

First report on the occurrence of *Typhlodromus (Anthoseius) transvaalensis* (Nesbitt) (Acari: Phytoseiidae) in India with a redescription of the species

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Original research

ABSTRACT

This paper reports for the first time the occurrence of *Typhlodromus (Anthoseius) transvaalensis* (Nesbitt) in India. Morphometric measurements of the Indian specimens collected on an unidentified plant in Ramanagara district of Karnataka are provided along with a redescription of the species, and a comparison with specimens from Japan, Africa, Argentina and La Réunion Island to show similarities and variations in morphological traits of taxonomic importance.

Keywords predatory mites; new record; Karnataka

Introduction

The family Phytoseiidae contains predatory mites used in biological control. It comprises three subfamilies: Amblyseinae, Phytoseiinae and Typhlodrominae. Within the subfamily Typhlodrominae, the genus *Typhlodromus* contains the highest number of species, and is divided into two subgenera, *Typhlodromus (Anthoseius)* De Leon and *Typhlodromus (Typhlodromus)* Scheuten (Chant and McMurtry 1994, 2007). There are 388 described species of *Typhlodromus (Anthoseius)* in the world (Demite *et al.* 2020).

Typhlodromus (Anthoseius) transvaalensis (Nesbitt), the species reported herein, is widely distributed in many tropical and subtropical parts of the world, viz. Algeria, Australia, Azerbaijan, Brazil, Cameroon, Cape Verde, China, Colombia, Costa Rica, Egypt, Georgia, Guinea, Hawaii, Indonesia, Israel, Jordan, Kenya, New Caledonia, Panama, Philippines, La Réunion Island, Russia, Singapore, South Africa, Taiwan and USA (Moraes *et al.* 2004; Ueckermann *et al.* 2008; Demite *et al.* 2020). Nesbitt (1951) first described this species from ground peanuts in Transvaal (South Africa) and from *Rattus* sp. in Florida, USA. It occurs on a great variety of plants (Muma and Denmark 1970), including sugarcane, *Saccharum officinarum* L., in South Africa (Ueckermann *et al.* 2008); chilli, *Capsicum annuum* L., and tomato, *Lycopersicon esculentum* Mill., in Argentina (Cédola and Castresana 2014); and ribwort plantain, *Plantago lanceolata* L., and rescuegrass, *Bromus catharticus* Vahl, in La Réunion Island (Kreiter *et al.* 2020). It was reported in laboratory cultures of mites such as the phytoseiid *Scapulaseius okinawanus* (Ehara) (Ehara and Kishimoto 2007), the pyroglyphid *Dermatophagoides* sp. and the otopheidomenid *Nabiseius* sp. (Prasad 1968). Kreiter *et al.* (2020) found this species in rearings of *Frankliniopsis* sp. and of unnamed beneficial insects

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in La Réunion Island, while Ueckermann *et al.* (2008) found it in a *Galleria* sp. colony in Kenya, and on the scale insect *Coccus viridis* (Green) in Cape Verde. The other habitats from where it was recorded earlier are: donkey's dunghill and chocolates in Israel (Amitai and Swirski 1978), an unlabelled stored commodity in the Philippines (Corpuz-Raros *et al.* 1988) and soil in South Africa (Ueckermann *et al.* 2008).

Since the present report of *T. (A.) transvaalensis* is the first from India, morphometric measurements of the Indian specimens collected on an unidentified plant in Ramanagara district of Karnataka are provided along with a redescription of the species. In addition, morphological traits of the Indian specimens are compared with those reported in redescrptions provided by Ehara and Kishimoto (2007), Ueckermann *et al.* (2008), Cédola and Castresana (2014) and Kreiter *et al.* (2020) for specimens collected in Japan, Africa, Argentina and La Réunion Island, respectively. All measurements are given in micrometres (µm).

Systematic account

Typhlodromus (Anthoseius) transvaalensis (Nesbitt)

Kampimodromus transvaalensis Nesbitt 1951: 55.

Typhlodromus transvaalensis, Chant 1955: 498.

Typhlodromus (Typhlodromus) transvaalensis, Chant 1959: 60.

Neoseiulus transvaalensis, Muma 1961: 295.

Typhlodromus (Neoseiulus) transvaalensis, Pritchard & Baker 1962: 222.

Typhlodromus transvaalensis, Chant & Baker 1965: 5.

Clavidromus transvaalensis, Muma & Denmark 1968: 238.

Mumaseius transvaalensis, Abbasova 1970: 1410.

Anthoseius (Anthoseius) transvaalensis, Wainstein & Vartapetov 1973: 104.

Typhlodromus (Anthoseius) transvaalensis, Chant & McMurtry 1994: 252.

Typhlodromus (Anthoseius) transvaalensis, Moraes *et al.* 2004: 355.

Typhlodromus (Anthoseius) transvaalensis, Chant & McMurtry 2007: 157.

Typhlodromus (Anthosieus) transvaalensis, Ehara & Kishimoto 2007: 139–143.

Typhlodromus (Anthosieus) transvaalensis, Ueckermann *et al.* 2008: 99–101.

Typhlodromus (Anthosieus) transvaalensis, Cédola & Castresana 2014: 61–63.

Typhlodromus (Anthosieus) transvaalensis, Kreiter *et al.* 2020: 183–184.

Typhlodromus (Anthoseius) jackmickleyi, De Leon 1958: 75. (synonymized by Muma & Denmark 1968)

Typhlodromus (Anthoseius) jackmickleyi, van der Merwe 1968: 23. (synonymized by Muma & Denmark 1968)

Typhlodromus pectinatus, Athias-Henriot 1958: 179. (synonymized by Muma & Denmark 1968)

Female

Dorsum — Dorsal shield 345 (343–346) long (from base of seta *j1* up to posterior margin of shield), 200 (196–210) wide (at seta *R1* level), gently reticulate, highly sclerotized with a total of 18 pairs of setae and 4 pairs of solenostomes. All setae, excepting *J5*, *z2* and *S5*, on dorsal shield are long, gently serrated or sparsely plumose and knobbed (Figure 1); *J5* and *S5* are short and smooth with a pointed tip, but *z2* is serrated with a pointed tip. Measurements of setae: *j1* 24 (23–25), *j3* 36 (33–37), *j4* 28 (27–29), *j5* 32 (31–33), *j6* 34 (33–35), *J2* 42 (40–43), *J5* 8 (7–9), *z2* 22 (21–23), *z3* 36 (35–37), *z4* 40 (38–41), *z5* 30 (29–31), *Z4* 51 (50–53), *Z5* 52 (51–53), *s4* 42 (41–43), *s6* 44 (43–45), *S2* 42 (41–43), *S4* 44 (43–45), *S5* 10(8–10), *r3* 20 (19–21), *R1* 36 (34–37).

Peritreme — Peritreme extends anteriorly up to the level of *j3* base and posteriorly gently curves inwards near coxa IV.

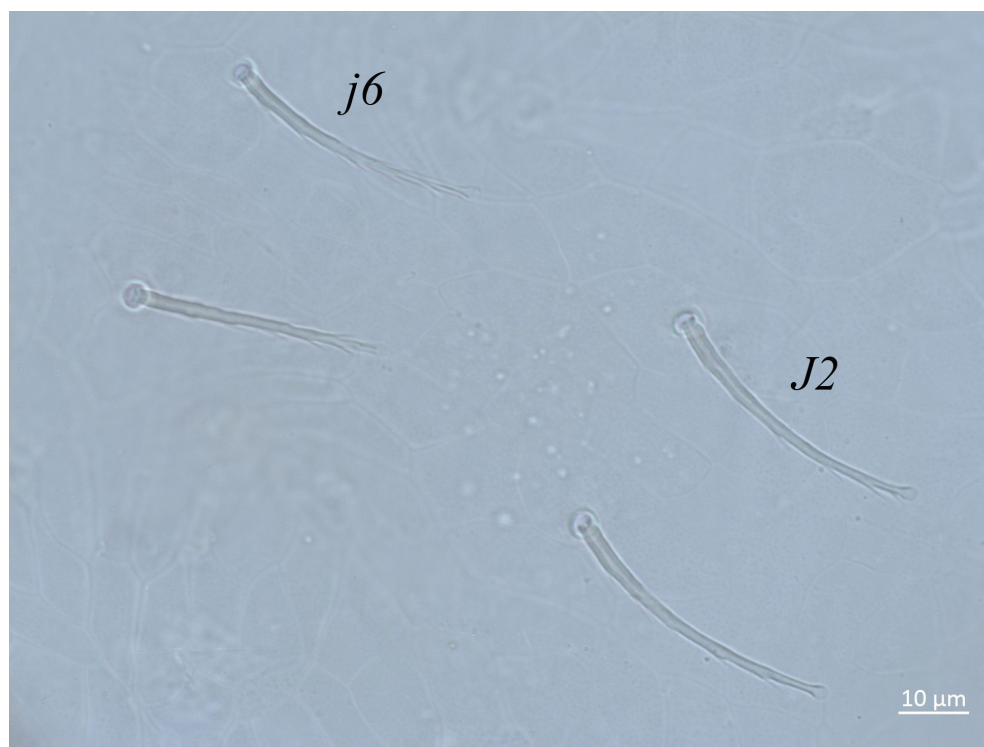


Figure 1 *Typhlodromus (Anthoseius) transvaalensis* (adult female): sparsely plumose and knobbed setae on the dorsal shield, 630 $\times$, differential interference contrast microscopy.

Venter — Sternal shield 130 (128–132) long at the level of *st1*–*st3*, 78 (77–79) wide at the level of *st3*–*st3*, with 3 pairs of sternal setae, posterior margin of sternal shield markedly indented medially, sternal setae measure *st1* 24 (22–25), *st2* 26 (25–27), *st3* 26 (25–27). Metasternal plate measures 10 (9–10) long, 4 (3–4) wide with a pair of setae, *st4* 24 (23–24). Genital shield 80 (79–81) wide at the level of posterior margin, *st5* 30 (28–31). Ventrianal shield 115 (112–120) long at the level of *JV1* up to posterior tip of shield, 72 (71–73) wide at the level of *ZV2*, 74 (72–75) wide at the level of anus, with 3 pairs of setae, *JV1* 24 (22–25), *ZV2* 24 (23–24), *JV2* 24 (23–25) with 1 pair of preanal pores. Metapodal plate I 26 (24–27) long, 3 wide, and metapodal plate II 10 (9–10) long, 2 wide. Anal and postanal setae measure 16 (15–17). Ratios of $JV1/JV1-JV1 = 0.5$, $JV2/JV2-JV2 = 0.5$, $ZV2/ZV2-ZV2 = 0.32$. Setae around ventrianal shield *ZV1* 24 (23–25), *ZV3* 14 (13–15), *JV4* 14 (13–15), *JV5* 56 (54–57), the latter setae gently serrated with a knobbed tip.

Chelicera — Fixed digit 30 (28–30) long with 2 teeth and a long, thin *pilus dentilis*, movable digit 28 (27–29) long with a barely discernible tooth (Figure 2).

Spermatheca — Calyx 30 (28–31) long, fundibuliform, with distal $\frac{1}{4}$ thick walled, atrium nodular, major duct highly sclerotized, minor duct invisible.

Legs — Leg IV with 3 knobbed macrosetae measuring *Sge IV* 26 (25–27), *Sti IV* 27 (26–28), *St IV* 45 (43–46). No macrosetae on legs I–III. Leg chaetotactic formula: genu II 2 2/0 2/0 1, tibia II 11/1 2/1 1, genu III 1 2/1 2/0 1, tibia III 11/1 2/1 1.

Male

Not found, probably because this species is known to reproduce by thelytokous parthenogenesis (Kishimoto 2015).



Figure 2 *Typhlodromus (Anthoseius) transvaalensis* (adult female): chelicera, 630×, differential interference contrast microscopy.

Specimens examined

Twenty females, India: Karnataka, Ramanagara district, Channapatna taluk (subdivision), Vandaraguppe Horticultural Station (12°41'15.4" N, 77°14'13.6" E), on an unidentified plant, 29 November 2019, collected by Prakya Sreerama Kumar, deposited in the Mite Repository of ICAR–National Bureau of Agricultural Insect Resources.

Discussion

Table 1 gives a comparison of morphological traits of taxonomic importance for specimens of *T. (A.) transvaalensis* collected in India, Japan, Africa, Argentina and La Réunion Island.

The Indian specimens are the smallest as indicated by the dimensions of dorsal and ventrianal shields. Globally, the Indian specimens have shorter setae, particularly *j1*, *j3*, *j4*, *j6*, *J2*, *z2*, *z3*, *z4*, *Z4*, *Z5*, *s4*, *s6*, *S2*, *S4*, *r3* and *R1* than specimens collected in other countries. On the contrary, *z5* and *S5* are longer, while *j5* has a similar length.

Although the dorsal setae of Indian specimens are sparsely plumose, they do not look like those of the Argentinian specimens described and illustrated as plumose by Cédola and Castresana (2014). The Indian specimens are similar to the Japanese specimens (Ehara and Kishimoto 2007) in regard to the setae *J5*, *z2* and *S5*, which have a pointed tip.

In regard to the macrosetae of leg IV, the Indian specimens are comparable to that of the African and La Réunionese specimens. It can be concluded that the differences between Indian and other specimens are very likely to correspond to intraspecific variations. It is worth noting that the Indian specimens are closer to the African specimens than to those from other regions.

Forty-one species of the genus *Typhlodromus (Anthoseius)* are reported from India (Demite *et al.* 2020), and *T. (A.) transvaalensis* is the 42nd species to be added to that list.

Table 1 Comparison of morphological traits of taxonomic importance for specimens of *Typhlodromus (Anthoseius) transvaalensis* collected in India, Japan, Africa, Argentina and La Réunion Island [mean (range) or mean $\pm$ SE for Japan; number of specimens in parentheses].

Part	India (20) (present study)	Japan (10)	Africa (9)	Argentina (3)	La Réunion Island (20)
<i>j1</i>	24 (23–25)	32.8 $\pm$ 0.3	28 (25–30)	26 (24–29)	28 (25–33)
<i>j3</i>	36 (33–37)	42.6 $\pm$ 0.4	38 (36–40)	41 (40–43)	39 (35–43)
<i>j4</i>	28 (27–29)	31.2 $\pm$ 0.5	30 (26–33)	32 (plumose, blunt-tipped)	31 (28–36)
<i>j5</i>	32 (31–33)	32.3 $\pm$ 0.4	30 (26–33)	33 (31–35) (plumose, blunt-tipped)	32 (30–35)
<i>j6</i>	34 (33–35)	38.9 $\pm$ 0.5	38 (35–41)	35 (32–38) (plumose, blunt-tipped)	39 (35–45)
<i>J2</i>	42 (40–43)	45.6 $\pm$ 0.5	44 (40–46)	48	46 (40–50)
<i>J5</i>	8 (7–9) (smooth, pointed tip)	10.7 $\pm$ 0.2 (smooth, attenuated)	9 (9–10) (smooth, sharp-tipped)	8 (7–10) (smooth)	10 (8–13)
<i>z2</i>	22 (21–23) (gently serrated, pointed tip)	25.6 $\pm$ 0.4 (serrated, attenuated)	24 (21–28)	23 (22–24) (plumose, blunt-tipped)	25 (23–28)
<i>z3</i>	36 (35–37)	40.1 $\pm$ 0.3	38 (36–40)	42 (41–43)	40 (35–43)
<i>z4</i>	40 (38–41)	45.1 $\pm$ 0.5	41 (39–42)	45 (43–47)	41 (38–45)
<i>z5</i>	30 (29–31)	28.6 $\pm$ 0.3	22 (21–28)	28 (27–29) (plumose, blunt-tipped)	28 (25–30)
<i>Z4</i>	51 (50–53)	55.5 $\pm$ 0.5	52 (47–60)	60 (58–62)	58 (53–60)
<i>Z5</i>	52 (51–53)	67.1 $\pm$ 0.7	62 (57–70)	64 (62–67)	65 (58–70)
<i>s4</i>	42 (41–43)	49.5 $\pm$ 0.4	45 (42–49)	48 (48–49)	46 (40–50)
<i>s6</i>	44 (43–45)	50.1 $\pm$ 0.7	49 (46–54)	52 (51–53)	50 (45–53)
<i>S2</i>	42 (41–43)	55.9 $\pm$ 0.4	55 (50–57)	60 (60–61)	56 (53–60)
<i>S4</i>	44 (43–45)	57.2 $\pm$ 0.7	56 (53–56)	60 (58–62)	58 (55–63)
<i>S5</i>	10 (8–10) (smooth, pointed tip)	8.5 $\pm$ 0.4 (smooth, attenuated)	9 (8–11) (smooth, sharp-tipped)	9 (9–10) (smooth)	7 (5–10)
<i>r3</i>	20 (19–21)	37.8 $\pm$ 0.4	32 (29–35)	34 (33–35)	35 (33–38)
<i>R1</i>	36 (34–37)	42.6 $\pm$ 0.4	40 (38–41)	45 (44–46)	43 (40–48)
Dorsal shield	345 (343–346) long 200 (196–210) wide	389 $\pm$ 6 long 253 $\pm$ 2 wide	352 (325–373) long 210 (188–232) wide	376 (360–392) long 237 (235–240) wide	362 (343–395) long 211 (200–223) wide
Sternal shield	130 (128–132) long 78 (77–79) wide	–	–	–	–
Genital shield	80 (79–81) wide	–	–	–	–
Ventrianal shield	115 (112–120) long 72 (71–73) wide (level ZV2), 74 (72–75) wide (level anus)	135.6 $\pm$ 2.3 long 83.3 $\pm$ 0.6 wide	118 (107–130) long 76 (73–78) wide (level ZV2), 78 (73–84) wide (level anus)	135 (130–141) long 79 (77–81) wide	124 (115–133) long 80 (73–88) wide (level ZV2), 82 (75–88) wide (level anus)
Metasternal plate	10 (9–10) long 4 (3–4) wide	–	–	–	–
Metapodal plate I	26 (24–27) long 3 wide	–	–	–	30 (23–25) long 3 (3–5) wide
Metapodal plate II	10 (9–10) long 2 wide	–	–	–	12 (8–18) long
Macrosetae on leg IV	<i>Sge IV</i> : 26 (25–27) <i>Sti IV</i> : 27 (26–28) <i>St IV</i> : 45 (43–46)	–	<i>Sge IV</i> : 26 (25–26) <i>Sti IV</i> : 27 (24–29) <i>St IV</i> : 46 (40–50)	–	<i>Sge IV</i> : 26 (23–28) <i>Sti IV</i> : 28 (25–30) <i>St IV</i> : 47 (43–50)

Sources of data — Japan: Ehara and Kishimoto (2007); Africa (Kenya, Cape Verde & South Africa): Ueckermann *et al.* (2008); Argentina: Cédola and Castresana (2014); La Réunion Island: Kreiter *et al.* (2020); – : not provided.

Typhlodromus (A.) transvaalensis is a type III generalist predator that feeds on mites, insects and pollen (McMurtry *et al.* 2013). It could complete its life cycle feeding on the eriophyid mites *Eriophyes dioscoridis* Soliman and Abou-Awad and *E. olivi* Zaher and Abou-Awad, eggs of the scale insect *Parlatoria ziziphus* (Lucas) and pollen of *Ricinus communis* (L.) under experimental conditions (Momen and Hussein 1999). Cañarte *et al.* (2017) showed that it has high potential to control *Polyphagotarsonemus latus* (Banks) in *Jatropha curcas* L. plantations.

Mass production and utilization of this species are planned for biological control in India (Gupta and Sreerama Kumar 2018).

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