguyễn Tuân Cuong for identification of plant species on which phytoseiid mites were collected. The International Center for Tropical Agriculture (CIAT, CGIAR) graciously provided logistical support for the in-country visit of M.-C. Bopp and facilitated the necessary permits for field visits. Financial support for the field collections in Vietnam was provided through the CGIAR research program on Roots, Tubers and Bananas - CRP-RTB and the CGIAR research program on Climate Change, Agriculture and Food Security - *i.e.*, CRP-CCAFS. We are also very grateful to Professor-Dr Marie-Stéphane Tixier (Montpellier SupAgro) for very valuable comments of an earlier version of this manuscript.

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