

Five Species of Predatory Mites of the Genus *Amblyseius* Berlese (Acari : Phytoseiidae) from Eastern Dry Zone of Karnataka

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ABSTRACT

The study reports five species of phytoseiid (Acari: Phytoseiidae) predatory mites of the genus *Amblyseius* Berlese, *Amblyseius adhatodae* Muma, *A. brachycalyx* Karmakar, Bhowmik & Sherpa, *A. herbicolus* (Chant), *A. largoensis* (Muma) and *A. tamatavensis* Blommers, from Eastern Dry Zone of Karnataka. We examined the holotype of *Amblyseius dahliae* and confirmed it as a junior synonym of *A. tamatavensis* due to great morphological similarities between these two species. Hence, *A. tamatavensis* is being reported for the first time from Indian subcontinent. A brief description of each of the five species including measurements and other important morphological characters is presented as well as new illustrations of important morphological characters such as ventrianal shield and spermathecae were included to facilitate species delineation. Furthermore, *A. adhatodae*, *A. brachycalyx* and *A. herbicolus* hitherto known from other Indian states are new reports for Karnataka.

Keywords : Fauna, Predatory mites, New record, Amblyseiini, New synonymy

TINY arthropod pests like mites, whiteflies and thrips cause damage to many cultivated crops and often become challenging to manage because of their rapid resistance development (Khadri and Srinivasa, 2018 and Augustine *et al.*, 2023). These small arthropods are often controlled in nature by predatory mites, insects, spiders and pathogens (McMurtry *et al.*, 2013; Flaboe *et al.*, 2007 and Maheswary *et al.*, 2015). Among these, predatory mites of Phytoseiidae family are probably the well explored and best utilized (Gupta and Kumar, 2018). Some of them, like *Phytoseiulus persimilis* (Athias Henriot), *Amblyseius swirskii* (Athias Henriot) and *Neoseiulus californicus* (McGregor) are commercially available for use in greenhouse. Besides the failed success to import predatory mites like *Phytoseiulus persimilis* (Athias Henriot) to India, it is always perceived with the risks of non-target effects and threats to the

environment and to indigenous biodiversity. A probable means of reducing such risk posed by exotic species is to use the native species, for which a thorough understanding about the native predatory phytoseiid fauna is necessary (Sankaran, 1976 and van Lenteren *et al.*, 2006).

Phytoseiid mites are widely distributed around the world and more than 2,500 valid species of Phytoseiidae are known till now, in three subfamilies and 94 genera (Demite *et al.*, 2023). Globally, 444 species are described in the genus *Amblyseius* and more than 50 species are reported from India as well (Gupta & Karmakar, 2015; Karmakar & Gupta, 2014; Rahul *et al.*, 2016; Karmakar *et al.*, 2017; Karmakar & Bhowmik, 2018; Kar & Karmakar, 2021; Kar & Karmakar, 2022 and Biswas & Karmakar, 2023). Most of the taxonomic studies on phytoseiid predatory mite

fauna is somehow confined to the humid north-eastern region of the country (Karmakar *et al.* 2017; Kar & Karmakar 2021 and Biswas & Karmakar 2023) except the unpublished work by Gowda (2009) that reports 51 species of phytoseiids in 14 genera from southern Karnataka.

The Eastern Dry Zone of Karnataka is the geographical region located in the eastern part of the South Indian state of Karnataka and comprises of six districts Bangalore Urban, Bangalore Rural, Kolar, Chikkabalapur, Tumakuru and Ramanagara. The zone is characterized by its arid and semi-arid climate and known for relatively low rainfall area compared to other parts in the state. Nevertheless, GKVK Campus of University of Agricultural Sciences, Bengaluru has been one of the national biodiversity heritage sites in the Eastern Dry Zone. In this study, we explored on the *Amblyseius* fauna in the Eastern Dry Zone of the Karnataka state.

MATERIAL AND METHODS

Phytoseiid mite collection surveys were undertaken from February 2022 to May 2023 at different locations in six districts *viz.*, Bangalore Urban, Bangalore Rural, Kolar, Chikkabalapur, Tumakuru and Ramanagara under Eastern Dry Zone of Karnataka state. Plant samples were collected and put in polythene bags with proper labelling, brought to laboratory and observed under stereo-binocular microscope for phytoseiid mites. The mites were picked using fine needle and transferred to MA 80 (40 parts of methanol, 40 parts of acetic acid, 20 parts of distilled water). Leaf litter and soil beneath the plant were also collected in separate polythene bags and subjected to extraction of mites from soil using modified Berlese/ Tullgren funnel to collect mites into a vial with 70 per cent alcohol. Mite specimens were mounted on standard microscopic slides using Hoyer's medium and slides were kept for drying in hot air oven at 40 °C for two weeks or till the required clarity of specimen is obtained.

The taxonomic system of Phytoseiidae proposed by Chant and McMurtry (2007) was used for identification. The nomenclature of setae used follows

Lindquist and Evans (1965) as adapted by Rowell *et al.* (1978) and ventral setal nomenclature is based on Chant and Yoshida-Shaul (1991); idiosomal setal pattern is based on Chant and Yoshida-Shaul (1992). Nomenclature of dorsal solenostomes (gland pores) is based on Athias-Henriot (1975). Leg chaetotaxy follows that of Evans (1963).

The images were captured using compound microscope Zeiss Axio Imager A1, equipped with Differential Interference Contrast optical system and Nikon D7500 camera. Measurements were recorded using ProgRes® Image Capture Software and given in micrometers as mean followed by range values in parenthesis. Specimens examined and studied in the study are deposited in the repository of the project - All India Network Project on Agricultural Acarology, Bangalore, Karnataka, India.

RESULTS AND DISCUSSION

Survey record revealed five species of *Amblyseius*, *A. adhatodae* Muma, *A. brachycalyx* Karmakar, Bhowmik & Sherpa, *A. tamatavensis* Blommers, *A. herbicolus* (Chant) and *A. largoensis* (Muma) in the Eastern Dry Zone of Karnataka. Plants on which these mites were collected and the location details are given in Table 1. The most widely distributed species reported from 60 plants was *A. largoensis*, followed by *A. adhatodae* (18 plants), *A. herbicolus* (6 plants), *A. tamatavensis* (4 plants) and *A. brachycalyx* (3 plants). *Amblyseius adhatodae*, *A. herbicolus* and *A. largoensis* was recorded from both leaf sample and from the soil litter as well.

Amblyseius Adhatodae Muma

Amblyseius adhatodae Muma, 1967: 268.

(Fig. 1),

Female (n = 5)

Dorsal shield smooth, 338 (328-352) long, 258 (250-265) wide at level of setae *s4* and 271(262-278) wide at level of setae *S2*; with seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8* and *gd9*). Measurements of setae as follows: *j1* 37 (36-39), *j3* 49 (47-52), *j4* 4 (3-6), *j5* 4 (3-5), *j6* 5 (4-6), *J2* 6

TABLE 1
Collection details of *Amblyseius* species

Mite species	Habitat	Plant/ litter	Site of collection
<i>Amblyseius adhatodae</i>	<i>Acacia</i> sp. <i>Artrocarpus</i>	Litter	GKVK*
	<i>Anamirta cocculus</i> (L.) Wight & Arn.	Litter	GKVK
	<i>heterophyllus</i> Lam.	Litter	GKVK
	<i>Bambusa</i> sp.	Litter	GKVK
	<i>Codiaeum variegatum</i> (L.) A. Juss	Litter	GKVK
	<i>Ficus religiosa</i> L.	Litter	GKVK
	<i>Filicium decipiens</i> (Wight & Arn.) Thwaites	Litter	GKVK
	<i>Ixora brachiata</i> Roxb.	Litter	GKVK
	<i>Mallotes philippiensis</i> (Lam.) Muell. Arg.	Litter	GKVK
	<i>Milletia pinnata</i> (L.) Panigrahi	Litter	GKVK
	<i>Tamarindus indica</i> L.	Litter	GKVK
	<i>Anacardium occidentale</i> L.	Litter	GKVK
	<i>Artocarpus hirsutus</i> Lam.	Litter	GKVK
	<i>Barleria</i> sp.	Plant	GKVK
	<i>Jasminum sambac</i> (L.) Alton	Plant	GKVK
	<i>Piper nigrum</i> L.	Plant	Nagasandra
<i>Tectona grandis</i> L.f.	Plant	Malleshwaram	
<i>Pouteria campechiana</i> (Kunth)Baehni	Plant	Hirehalli	
<i>Amblyseius brachycalyx</i>	<i>Mangifera indica</i> L.	Plant	Tamaka
	<i>Punica grantum</i> L.	Plant	Chintamani
	<i>Annona squamosa</i> L.	Plant	Hesaraghatta
<i>Amblyseiusherbicolus</i>	<i>Tectona grandis</i> L.f.	Plant	Malleshwaram
	<i>Milletia pinnata</i> (L.) Panigrahi	Plant	Nandi hills
	<i>Hydnocarpus pentandra</i> (Buch.-Ham.)Oken	Litter	GKVK
	<i>Amoora lawii</i> (Wight) C. J. Sadanha	Plant	GKVK
	<i>Anacardium occidentale</i> L.	Plant	GKVK
	<i>Santalum album</i> L.	Plant	GKVK
<i>Amblyseius largoensis</i>	<i>Anacardium occidentale</i> L.	Plant	GKVK
	<i>Monoon longifolium</i> Sonn. B. Xue & R. M. K. Saunders	Plant	GKVK
	<i>Milletia pinnata</i> (L.) Panigrahi	Plant	GKVK,
			Hadonahalli
	<i>Acacia</i> sp.	Plant	GKVK
	<i>Ficus microcarpa</i> L.f.	Plant	GKVK
	<i>Ixora brachiata</i> Roxb.	Plant, Litter	GKVK
	<i>Bambusa</i> spp.	Plant	GKVK
	<i>Artocarpus heterophyllus</i> Lam.	Plant	GKVK,
			Tamaka,
			Chintamani
	<i>Artocarpus hirsutus</i> Lam.	Plant	GKVK
	<i>Magnolia alba</i> (DC.) Figlar	Plant	GKVK
<i>Putranjiva roxburgii</i> Wall.	Plant	GKVK	
<i>Mangifera indica</i> L.	Plant	Tamaka, Magadi,	
		Hesaraghatta,	
		Chintamani, Rama	
		devarabetta hills	

Continued....

Table 1 Continued

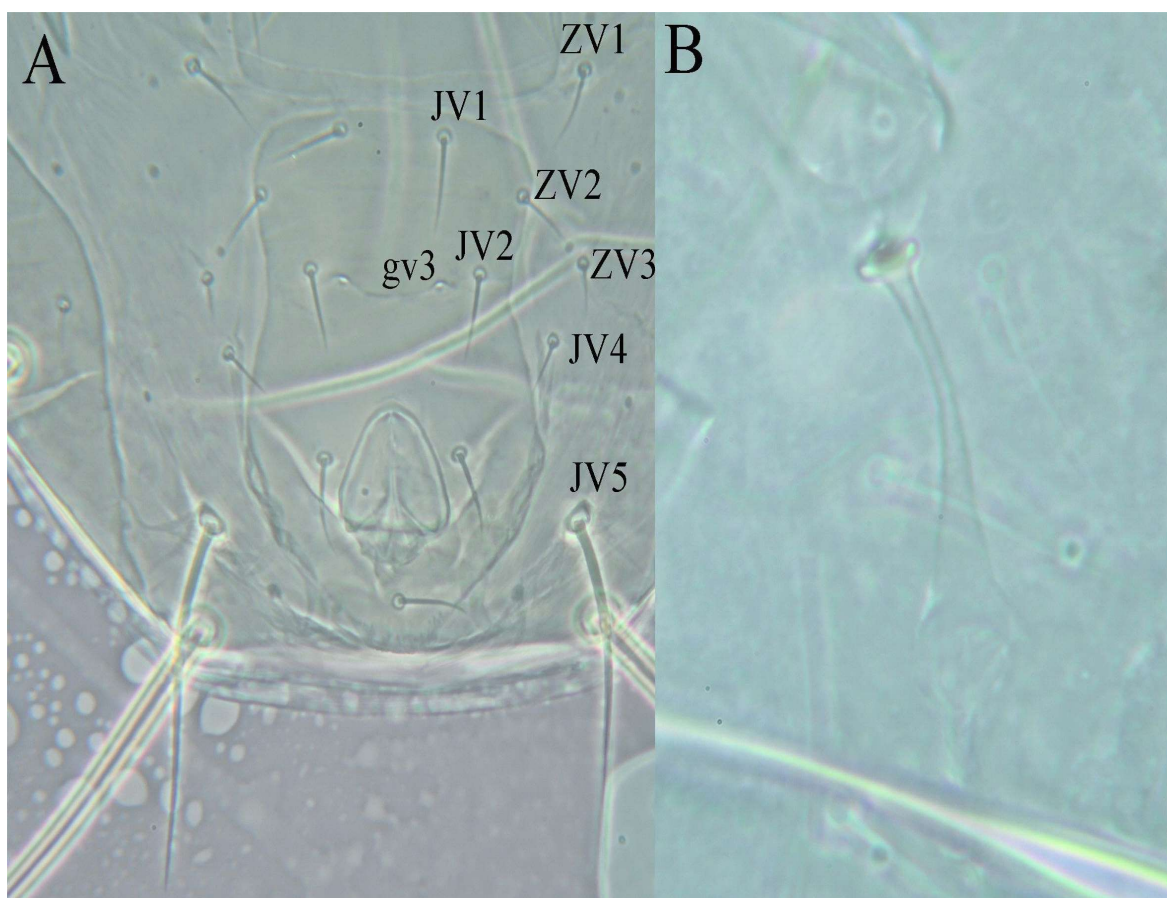
Mite species	Habitat	Plant/ litter	Site of collection
	<i>Acalypha</i> sp.	Plant	Tamaka
	<i>Ficus carica</i> L.	Plant	Tamaka
	<i>Pimenta dioica</i> (L.) Merr.	Plant	Tamaka
	<i>Ixora</i> sp.	Plant	Tamaka
	<i>Morinda citrifolia</i> L.	Plant	Tamaka
	<i>Citrus</i> sp.	Plant	Tamaka
	<i>Solanum melongena</i> L.	Plant	Tamaka
	<i>Punica grantaum</i> L.	Plant	Chintamani
	<i>Syzygium cumini</i> (L.) Skeels	Plant	Magadi, GKVK, Chintamani
	<i>Psidium guajava</i> L.	Plant	Magadi
	<i>Manilkara zapota</i> (L.) P. Royen	Plant	Magadi, Hirehalli
	<i>Malpighia emarginata</i> DC.	Plant	Hirehalli
	<i>Syzygium aqueum</i> (Burm.f.) Alston	Plant	Hirehalli
	<i>Strychno spotatorum</i> L.f.	Plant	GKVK
	<i>Catha edulis</i> (Vahl) Forssk. Ex Endl.	Plant	GKVK
	<i>Hydnocarpus pentandra</i> (Buch.-Ham.) Oken	Plant	GKVK
	<i>Schefflera capitata</i> (Wight & Arn.) Harms	Plant	GKVK
	<i>Thunbergia mysorensis</i> (Wight) T. Anderson ex. Bedd.	Plant	GKVK
	<i>Coffea arabica</i> L.	Plant	GKVK
	<i>Guazum aulmifolia</i> Lam.	Plant	GKVK
	<i>Zamia furfuracea</i> L.f.	Plant	GKVK
	<i>Barleria</i> sp.	Plant	GKVK
	<i>Cycas</i> sp.	Plant	GKVK
	<i>Cinnamomum verum</i> J. Presl	Plant	GKVK
	<i>Sauropus androgynus</i> (L.) Merr.	Plant	Magadi
	<i>Annona squamosa</i> L.	Plant	Hirehalli
	<i>Syzygium malaccense</i> (L.) Merr. & L. M. Perry	Plant	Hirehalli
	<i>Citrus maxima</i> (Burm.) Merr.	Plant	Hirehalli
	<i>Syzygium jambos</i> L. (Alston)	Plant	Hirehalli
	<i>Pouteria campechiana</i> (Kunth) Baehni	Plant	Hirehalli
	<i>Allamanda blanchetti</i> A.DC.	Plant	Hadonahalli
	<i>Croton</i>	Plant	Hadonahalli
	<i>Jasminum</i> sp.	Plant	Hadonahalli
	<i>Nerium oleander</i> L.	Plant	Hadonahalli
	<i>Eriobotrya japonica</i> (Thunb.) Lindl.	Plant	GKVK
	<i>Cordia dichotoma</i> G. Frost.	Plant	GKVK
	<i>Chrysophyllum cainito</i> L.	Plant	GKVK
	<i>Dillenia indica</i> L.	Plant	GKVK
	<i>Nephelium lappaceum</i> L.	Plant	GKVK
	<i>Flacourtia inermis</i> (Burm. f.) Merr.	Plant	GKVK
	<i>Ixora chinensis</i> Lam.	Plant	GKVK
	<i>Garcinia gummigutta</i> (L.) N. Robson	Plant	GKVK
	<i>Amoora lawii</i> (Wight) C.J. Sadanha	Plant	GKVK
	<i>Etlingera elatior</i> (Jack) R. M. Sm.	Plant	GKVK
	<i>Tectona grandis</i> L.f.	Plant	GKVK
	<i>Cyathocalyx zeylanicus</i> Champ.	Plant	GKVK
	<i>Ex. Hook. f. & Thomson</i>		
	Malvaceae sp.	Plant	Ramadevarabetta hills

Continued....

Table 1 Continued

Mite species	Habitat	Plant/ litter	Site of collection
	<i>Acalypha</i> sp.	Plant	Tamaka
	<i>Punica grantum</i> (L.)	Plant	Chintamani
	<i>Senna spectabilis</i> (DC.) Irwin & Barneby	Plant	Nandi hills
	<i>Achyranthus aspera</i> L.	Plant	Ramadevarabetta hills

*GKVK- Gandhi Krishi Vigyan Kendra, Bangalore

Fig. 1 : *Amblyseius adhatodae* Muma 1967, female. A. ventrianal shield; B. Spermatheca

(5-7), *J5* 9 (8-11), *z2* 5 (4-6), *z4* 5 (4-7), *z5* 4 (4-5), *Z1* 6 (5-8), *Z4* 153 (151-159), *Z5* 293 (286-302), *s4* 125 (115-131), *S2* 8 (8-9), *S4* 7 (7-8), *S5* 8 (7-9), *r3* 8 (7-10), *R1* 7 and *JV5* 73 (67-79). Peritreme extends beyond bases of *jl*. Distance between *ST1-ST3* 64 (63-65), *ST2-ST2* 72 (70-76), *ST5-ST5* 74 (73-77). Length of ventrianal shield 117 (108-127), width at level

of anus 70 (62-79); distance between preanal pores (*gv3-gv3*) 24 (22-26); preanal pores large crescentic (Fig. 1A). Two pairs of metapodal shields, primary 23 (21-25) long, secondary 13 (11-15) long. Fixed cheliceral digit with 11 teeth and pilus dentilis, movable digit with four teeth. Calyx of spermatheca 37 (35-39) long (Fig. 1B). Length of legs as follows: Leg I 416 (399-429), Leg II 325 (309-341), Leg III

325 (315-336), Leg IV 443 (435-459). Genua II, III and IV each with seven setae. Measurements of macrosetae as follows: *SgeI* 53 (50-58), *SgeII* 41 (40-43), *SgeIII* 50 (44-56), *StiIII* 39 (35-41), *StIII* 33 (31-36), *SgeIV* 140 (132-148), *StiIV* 97 (94-102), *StIV* 79 (74-84).

Distribution in World : Brazil, India, Pakistan, Kenya, Sri Lanka (Demite *et al.*, 2023) and Maldives (Döker *et al.*, 2022a).

Distribution in India : Kerala, Maharashtra (Demite *et al.*, 2023) and Karnataka (Gowda 2009, this study).

Remarks : *Amblyseius adhatodae* was described by Muma (1967) based on the specimens collected from Pakistan and India. Morphological characters and measurements of the specimens examined in this study are almost identical to its original description as well as redescriptions (Denmark and Muma, 1989; Moraes *et al.*, 1989; Moraes *et al.*, 2004; Zannou *et al.*, 2007; Döker *et al.*, 2022a).

Amblyseius Brachycalyx Karmakar Bhowmik & Sherpa

Amblyseius brachycalyx Karmakar, Bowmik & Sherpa, 2017 : 44.

(Fig. 2)

Female (n = 4)

Dorsal shield smooth, 314 (304-325) long, 189 (188-191) wide at level of setae *s4* and 223 (222-225) wide at level of setae *S2*; with seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8* and *gd9*). Measurements of setae as follows: *j1* 26 (25-26), *j3* 47 (46-49), *j4* 6 (5-6), *j5* 5 (4-6), *j6* 6 (5-7), *J2* 5 (5-6), *J5* 7 (6-8), *z2* 10 (9-13), *z4* 7 (6-8), *z5* 5 (5-6), *Z1* 7 (7-8), *Z4* 72 (70-75), *Z5* 133 (123-142), *s4* 61 (60-62), *S2* 9 (9-10), *S4* 7 (6-8), *S5* 9 (8-9), *r3* 15 (14-17), *R1* 7 and *JV5* 55 (51-59). Peritreme extends beyond bases of *j1*. Distance between *ST1-ST3* 59 (57-59), *ST2-ST2* 67 (66-68), *ST5-ST5* 70 (68-73). Length of ventrianal shield 107 (103-112), width at level of setae *ZV2* 80 (79-82), width at level of anus 65 (61-71); distance

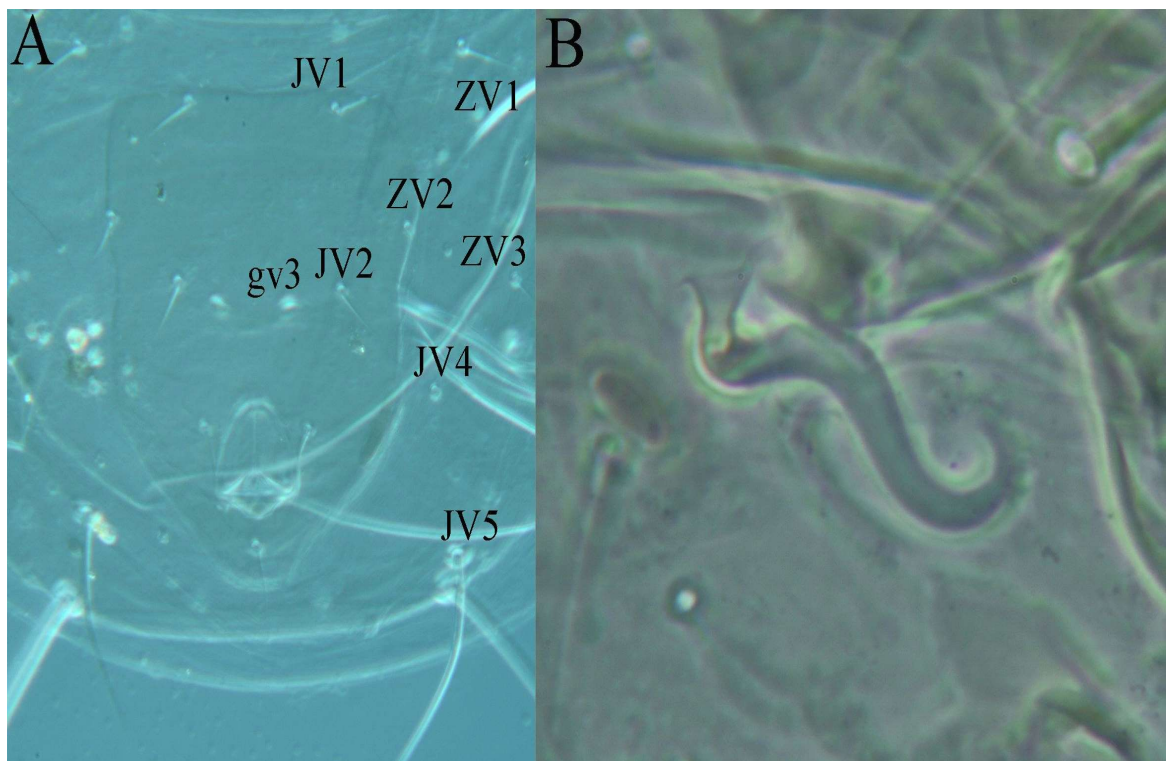


Fig. 2 : *Amblyseius brachycalyx* Karmakar, Bowmik & Sherpa, 2017, female. A. ventrianal shield; B. Spermetheca

between preanal pores (*gv3-gv3*) 20 (18-23); preanal pores large crescentic (Fig. 2A). Two pairs of metapodal shields, primary 21 (20-23) long and secondary 9 (7-10) long. Fixed cheliceral digit with 12 teeth and pilus dentilis, movable digit with three teeth. Calyx of spermatheca 7 (6-8) long (Fig. 2B). Length of legs as follows: Leg I 291 (279-298), Leg II 248 (236-261), Leg III 246 (238-251), Leg IV 322 (312-341). Genua II, III and IV each with seven setae. Measurements of macrosetae as follows: *SgeI* 29 (28-29), *SgeII* 29 (28-30), *SgeIII* 39 (37-41), *StiIII* 26 (23-29), *SgeIV* 71 (68-73), *StiIV* 41 (39-42) and *StIV* 49 (38-54).

Distribution in World : This species is only known from India.

Distribution in India : West Bengal (Karmakar *et al.*, 2017) and Karnataka (this study).

Remarks : Morphological characters and measurements of the specimens examined in this study are very close to those of the original description by Karmakar *et al.* (2017).

Amblyseius herbicolus (Chant)

Typhlodromus (Amblyseius) herbicolus Chant, 1959:84.

(Fig. 3)

Female (n = 4)

Dorsal shield smooth, 345 (340-348) long, 229 (212-242) wide at level of setae *s4* and 256 (236-267) wide at level of setae *S2*; with seven pairs of solenostomes (*gd1, gd2, gd4, gd5, gd6, gd8* and *gd9*). Measurements of setae as follows: *j1* 32 (31-33), *j3* 39 (37-43), *j4* 6 (5-7), *j5* 6 (5-6), *j6* 6 (5-7), *J2* 8 (6-9), *J5* 8 (7-8), *z2* 11 (9-12), *z4* 10 (9-11), *z5* 7 (6-7), *Z1* 8 (6-9), *Z4* 100 (92-107), *Z5* 263 (253-270), *s4* 93 (84-99), *S2* 11 (9-13), *S4* 11 (10-13), *S5* 8 (7-9), *r3* 11 (11-12), *R1* 8 (7-9) and *JV5* 66 (62-70). Peritreme extends beyond bases of *j1*. Distance between *ST1-ST3* 68 (65-71), *ST2-ST2* 73 (71-73), *ST5-ST5* 66 (62-69). Length of ventrianal shield 117 (111-127), width at level of setae *ZV2* 53 (51-55), width at level of anus 70 (68-71); distance between preanal pores (*gv3-gv3*) 27 (26-28); preanal pores large crescentic (Fig. 3A).

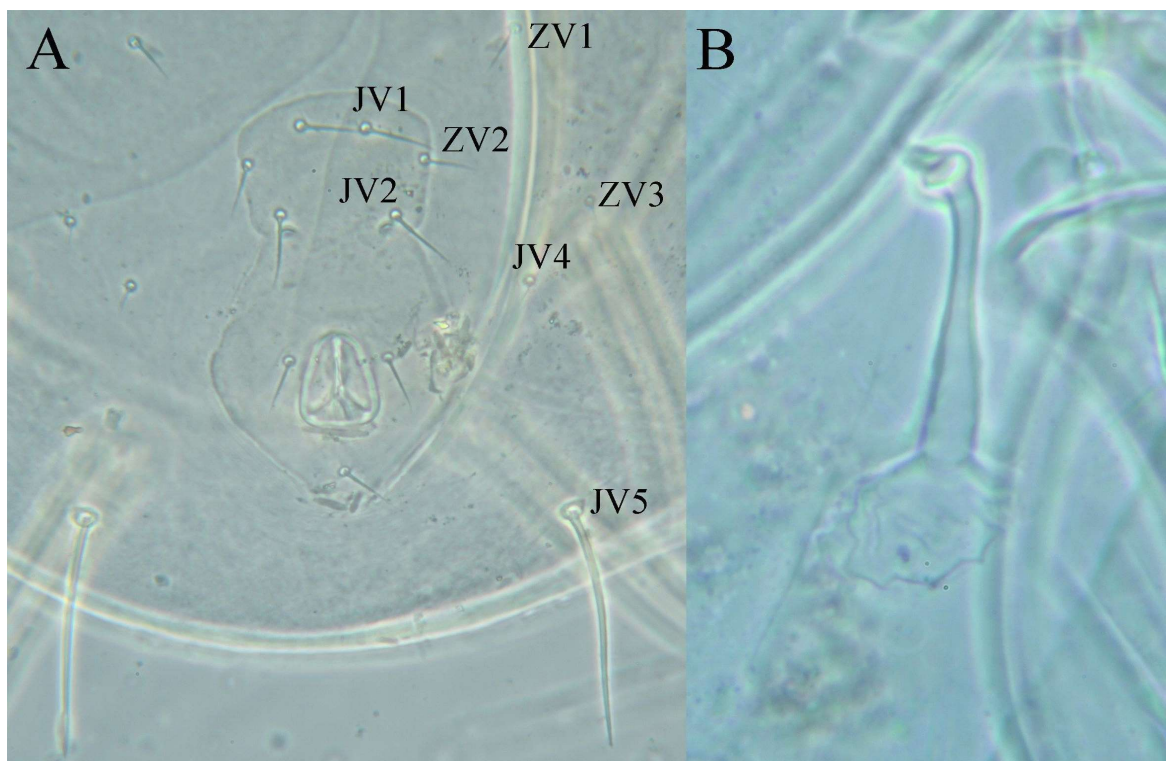


Fig. 3 : *Amblyseius herbicolus* (Chant 1959), female. A. ventrianal shield; B. Spermatheca

Two pairs of metapodal shields, primary 22 (20-25) long and secondary 16 (14-17) long. Fixed cheliceral digit with 11 teeth and pilus dentilis, movable digit with four teeth. Calyx of spermatheca 29 (27-30) long (Fig. 3B). Length of legs as follows: Leg I 409 (401-414), Leg II 332 (314-342), Leg III 333 (314-348), Leg IV 426 (415-435). Genua II, III and IV each with seven setae. Measurements of macrosetae as follows: *SgeI* 45 (44-48), *SgeII* 38 (36-41), *SgeIII* 46 (40-50), *StiIII* 39 (35-43), *StiIII* 31 (30-34), *SgeIV* 115 (107-120), *StiIV* 82 (77-87) and *StiIV* 65 (57-72).

Distribution in World : Cosmopolitan in most of the tropical and subtropical areas of the world (Demite *et al.*, 2023).

Distribution in India : Kerala, West Bengal and Karnataka (this study). Specimens previously reported as *A. herbicolus* from Arunachal Pradesh and Tripura by Gupta (1986) and from West Bengal by Karmakar *et al.* (2017) may represent another species and require reconsideration (see remarks).

Remarks : Morphological characters and measurements of the specimens examined in this study are identical to the original description and re-descriptions (Chant, 1959; Denmark and Muma, 1989; Demite *et al.*, 2017; Zannou *et al.*, 2007; Guanilo *et al.*, 2008a, b; Ferragut *et al.*, 2010; Akyazy *et al.*, 2016; Kreiter *et al.*, 2018; Doker *et al.*, 2020; Doker *et al.*, 2022b). Gupta (1986) redescribed this species based on the specimens collected from Arunachal Pradesh and Tripura. His illustration depicts three teeth as opposite to four in the holotype and other re-descriptions. Karmakar *et al.* (2017) redescribed it from specimens of both sexes (females and males) collected from West Bengal. However, *A. herbicolus* has thelytokous reproduction (parthenogenetic reproduction without males) (Reiss *et al.*, 2007). Therefore, the specimens reported by Gupta (1986) and Karmakar *et al.* (2017) might represent another species and require reconsideration.

***Amblyseius largoensis* (Muma)**

Amblyseiopsis largoensis Muma, 1955:266.

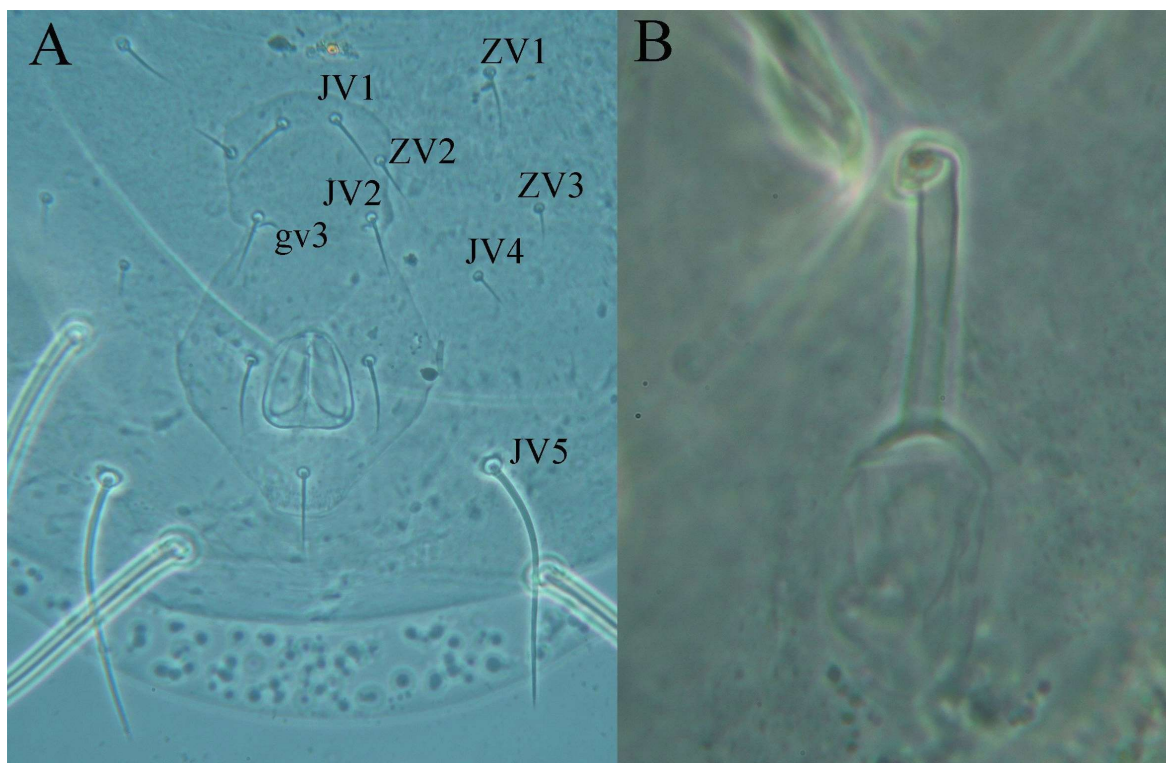


Fig. 4 : *Amblyseius largoensis* (Muma 1955), female. A. ventrianal shield; B. Spermatheca

(Fig. 4)

Female (n=5)

Dorsal shield smooth, 335 (321-354) long, 224 (223-226) wide at level of setae *s4* and 253 (252-263) wide at level of setae *S2*. Seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8* and *gd9*) present. Measurements of setae as follows: *j1* 37 (36-38), *j3* 50 (48-52), *j4* 6 (5-7), *j5* 5 (4-6), *j6* 7 (5-9), *J2* 8 (5-12), *J5* 9 (8-10), *z2* 10 (8-13), *z4* 8 (7-10), *z5* 6 (5-7), *Z1* 9 (7-12), *Z4* 99 (84-112), *Z5* 256 (235-278), *s4* 103 (99-106), *S2* 12 (10-13), *S4* 11 (10-14), *S5* 8 (6-10), *r3* 13 (10-16), *R1* 9 (7-11) and *JV5* 69 (56-75). Peritreme extends beyond bases of *j1*. Distance between *ST1-ST3* 68 (66-70), *ST2-ST2* 69 (69-70), *ST5-ST5* 72 (68-74). Length of ventrianal shield 122 (117-127), width at level of setae *ZV2* 49 (46-54), width at level of anus 71 (67-75); distance between preanal pores (*gv3-gv3*) 27 (24-29); preanal pores large crescentic (Fig. 4A). Two pairs of metapodal shields, primary shield 25 (23-27) long and secondary shield 11 (9-11) long. Fixed cheliceral digit with 11

teeth and pilus dentilis, movable digit with three teeth. Calyx of spermatheca 28 (26-31) long (Fig. 4B). Length of legs as follows: Leg I 367 (357-385), Leg II 301 (285-325), Leg III 312 (300-324), Leg IV 396 (381-407). Genua II, III and IV each with seven setae. Measurements of macrosetae as follows: *SgeI* 39 (34-42), *SgeII* 38 (34-43), *SgeIII* 49 (43-56), *StiIII* 40 (32-45), *StiIII* 32 (29-36), *SgeIV* 120 (106-133), *StiIV* 97 (79-112) and *StIV* 69 (55-77).

Distribution in World : This species has a cosmopolitan distribution and is reported from most of the tropical and subtropical areas of the world (Demite *et al.*, 2023).

Distribution in India : Himachal Pradesh, Andaman and Nicobar Islands, Gujarat, Andhra Pradesh, Arunachal Pradesh, Karnataka (also this study), Tamil Nadu, Kerala, Pondicherry, Assam, Manipur, Meghalaya, Nagaland, Tripura, Orissa, Bihar, Uttar Pradesh, Jammu & Kashmir, Punjab and West Bengal (Demite *et al.*, 2023).

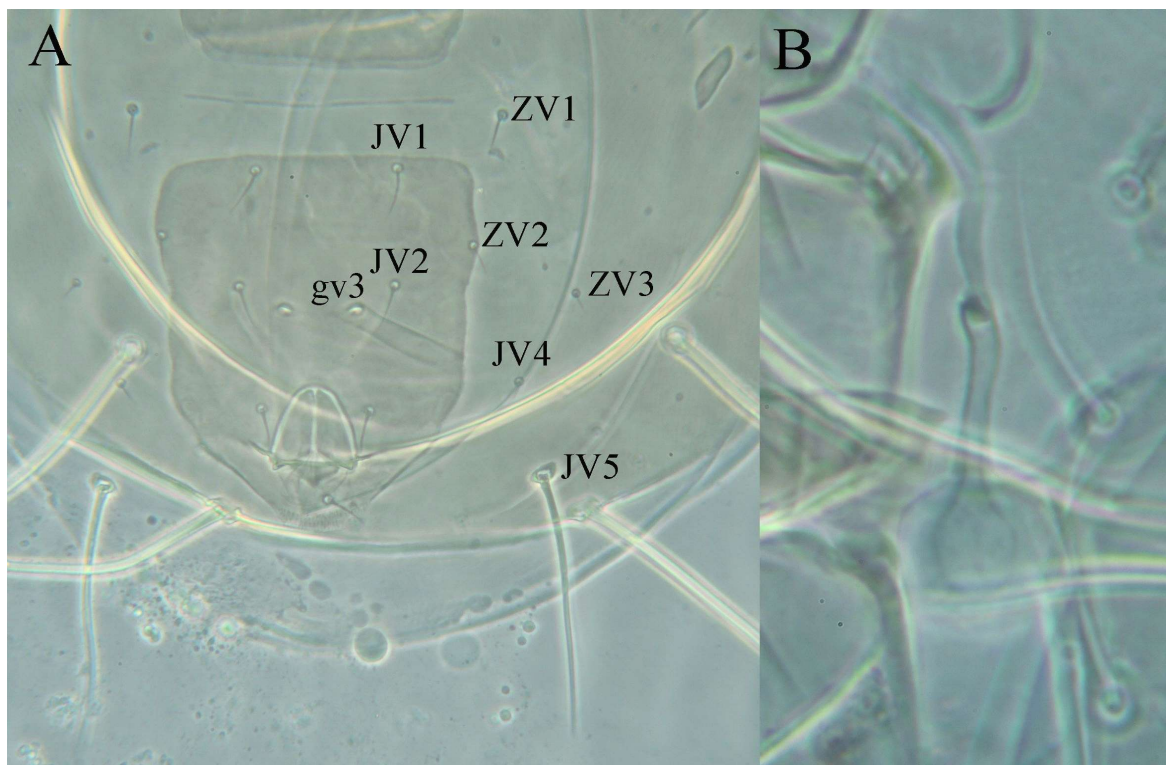


Fig. 5 : *Amblyseius tamatavensis* Blommers 1974, female. A. ventrianal shield; B. Spermatheca

Remarks : Morphological characters and measurements of the specimens examined in this study are identical to the original description and subsequent redescrptions by Schicha (1987), Denmark and Muma (1989), Zannou *et al.* (2007), Navia *et al.* (2014), Karmakar *et al.* (2017), Ferragut and Baumann (2019), Liao *et al.* (2020) and Döker *et al.* (2022b).

***Amblyseius tamatavensis* Blommers**

Amblyseius (Amblyseius) tamatavensis Blommers, 1974:144.

Amblyseius dahliae Karmakar, Bhowmik & Sherpa, 2017: 40. **Syn. Nov.**

(Fig. 5)

Female (n = 4)

Dorsal shield smooth, 327 (321-337) long, 213 (212-214) wide at level of setae *s4* and 242 (239-247) wide at level of setae *S2*; with seven pairs of solenostomes (*gd1, gd2, gd4, gd5, gd6, gd8* and *gd9*). Measurements of setae as follows: *j1* 30 (25-34), *j3* 46 (43-49), *j4* 3 (3-4), *j5* 3 (3-4), *j6* 4 (3-5), *J2* 5 (4-6), *J5* 7 (6-7), *z2* 6 (5-7), *z4* 5 (4-6), *z5* 4 (3-4), *Z1* 5, *Z4* 114 (110-119), *Z5* 236 (223-245), *s4* 85 (83-87), *S2* 6 (5-6), *S4* 5 (4-6), *S5* 6 (5-6), *r3* 12 (11-13), *R1* 6 (6-7) and *JV5* 83 (79-87). Peritreme extends beyond bases of *j1*. Distance between *ST1-ST3* 56 (53-61), *ST2-ST2* 71 (70-71), *ST5-ST5* 72 (69-73). Length of ventrianal shield 112 (110-115), width at level of setae *ZV2* 88 (84-91), width at level of anus 78 (77-79); distance between preanal pores (*gv3-gv3*) 21 (21-22); preanal pores large crescentic (Fig. 5A). Two pairs of metapodal shields, primary 21 (20-23) long and secondary 11 (11-12) long. Fixed cheliceral digit with 11 teeth and pilus dentilis, movable digit with four teeth. Calyx of spermatheca 17 (16-18) long (Fig. 5B). Length of legs as follows: Leg I 322 (308-330), Leg II 277 (267-291), Leg III 273 (254-293), Leg IV 351 (337-367). Genua II, III and IV each with seven setae. Measurements of macrosetae as follows: *SgeI* 38 (37-39), *SgeII* 35 (31-39), *SgeIII* 55 (49-58), *StiIII* 41 (35-46), *SgeIV* 105 (102-112), *StiIV* 75 (69-81) and *StIV* 67 (63-72).

Distribution in World : Wide distribution and reported from several countries (Demite *et al.*, 2023).

Distribution in India : West Bengal (Karmakar *et al.*, 2017) reported as *A. dahliae*, Karnataka (this study).

Remarks : Morphological characters and measurements of the specimens examined in this study are identical to the original description and subsequent redescrptions by Schicha (1987), Ueckermann & Loots (1988), Denmark & Muma (1989), Schicha & Corpuz-Raros (1992), Ehara (2002), Moraes *et al.* (2004), Zannou *et al.* (2007), Oliveira *et al.* (2012), Döker *et al.* (2018), Ferragut & Baumann (2019), Kreiter *et al.* (2020) and Liao *et al.* (2020).

Karmakar *et al.* (2017) described *A. dahliae* based on the specimens collected from West Bengal. The authors separated their new species from *A. tamatavensis* based on the shape of ventrianal and genital shields, the posterior margin of the sternal shield and the length of macrosetae on leg IV. Karmakar *et al.* (2017) implied that the posterior margin of the sternal shield in *A. dahliae* is concave and wavy with a posterior lateral extension and the genital shield is wider at the level of *ST5*. We examined the holotype of *A. dahliae* deposited in National Zoological Collections, Prani Vigyan Bhawan, Zoological Survey of India, Kolkata and compared the two species based on their original descriptions and also considered the redescrptions of *A. tamatavensis*. Indeed, measurements of the genital shield width of *A. dahliae* [71 (70-72)] and also macrosetae on leg IV [genu 105 (100-113), tibia 72 (70-75), basitarsus 68 (66-70)] fall into the range with those provided in the redescrptions given above. Therefore, it is concluded that such slight differences used to separate *A. dahliae* and *A. tamatavensis* by Karmakar *et al.* (2017) might represent intraspecific variation. Hence, we considered *A. dahliae* as a junior synonym of *A. tamatavensis*.

Moreover, *A. tamatavensis* is a promising biocontrol agent of *Bemisia tabaci* (Gennadius) (Cavalcante *et al.*, 2017), a major pest and vector of many plant diseases. Massaro *et al.* (2021) developed mass production technology for *A. tamatavensis* using a

factitious host, *Thyreophagus cracentiseta* (Acari: Acaridae) and thus, further studies can be done to study biocontrol potential of this phytoseiid mite.

Phytoseiid mites are often considered as one of the groups of predators for control of spider mites and small soft bodied insects such as thrips and whiteflies (McMurtry *et al.* 2013). In this study, we reported five species of *Amblyseius*, of which *A. tamatavensis* is new report for Indian mite fauna. Also *A. dahliae* is proposed as junior synonym of *A. tamatavensis* in this study as we could find no difference between these two species.

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