

New records of phytoseiid mites from Madagascar, with descriptions of two new species

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Original research

ABSTRACT

Madagascar is one of the most important biodiversity hotspots worldwide. Many studies have investigated the arthropodofauna of the island in the last two decades, but studies on Phytoseiidae go back to the '80s. In the present paper authors report on phytoseiid mites collected on cultivated and spontaneously growing arboreal plants in various areas of the country. Nine species are identified during surveys, two of them, *Moraseius papayana* and *Kuzinellus querellus* are new records for Madagascar, and other two species are new for the science, *Typhlodromalus andramasinus* n.sp. and *Typhlodromus (Anthoseius) amphoraeformis* n.sp. and are herein described.

Keywords Madagascar; taxonomy; Phytoseiidae; biological control agents; new species

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Introduction

Predatory mites of the family Phytoseiidae (Acari, Parasitiformes) are considered important biocontrol agents in agricultural and natural ecosystems (McMurtry *et al.* 2013, 2015; Heyler *et al.* 2014; Lorenzon *et al.* 2018). The family includes at present more than 2,500 valid species (Demite *et al.* 2024) and many new species are added in the family every year (Kreiter *et al.* 2021; Döker *et al.* 2021; Arjmandi-Nezhad *et al.* 2022; Biswas and Karmakar 2024). Some geographic areas, i.e. Europe or single countries, i.e. India, China, Japan, U.S.A., Canada, Brazil, Israel, Egypt, South Africa, Australia, were widely investigated during the last decades because of specialists' presence and research groups created for that purpose. In other parts of the world, information on the phytoseiid fauna is limited and fragmented. However, investigation for discovering indigenous phytoseiid species, in inadequately investigated areas is useful to enrich our knowledge on the third trophic level in natural and agricultural ecosystems worldwide and to discover new biocontrol agents able to control infestations of mite pests (Kreiter *et al.* 2018; Novljan *et al.* 2023; Abo-Shnaf and Moraes 2014).


Madagascar is the fourth largest island of the world located at about 400 km of the southeastern coast of Africa. It is identified as one of the most important biotopes on Earth and it is one of the 25 "biodiversity hotspots", i.e. biogeographic areas with a high level of species endemism suffering a remarkable habitat loss (Myers *et al.* 2000; Vences *et al.* 2009). Several studies in recent decades have dealt with the specific composition of arthropods in Madagascar, particularly insects (Biondi 2001; Huber 2003; Fisher 2005; Wesener *et al.* 2011; Biondi and D'Alessandro 2013, 2016), but studies on Phytoseiidae dates back to the 1980s. Currently, 41 species are known from Madagascar, eight of which endemic (Demite *et al.* 2024). About 76% of records are attributed to Blommers (1973, 1974, 1976) and the remaining to Chazeau (1970), Blommers and Chazeau (1974), Blommers and Gutierrez (1975) and Schicha (1983, 1987) (Demite *et al.* 2024).

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The objective of this paper is to present the results of a new survey for phytoseiid mites in Madagascar, with the descriptions of new species.

Material and methods

Mites were collected in October and November 2023 in the central and northern areas of Madagascar on cultivated and spontaneous arboreal plants (Table 1).

Phytoseiid mites were collected using the branch-shaking method (Tsolakis and Ragusa 1999). Mites were collected using a micro-aspirator, preserved in alcohol 70%, cleared in Nesbitt solution and mounted in Hoyer’s medium. Identification and measurements were done using a differential interference contrast microscope (DIC) Zeiss Axioplan. Illustrations and measurements were made using the Axiovision 40V 4.6.1.0 application (Zeiss, 2002–2007); measurements are given in micrometres (µm), reporting mean (in bold), minimum and maximum (in brackets). Drawings were hand-made using the Zeiss Axioplan Camera lucida and defined in vectorial format by Affinity Designer 1.10.8. In the description of the new species, we followed the setal nomenclature proposed by Lindquist and Evans (1965), as adapted to the Phytoseiidae by Rowell *et al.* (1978). For dorsal and ventral patterns, we

Table 1 Phytoseiid species collected on various host plants in Madagascar

Host plant	District	Place	Coordinates	Altitude (m a.s.l.)	Species	Female	Male
<i>Anacardium occidentale</i> L.	Mahajanga	Mahajanga	15°41'27"S 46°25'34"E	10	<i>Typhlodromus (Anthoseius) amphoraeformis</i> sp. nov.	9	
					<i>Euseius rotundus</i> (Blommers)	12	
<i>Corymbia citriodora</i> (Hook.)	Andramasina	Ambohimasina	19°12'23"S 47°38'33"E	1354	<i>Scapulaseius hova</i> (Blommers)	12	
<i>Dombeya reclinata</i> Cordem.	Andramasina	Andredretra	19°13'41"S 47°38'32"E	1470	<i>S. hova</i>	3	
	Mahajanga	Analarotra river	15°29'31"S 47°44'1"E	19	<i>Amblyseius herbicolus</i> Chant	3	
<i>Mangifera indica</i> L.	Andramasina	Ambohiriana	19°12'35"S 47°38'7"E	1353	<i>Typhlodromalus andramasinus</i> sp. nov.	4	
		Ambohimasina	19°12'23"S 47°38'33"E	1354	<i>S. hova</i>	2	1
	Mahajanga	Ambovovy	15°40'49.37"S 46°21'17"E	16	<i>T. (A.) amphoraeformis</i> sp. nov.	1	
					<i>E. rotundus</i>	10	
					<i>S. hova</i>	1	
	Mahajanga	Mahabibo	15°42'43"S 46°23'34"E	13	<i>T. (A.) amphoraeformis</i> sp. nov.	7	
					<i>E. rotundus</i>	43	2
					<i>S. hova</i>	4	
					<i>T. andramasinus</i> sp. nov.	1	
	<i>Pinus pinea</i> L.	Andramasina	Ambohiriana	19°12'35"S 47°38'7"E	1353	<i>A. herbicolus</i>	1
Ambohimasina			19°12'23"S 47°38'33"E	1354	<i>S. hova</i>	1	
Mahajanga		Analarotra river	15°29'31"S 47°44'0"E	19	<i>T. (A.) amphoraeformis</i> sp. nov.	10	2
					<i>Kuzinellus querellus</i> (Ueckermanna & Loots)	1	
					<i>S. hova</i>	19	2
					<i>Typhlodromus (Anthoseius) gutierrezii</i> Blommers	1	
<i>Psidium guajava</i> L.	Andramasina	Ambohimasina	19°12'23"S 47°38'33"E	1354	<i>Anthoseius</i> sp.	1	
		Andoharina	19°12'48"S 47°37'50"E	1384	<i>S. hova</i>	5	
	Andramasina	Andoharina	19°12'48"S 47°37'50"E	1384	<i>T. andramasinus</i> sp. nov.	2	
					<i>Typhlodromips shi</i> Pritchard & Baker	3	
<i>Syzygium cumini</i> (L.) Skeels	Andramasina	Andredretra	19°13'41"S 47°38'32"E	1470	<i>S. hova</i>	2	2
<i>Syzygium jambos</i> (L.) Alston	Andramasina	Andredretra	19°13'41"S 47°38'32"E	1470	<i>E. rotundus</i>	5	
<i>Tamarindus indica</i> L.	Mahajanga	Ankarafantsika	16°16'21"S 46°48'35"E	75	<i>S. hova</i>	3	
					<i>T. (A.) gutierrezii</i>	1	
					<i>T. (A.) amphoraeformis</i> sp. nov.	6	1
<i>Terminalia mantaly</i> Perrier	Mahajanga	Tsaramandroso	16°22'37"S 47° 4'53"E	59	<i>Moraseius papayana</i> van der Merwe	3	
					<i>T. (A.) amphoraeformis</i> sp. nov.	2	
					<i>E. rotundus</i>	17	1
					<i>S. hova</i>	1	
					<i>T. (A.) gutierrezii</i>	4	
					<i>T. andramasinus</i> sp. nov.	2	

followed Chant and Yoshida-Shaul (1989, 1991). For the terminology of various sections of the insemination apparatus (spermathecal apparatus), we followed Wainstein (1973), Athias-Henriot (1975; 1977) and Beard (2001), with some additions and changes. For setal patterns of legs podomeres (genu, tibia, tarsus), the formulae proposed by Evans and Till (1979) were adopted. For the macrosetae, we considered the concept defined by Beard (2001). Nomenclature of the adenotaxy was that suggested by Athias-Henriot (1975). Dorsal shield length was measured along the midline from *jl* setae level to the end of the shield. The apical tooth of each cheliceral digit was not included in the determination of the number of teeth. For descriptive terms of morphological characters, see Tsolakis and Ragusa (2020). The world distribution of species found during our surveys is based on Demite *et al.* (2024).

Type materials and specimens of all identified species are kept in the Acari collection of the laboratory of Agricultural and Applied Acarology “Eliahu Swirski”, Department of Agricultural, Food and Forestry Sciences, University of Palermo (Italy).

Results

During surveys carried out on 10 species of arboreal plants, 228 specimens of phytoseiid mites (217 females and 11 males) were collected and identified (Table 1). Nine species belonging to seven genera within the sub-families Amblyseiinae and Typhlodrominae have been identified; two of them are new records for Madagascar and other two are new for science and described herein.

Amblyseiinae Muma 1961

Euseiini Chant and McMurtry 2005

Subtribe Typhlodromalina

***Typhlodromalus* Muma, 1961**

***Typhlodromalus andramasinus* sp. nov.**

Zoobank: [4193DE30-AEEE-4A10-B79D-9AD6AD03D3DF](https://doi.org/10.1111/1365-3113.12345)

Diagnosis of female

(Figure 1)

Peritrematal shield is fused with the dorsal one at level of setae *jl*. A caudal lobe after the level of seta *Z5*, which is a characteristic of many species of this genus is present. Setae *J5* are present on this lobe, below of level of setae *Z5*. Dorsal shield slightly reticulate, all dorsal setae slender and smooth, except *Z4* and *Z5* which are slightly serrated. Adenotaxy complete (holoadenic), all solenostomes small and crateriform. Solenostomes *gd3* and poroids *id3* well visible on peritrematal shield. Peritreme reaching the base of *jl*. Sternal shield smooth with three pairs of setae (*ST1–ST3*). Setae *ST4* and poroids *iv3* tylochorous (on metasternal platelets). Genital shield flask shaped with posterior margin almost transversally straight; Ventrianal shield smooth with three pairs of preanal setae and a pair of large crateriform solenostomes (*gv3*). Setae *JV5* smooth. Calyx of the spermathecal apparatus vase shaped. Atrium differentiated, minor duct well visible. Major duct short. Fixed digit of chelicera with nine teeth, movable digit with three teeth. Seven setae on genu II, with three smooth and pointed macrosetae on leg IV, of which the shortest on the tibia and the longest on the basitarsus.

Description of female

Dorsum — (Fig. 1A) (Eight females measured)

Dorsal setal pattern 10A:9B. Seventeen pairs of setae on dorsal shield, two pairs of lateral setae (*r3*, *R1*) on the interscutal membrane. Dorsal shield **349** (334–363) long, **209** (200–219)

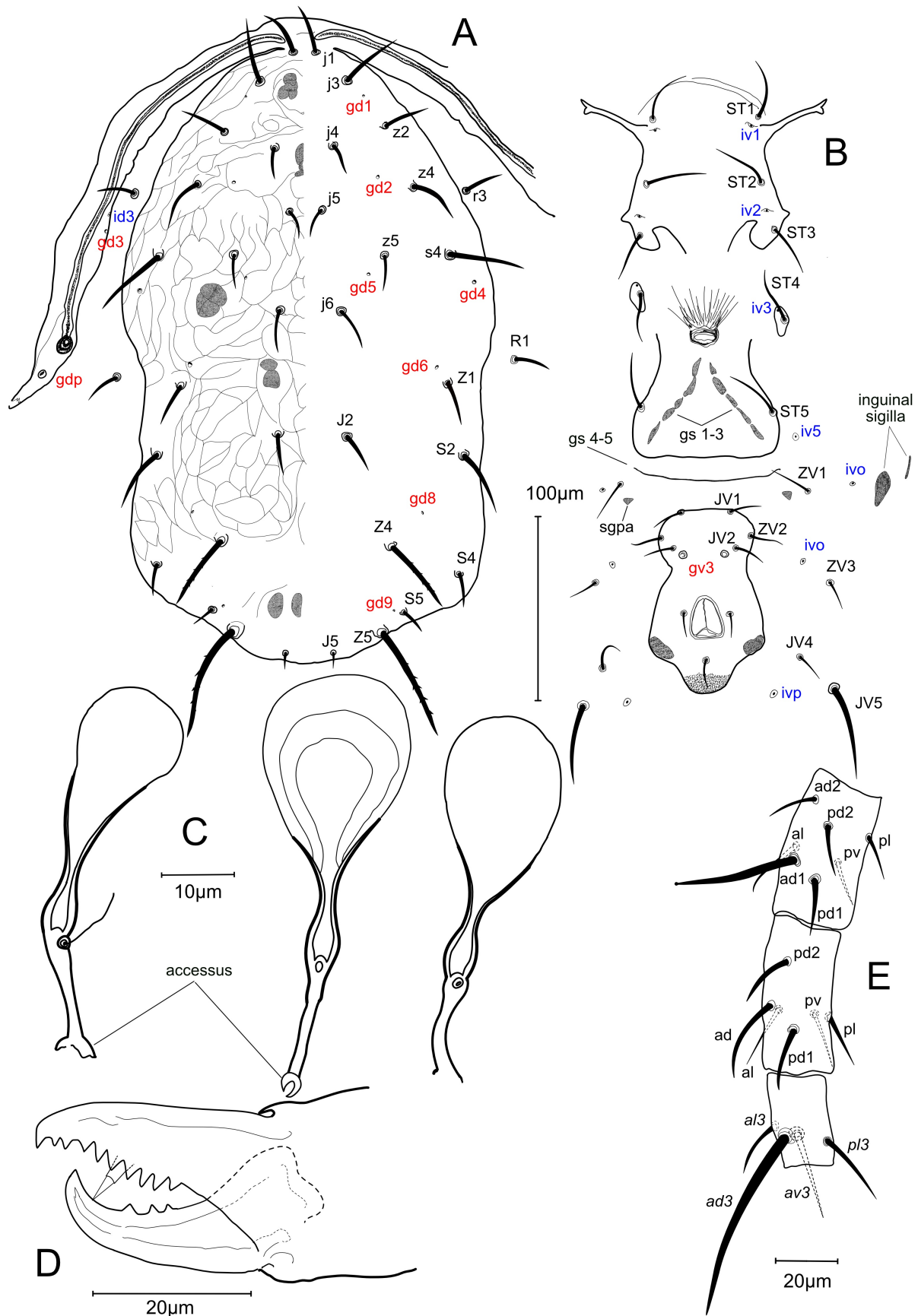


Figure 1 *Typhlodromalus andramasinus* sp. nov. Female: A – dorsal shield; B – ventral view; C – Spermathecal apparatus. D – chelicera; E – genu, tibia and tarsus of leg IV.

wide at level of *s4*, **195** (184–207) at level of seta *Z1*, **197** (188–207) at level of seta *S2* and **193** (175–202) at level of seta *S4*. Measurements of setae: *j1* **27** (23–31); *j3* **33** (28–35); *j4* **18** (14–21); *j5* **17** (14–20); *j6* **26** (21–29); *J2* **25** (17–28); *J5* **9** (9–13); *z2* **25** (17–28); *z4* **33** (28–36); *z5* **21** (18–24); *s4* **45** (41–47); *Z1* **27** (23–30); *Z4* **47** (42–52); *Z5* **67** (60–72); *S2* **36** (31–40); *S4* **21** (17–25); *S5* **15** (11–19); *r3* **23** (20–25); *R1* **21** (19–26). Seven pairs of solenostomes are present on dorsal shield: *gd1* posteroantiaxial to *j3*, *gd2* posteroantiaxial to *j4*, *gd4* posteroantiaxial to *s4*, *gd5* posteroparaxial to *z5*, *gd6* anteroparaxial to *Z1*, *gd8* anteroantiaxial to *Z4*, *gd9* paraxial to *S5*.

Peritreme — (Fig. 1A). The apex of peritreme reaching the basis of *j1*. Length of peritreme **213** (201–222). Solenostome *gd3* and poroid *id3* on peritrematal shield, posteriad to *r3*. Solenostome *gdp* crateriform.

Ventral idiosoma — (Fig. 1B). Sternal shield smooth; anterior arms well visible. Poroids *iv1* and *iv2* well visible on the shield. Two small projections of the shield visible at level of poroids *iv2*. Posterior margin of the shield with a median lobe, whose tip is not discernible. Distance between bases of setae *ST1–ST1* **62** (59–65), *ST2–ST2* **68** (64–70), *ST3–ST3* **80** (76–84), *ST1–ST3* **68** (64–72). Distance between the genital seta *ST5* **73** (68–78). First to third pairs genital sigilla (*gs*) well visible. Fourth and fifth pairs of sigilla well visible on the interscutal membrane between genital shield and setae *ZV1*; sixth pair of sigilla posteroparaxial to *ZV1*. Ventrianal shield narrow, flask-shaped, with a pronounced constriction posteriad *gv3*, **112** (103–120) long, **59** (53–62) at level of *ZV2*, **56** (51–60) at level of *JV2*, **63** (58–67) at level of paranal setae. Distance between solenostomes *gv3* **24** (22–26). Setae *JV1* insert on anterior margin of ventrianal shield. Seta *JV5* smooth, **25** (20–29) long. Inguinal sigilla (metapodal platelets) **19** (18–19) and **7** (7–8) long.

Spermathecal apparatus — (Fig. 1C)

The proximal part of the major duct differentiated (*Receptaculum*); **13** (12–14) long, cylindrical and simple (**2** wide). Atrium almost bulbous, slightly differentiated from the major duct (**3** long), inserted at the basis of calyx; accessus absent. Minor duct well visible in most specimens. Calyx **18** (15–21) long, enlarged near atrium, narrow afterwards, forming a funnel towards vesicle **10** (8–12 wide).

Chelicerae — (Fig. 1D). Fixed digit **34** (32–36) long with 9 teeth. *Pilus dentilis* visible in some specimens. Movable digit **33** (30–38) long, with three teeth.

Legs (Fig. 1E). Macrosetae *sensu* Beard (2001) present on all legs: *Sge I* **18** (16–19), *Sge II* **19** (18–19), *Sge III* **24** (23–24), *Sge IV* **38** (36–42), *Sti IV* **26** (24–29) and *St IV* **62** (57–65). All macrosetae pointed except *Sge IV* which is slightly knobbed. Chaetotaxy of legs: Leg I, coxa 0 0/1 0/1 0, trochanter 1 0/1 0/2 1, femur 2 3/2 2/2 2, genu 2 2/1 2/1 2, tibia 2 2/1 2/1 2. Leg II, coxa 0 0/1 0/1 0, trochanter 1 0/1 0/2 1, femur 2 3/1 2/1 1, genu 2 2/0 2/0 1, tibia 1 2/1 1/1 1, tarsus 1 1/0 1/0 1. Leg III, coxa 0 0/1 0/1 0, trochanter 1 0/1 0/2 1, femur 1 2/1 1/0 1, genu 1 2/1 2/0 1, tibia 1 1/1 2/1 1, tarsus 1 1/0 1/0 1. Leg IV, coxa 0 0/1 0/0 0, trochanter 1 0/1 0/2 1, femur 1 2/0 1/0 1, genu 1 2/0 2/1 1, tibia 1 1/0 2/1 1, tarsus 1 1/1 0/0 1.

Comparative notes

Typhlodromalus andramasinus sp. nov. mostly resembles the following *Typhlodromalus* species: *T. araucariae* Gonçalves & Ferla, *T. olombo* (Pritchard & Baker), *T. mangiferae* (Chatterjee & Gupta), *T. aripo* De Leon, *T. serengati* El-Banhawy & Abou-Awad, *T. spinosus* (Meyer & Rodrigues) and *T. sinespinosus* Moraes, Zanou & Oliveira, differing as subsequently described. *Typhlodromalus araucariae* has shorter *j3*, *j5*, *j6*, *z4*, *z5*, *s4*, *Z1*, *S2*, *S4* and *Z4*; respectively seven and two teeth on fixed and movable cheliceral digits; a single macroseta on leg IV, which is shorter (37µm) and knobbed; spermathecal apparatus of different shape. *Typhlodromalus olombo* has some setae shorter (*z2*, *z5*, *Z1*, *R1*) and others longer (*j3*, *s4*, *S2*); four teeth on the movable cheliceral digit; macrosetae of leg IV shorter; macroseta of basitarsus IV knobbed; spermathecal apparatus of different shape. *Typhlodromalus aripo* has *j4*, *j5*, *j6* and *J2* shorter and *j3* longer; macroseta of genu and tarsus of leg IV longer (53 and 73, respectively), macroseta of tarsus IV knobbed; spermathecal apparatus of different shape. *Typhlodromalus*

mangiferae has *j3*, *j6*, *z5*, *Z1*, *S2*, *S5*, *R1* and macroseta on tarsus IV shorter. *Typhlodromalus spinosus*, *T. sinespinosus* and *T. serengati* differ from the new species by the length of several dorsal shield setae, the absence of *S5* and the different shapes of the spermathecal apparatus (Table 2).

Specimens examined

Holotype female (serial number M-019) collected from *Mangifera indica* L. (Anacardiaceae) in the Ambohimasina forest in the Andramasina district, 19°12'23"S, 47°38'33"E, 1354 m a.s.l., November 4, 2023. Two paratype females (serial number M-016) collected on *Psidium guajava* L. (Myrtaceae), November 2, 2023, at the same locality as holotype. Four paratype females (serial number M-008 and M-009) collected on *Dombeya reclinata* Cordem. (Malvaceae) along the edge of the river Analasarotra (15°29'31.48"S, 47°44'0.64"E, m 19 a.s.l.), October 14, 2023. One paratype female (serial number M-042) collected on *M. indica* in Mahabibo forest in the Mahajanga district, (15°42'43.15"S, 46°23'34.18"E), November 19, 2023.

Etymology

The specific name *andramasinus* refers to the district Andramasina where the holotype and two of the paratypes were collected.

Euseiini Chant & McMurtry 2005

Subtribe Euseiina

Moraeseius Chant & McMurtry 2005

Moraeseius papayana (Van der Merwe 1965)

Amblyseius (Amblyseius) papayana — Van der Merwe (1965)

Amblyseius (Proprioseiospsis) papayana — Van der Merwe (1968)

Euseius papayana — Moraes *et al.* (1986, 2004)

Originally described from specimens collected on *Carica papaya* L in Mbombela, Mpumalanga Province, South Africa. This is the first report of *M. papayana* from Madagascar.

World distribution — Kenya; Mayotte Island; Mozambique; South Africa, Madagascar.

Table 2 Morphological differences between *Typhlodromalus andramasinus* sp. nov., and other related species of the same genus. In bold the characters that differ significantly from the new species (n.r. not reported)

	<i>T. andramasinus</i>	<i>T. insolitus</i> ¹	<i>T. araucariae</i> ²	<i>T. olombo</i> ³	<i>T. mangiferae</i> ⁴	<i>T. aripo</i> ³	<i>T. serengati</i> ⁵	<i>T. spinosus</i> ³	<i>T. sinespinosus</i> ³
j3	33(28-35)	30(30-32)	24(20-27)	42(41-44)	19	41(39-43)	32	33(29-38)	44(38-46)
j6	26(21-29)	9(7-10)	12(10-13)	21(18-25)	12	15(14-16)	18	22(19-25)	20(18-26)
J2	25(17-28)	11(9-12)	18(15-20)	24(22-25)	17	14(13-15)	20	24(21-25)	21(16-24)
z5	21(18-24)	6(6-7)	11(10-13)	15(13-16)	4	10(10-11)	14	16(14-18)	14(11-16)
s4	45(41-47)	36(32-41)	33	53(51-56)	51	49(44-51)	46	47(43-53)	58(53-61)
Z1	27(23-30)	11(10-12)	16(15-17)	23(17-24)	10	20(18-23)	22	23(19-26)	19(16-24)
S2	36(31-49)	13(11-15)	26(25-28)	46(41-51)	5	30(25-32)	44	42(37-48)	47(38-53)
S5	15(11-19)	10(9-10)	11(10-13)	13(10-18)	9	11(10-12)	absent	absent	absent
ZA	47(42-52)	10(10-11)	29(25-33)	52(45-60)		56(45-64)	46	48(43-50)	54(48-58)
R1	21(19-26)	9(8-10)	15	16(13-18)	10	18(17-20)	26	18(14-21)	19(14-24)
Dm	3	4	2	4		3		03-avr	03-avr
Macroseta genu IV	39(36-43)	n.r.	no	52(44-56)	40	53(47-59)	46	43(40-48)	52(48-56)
Tip of macroseta genu IV	knobbed			knobbed		knobbed			knobbed
Macroseta tibia IV	26(24-27)	n.r.	no	35(31-37)	36	26(23-28)	24	26(24-30)	30(27-34)
Tip of macroseta tibia IV	pointed			blunt					blunt
Macroseta tarsus IV	61(57-65)	n.r.	37(35-40)	78(65-86)	45	73(70-77)	55	55(53-58)	66(59-70)
Tip of macroseta tarsus IV	pointed		knobbed	knobbed	n.r.	knobbed			knobbed

1—From the original description by Nuvoloni *et al.* (2015); 2— From the original description by Goncalves *et al.* (2015); 3—by Moraes *et al.* (2006); 4— From the original description by Gupta (2003); 5— From the original description by El-Banhawy & Abou-Awad (1990)

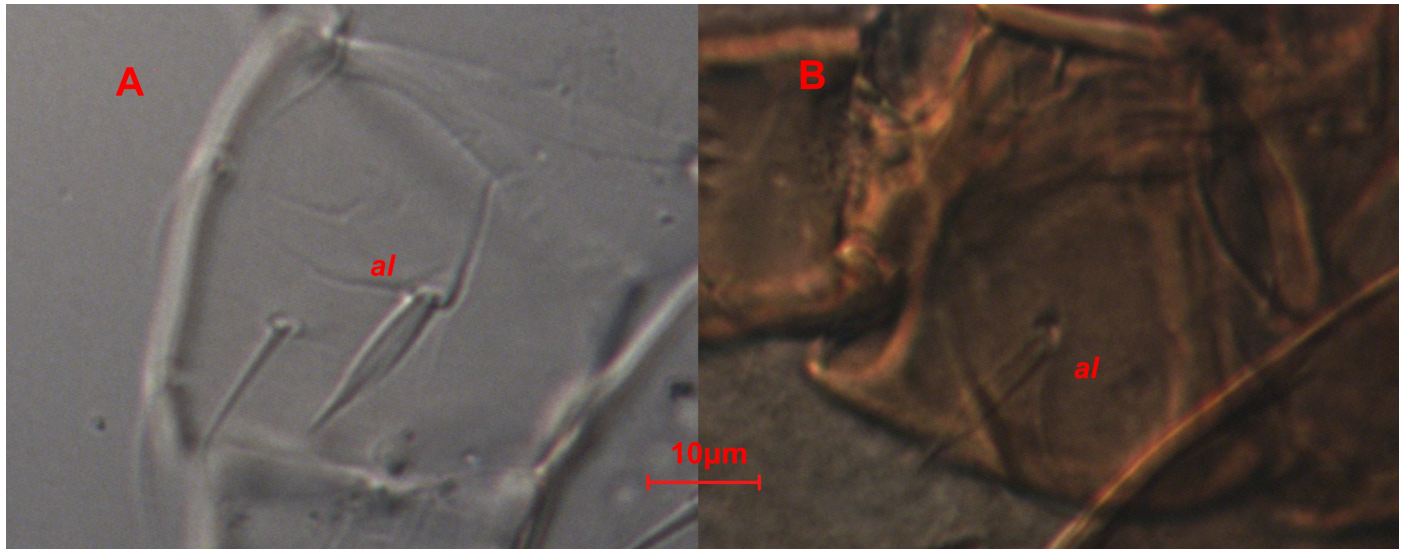


Figure 2 Subulate seta (*al*) present on trochanter I of *Moraseius papayana* (A) and *Euseius degenerans* (B)

Remarks — Measurements of setae of the three females collected, correspond to those reported by van der Merwe (1965) and by Moraes *et al.* (2001). However, the above-mentioned authors reported an entire ventrianale shield, while in our specimens it is divided into ventral and anal shield, being the solenostome gv3 on the interscutal membrane. However, the posterior margin of ventral shield and the anterior one of the anal shield are evanescent and further collections are needed to clarify if it is an inter population variation and to define the systematic weight of this character. With a subulate seta (*al*) on trochanter I, as also reported for other *Euseius* species (Döker *et al.* 2024, 2025) and as observed in our examination of specimens of *Iphiseius degenerans* (Berlese) from *Citrus x limon* (L.) Osbeck collected in Sicily (Fig. 2). Basing on molecular analyses, the latter phytoseiid is now included within the genus *Euseius* (Döker *et al.* 2025), as already hypothesized by Santos and Tixier (2018). With *E. degenerans*, *M. papayana* shares also a similar spermathecal apparatus. Further investigation within these genera, could be in searching for systematic characters to evaluate their possible relationship as also suggested by Döker *et al.* (2025).

Specimens examined — Mahajanga, natural park of Ankarafantsika, 16°16'26"S, 46°48'39"E, 67 m a.s.l., 3 ♀♀ on *Tamarindus indica* L. (Fabaceae).

Typhlodrominae Wainstein 1962

Paraseiulini Wainstein 1976

***Kuzinellus* Wainstein 1976**

***Kuzinellus querellus* (Ueckermann & Loots, 1988)**

Typhlodromus (*Anthoseius*) *querellus* Ueckermann & Loots, 1988

Originally described from specimens collected on *Hemizygia parvifolia* Codd at Motlatse Canyon (Mpumalanga Province) South Africa. It was also reported from Zimbabwe (Ueckermann and Loots 1988) and afterwards from Burundi and Sierra Leone (Moraes *et al.* 2008) and from Kenya (Santos *et al.* 2021). This is the first record of *K. querellus* from Madagascar.

Specimens examined — Andramasina, Abohimasina, 19°12'23"S, 47°38'33"E, 1354 m a.s.l., 1 ♀ on *Pinus pinea* L. (Fabaceae).

Typhlodrominae Wainstein 1962**Typhlodromini Wainstein 1962*****Typhlodromus* Scheuten 1857****Subgenus *Anthoseius* De Leon 1959*****Typhlodromus (Anthoseius) amphoraeformis* sp. nov.**

Zoobank: [135E1860-795A-4E3A-8EC8-FCAF68017B24](https://zoobank.org/135E1860-795A-4E3A-8EC8-FCAF68017B24)

Diagnosis of female

(Figure 3)

Dorsal shield slightly reticulated. Peritreme reaching the base of seta *jl*. All dorsal setae are slender, smooth and sharp-tipped, except *Z4* and *Z5* which are slightly serrated and the latter is also spatulate. Adenotaxy incomplete (meriadenic), solenostomes *gd1* and *gd5* absent. Sternal shield smooth with two pairs of setae (*ST1*–*ST2*) and two pairs of poroids (*iv1* and *iv2*). Seta *ST3* gymnochorous (situated on the interscutal membrane); seta *ST4* and poroids *iv3* tylochorous (situated on a sclerite, often indicated as metasternal platelet). Genital shield almost smooth with the posterior margin straight; first to third pairs of sigilla well visible. Ventrianal shield smooth with four pairs of preanal setae and a pair of small crateriform solenostomes (*gv3*) between setae *JV3*. Seta *JV5* smooth and spatulate. Calyx of the spermathecal apparatus distinctly constricted shortly before fusion with vesicle. Atrium nodular, accessus present; spermathecal channel (minor duct) visible. Major duct cylindrical and narrow. Fixed digit of chelicera with five teeth, movable digit with three teeth. Seven setae on genu II; three smooth and spatulate macrosetae on leg IV and none on other legs; macrosetae not much longer than other setae of the respective segments but distinguished for being slightly stout and spatulate.

Description of female

Dorsum — (Fig. 3A) (Sixteen females measured)

Dorsal setal pattern 12A:8A. Eighteen pairs of setae on dorsal shield, two pairs of lateral setae on the interscutal membrane (*r3*, *R1*). Dorsal shield **315** (297–337) long, **173** (165–181) wide at level of seta *s4*, **165** (161–170) at level of *R1*, **189** (181–202) at level of *S4*. Measurements of setae: *jl* **18** (16–20); *j3* **20** (16–22); *j4* **14** (11–16); *j5* **15** (13–16); *j6* **19** (15–21); *J2* **21** (19–23); *J5* **11** (8–16); *z2* **17** (15–19); *z3* **19** (17–21); *z4* **20** (18–22); *z5* **17** (13–23); *s4* **22** (18–25); *s6* **23** (20–25); *Z4* **32** (27–35); *Z5* **46** (42–50); *S2* **26** (23–28); *S4* **24** (21–27); *S5* **17** (13–19); *r3* **15** (13–17); *R1* **18** (16–20). Five pairs of solenostomes on dorsal shield: *gd2* posteroparaxial to *z3*, *gd4* posteroantiaxial to *s4*, *gd6* posteroparaxial to *s6*, *gd8* anteroantiaxial to *Z4*, *gd9* paraxial and very close to the basis of *S5*.

Peritreme — (Fig. 3A). Length of peritreme **183** (174–208). The apex reaches the basis of *jl*. Solenostome *gd3* and poroid *id3* on peritrematal shield, posteriad to *r3*. Solenostome *gdp* crateriform.

Ventral idiosoma — (Fig. 3B). Sternal shield smooth, anterior arms visible. Poroids *iv1* and *iv2* well visible on the shield; posterior margin almost convex. Setae *ST3* on the interscutal membrane. Distance between bases of setae *ST1*–*ST1* **46** (42–48), *ST2*–*ST2* **54** (52–57), *ST3*–*ST3* **66** (63–69), *ST1*–*ST2* **32** (30–33). Distance between the genital setae *ST5* **61** (56–64). Two arcuated arms of the membranous cover of the genital opening are well visible. Sigilla of fourth and fifth pairs well visible on the interscutal membrane anteroparaxially to setae *ZV1*; sigilla of sixth pair posteroparaxial to setae *ZV1*. Ventrianal shield subpentagonal, **107** (101–110) long, **86** (81–92) wide at level of setae *ZV2*, **84** (81–87) at level of setae *JV3*, **76** (72–80) at level of paranal setae. Distance between solenostomes *gv3* **19** (18–21). Seta *JV5* smooth, spatulate **31** (28–33) long. Inguinal sigilla well visible, **22** (20–25) and **7** (7–8) long.

Spermathecal apparatus — (Fig. 3C). Major duct **7** (6–8) long, cylindrical, simple (2 wide) (receptaculum not visible). Atrium almost bulbous, inserted at the basis of calyx,

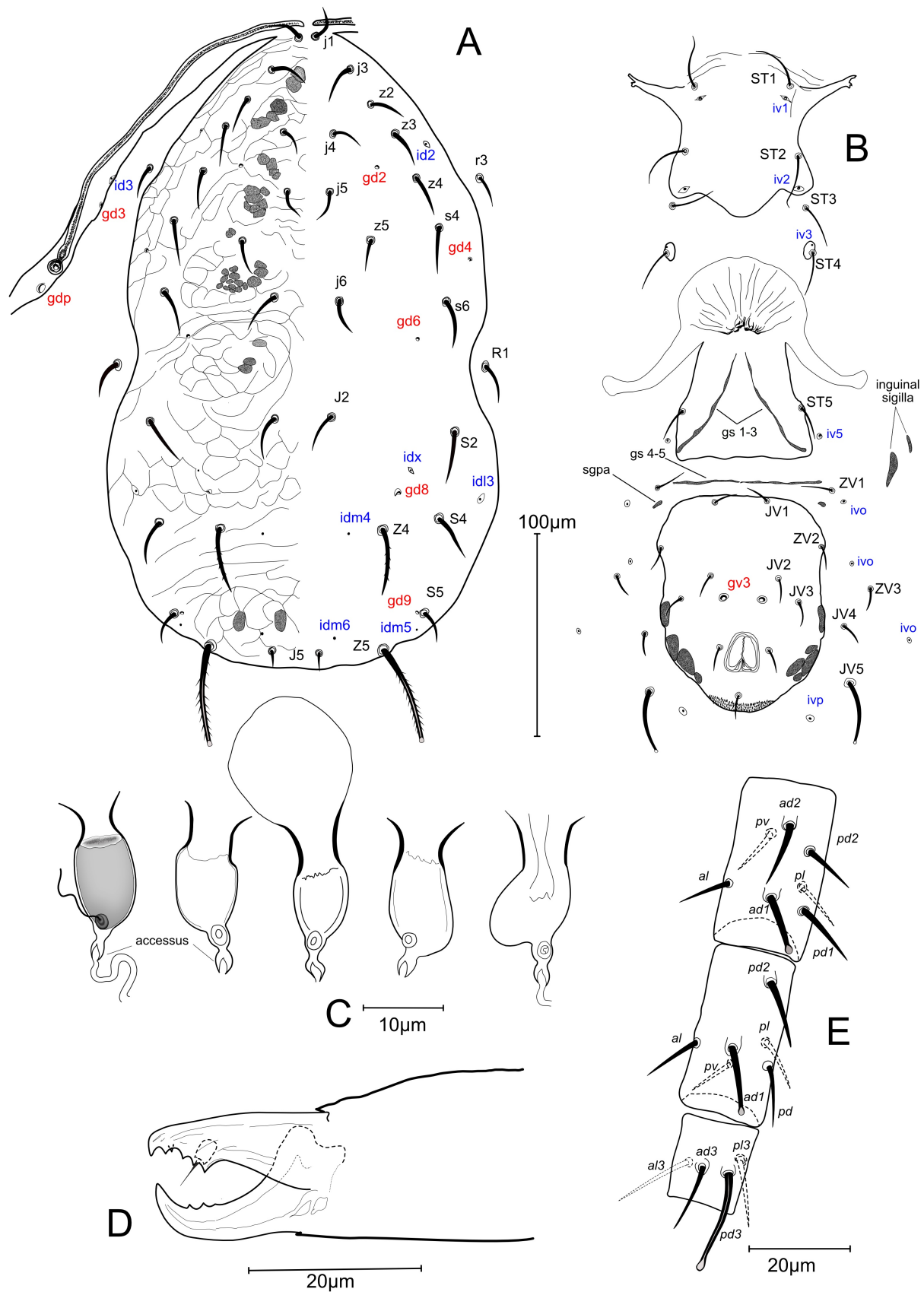


Figure 3 *Typhlodromus (Anthoseius) amphoraeformis* sp. nov. Female: A – dorsal shield; B – ventral view; C – Spermathecal apparatus. D – chelicera; E – genu, tibia and tarsus of leg IV.

accessus into the major duct visible. Spermatic channel discernible in many specimens. Calyx **17** (16–18 long, it enlarged near atrium (8 wide), with a pronounced constriction just before connection with the vesicle, resembling an amphora-shaped vase.

Chelicerae — (Fig. 3 D). Fixed digit of the chelicera **22** (22–23) long with 5 teeth. *Pilus dentilis* well visible. Movable digit **21** (20–22) long, with three teeth plus the apical tooth the basal of which vestigial.

Legs — (Fig. 3E). Chaetotaxy of genu II 2 2/0 2/0 1. Three spatulate macrosetae *sensu* Beard (2001) present on leg IV: *Sge* **12** (11–13), *Sti* **14** (12–15) and *St* **20** (18–21). Absence of macrosetae on the other legs. Chaetotaxy of legs: Leg I, coxa 0 0/1 0/1 0, trochanter 1 0/1 1/2 1, femur 2 3/1 2/2 2, genu 2 2/1 2/1 2, tibia 2 2/1 2/1 2. Leg II, coxa 0 0/1 0/1 0, trochanter 1 0/1 0/2 1, femur 2 3/1 2/1 1, genu 2 2/0 2/0 1, tibia 1 2/1 1/1 1, tarsus 1 1/0 1/0 1. Leg III, coxa 0 0/1 0/1 0, trochanter 1 1/1 0/2 0, femur 1 2/0 1/0 1, genu 1 2/1 2/0 1, tibia 1 1/1 2/1 1, tarsus 1 1/0 1/0 1. Leg IV, coxa 0 0/1 0/0 0, trochanter 1 1/1 0/1 1, femur 1 2/ 1/0 1, genu 1 2/0 2/1 1, tibia 1 1/0 2/1 1, tarsus 1 1/0 1/0 1.

Comparative notes

Typhlodromus (Anthoseius) amphoraeformis **sp. nov.** resembles 12 African species belonging to the subgenus *Anthoseius*, eight of which described by van der Merwe (1968) and four, by Ueckermann and Loots (1988): *T. (A.) terrulentis* van der Merwe, *T. (A.) saevus* van der Merwe, *T. (A.) incisivus* van der Merwe, *T. (A.) apoxys* van der Merwe, *T. (A.) capparidis* van der Merwe, *T. (A.) muliebris* van der Merwe, *T. (A.) microbullatus* van der Merwe, *T. (A.) februs* van der Merwe, *T. (A.) grastis* Ueckermann & Loots, *T. (A.) michaeli* Ueckermann & Loots, *T. (A.) umbraculus* Ueckermann & Loots and *T. (A.) drymis* Ueckermann & Loots. The new species differs from all the abovementioned species in the unique shape of the spermathecal apparatus, the number of teeth on the movable cheliceral digit, the number and lengths of macrosetae on leg IV, as well as in the length of various setae of the dorsal shield (Table 3).

Specimens examined

Holotype female (serial number M-051) and 2 paratype females collected on *Anacardium occidentale* L. at Mahajanga, Mahabibo forest, 15°41'27.81"S, 46°25'34.17"E, 10 m a.s.l., November 22, 2023. Seven paratype females (serial numbers M-033, M-034, M-037, M-038, M-040 and M-041) collected on *Mangifera indica* on the same date and at the same locality as holotype. Six paratype females (serial number M-056 and M-057) collected on *Tamarindus indica* L. (Fabaceae) in Natural parks of Ankarafantsika (Mahajanga), 16°16'21.14"S, 46°48'35.71"E, 13m a.s.l., November 24, 2023. Two paratype females (serial number M-054) collected on

Table 3 Morphological differences between *Typhlodromus (Anthoseius) amphoraeformis* **sp. nov.**, and related species of the same genus and subgenus (setae: average length in µm followed by ranges in parentheses); cheliceral digits (Dm-movable digit, Df-fixed digit: number of teeth). In bold the characters that differ significantly from the new species (n.r. not reported)

	j3	s4	s6	S2	S4	S5	Z5	Dm	Df	St IV ge	St IV ti	St IV ta
<i>T.(A.) amphoraeformis</i>	20(16-21)	22(18-25)	23(20-25)	25(23-28)	24(21-27)	17(13-19)	46(42-50)	3	5	12(11-13)	14(12-15)	20(18-21)
<i>T. (A.) terrulentis</i> ¹	19	17	21	21	29	29	56	0	4	17	23	35
<i>T. (A.) saevus</i> ¹	23(20-24)	23(20-24)	26(25-26)	28(27-30)	28(27-30)	28(27-30)	51(47-52)	1	4	no	no	25 (24-27)
<i>T. (A.) incisivus</i> ¹	19(18-21)	24(23-26)	24(23-26)	26(25-29)	22(21-24)	19(18-21)	49(48-53)	2	2	no	no	25(25-26)
<i>T. (A.) apoxys</i> ¹	24(21-24)	24(21-24)	26(24-26)	29(27-29)	32(28-32)	32(28-32)	49(45-49)	1	3	no	no	23(20-23)
<i>T. (A.) capparidis</i> ¹	27(27-30)	32(30-33)	34(34-36)	38(37-39)	40(39-41)	40(39-41)	56(56-60)	2	4	no	no	25(25-26)
<i>T. (A.) muliebris</i> ¹	32(30-32)	28(26-28)	28(26-28)	28(26-28)	28(26-28)	27(25-27)	51(47-51)	3	5	21	no	30
<i>T. (A.) microbullatus</i> ¹	26(24-26)	31(29-32)	31(29-32)	31(29-32)	31(29-32)	31(29-32)	46(45-50)	2	4	no	no	24(20-24)
<i>T. (A.) februs</i> ¹	23(21-24)	28(26-29)	26(24-26)	26(24-26)	30(29-32)	28(26-29)	47(45-48)	1	3	no	no	23(22-24)
<i>T. (A.) grastis</i> ²	13(13-16)	19(18-19)	22(22-23)	26(26-28)	31(28-32)	31(28-32)	51(46-51)	3	4	15	22	34
<i>T. (A.) michaeli</i> ²	25(22-25)	28(19-28)	32(25-32)	35(28-32)	41(32-38)	33(23-32)	47(41-44)	2	4	9(9-19)	22(22-25)	32(28-32)
<i>T. (A.) umbraculus</i> ²	16-19	16-19	16-19	16-19	16-19	16-19	n.r.	n.r.	n.r.	13	16	22-25
<i>T. (A.) drymis</i> ²	25(22-25)	25(22-25)	28(26-28)	28(26-28)	32(28-32)	19(16-17)	58(54-58)	n.r.	n.r.	19(17-21)	25	44(38-44)

1-Original description (van der Merwe 1968); 2- Original description (Ueckermann & Loots 1988)

Terminalia mantaly Perrier at Tsaramandroso (Mahajanga), 16°22'37.41"S, 47° 4'53.51"E, November 21, 2023.

Etymology

The specific name *amphoraeformis* is a composite word from the ancient Greek ἀμφορεύς transcribed in Latin as *Amphora* + the Latin word *Forma* = shape. It refers to the characteristic shape of the spermathecal apparatus that resembles an ancient Greek vase.

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