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Article

First record of two eriophyoid mites (Acari: Eriophyoidea) on *Cyperus rotundus* L. (Cyperaceae) from Egypt

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ABSTRACT

Eriophyoid mites offer a significant ecosystem service by weed control. They induce malformations (leaf rolling, erine, galls, stunting growth, blistering), rusting, bronzing, damages of seeds, and transmit viruses to their host plants. During a survey in Egypt, two eriophyoid species were recorded for the first time in the country on *Cyperus rotundus* L. (Cyperaceae) which has a worldwide relevance as weed: *Eriophyes rotundae* Mohanasundaram (Eriophyidae) and *Oziella gigantea* (Mohanasundaram) (Phytoptidae). Both species are vagrants underneath the inner surface of the leaf sheath around the stem, even though they can cause leaf rusting which leads to drying and death of the plants. A complementary description of the two species was presented, based on adult females. In addition, male and immature stages of *O. gigantea* and *E. rotundae* were described in detail for the first time. Furthermore, the checklist and morphological key for eriophyoid mite species associated with *Cyperus* plants worldwide were updated.

KEYWORDS: *Eriophyes*, Eriophyidae, new record, Phytoptidae, *Oziella*, weeds.

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INTRODUCTION

Cyperus rotundus L. (Cyperaceae), commonly known as purple nut-sedge, is recognized as one of the worst weeds in the world. It has been shown to grow in over 90 countries, infesting at least 52 distinct crops globally (Acevedo and Strong 2012). It can survive high temperatures, grow in a wide range of soil types and be found in numerous habitats, including cultivated fields, waste areas, roadsides, pastures, riverbanks, sandbanks, irrigation channels, river and stream beaches, and natural regions. Its undetected, quick growth and herbicide resistance make it a challenge for farmers and gardeners alike. Once established, *C. rotundus* is extremely hard to control due to its extensive underground tuber system, which allows it to easily renew (Santos *et al.* 1997).

Eriophyoidea is an economically significant taxon able to harm their host plants directly and indirectly (by the transmission of diseases) (Lindquist and Oldfield 1996). Eriophyoid mites have a

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very high specificity for their host plants; in fact, about 80% of known species have been reported on a single host species, 95% on a single host genus, and 99% on a single host family (Skoracka *et al.* 2010). This aspect as well as physiological and ecological characteristics make them significant tools as biological weed control agents (Marini *et al.* 2021).

Until now, eight *Eriophyes* species have been identified on Cyperaceae worldwide and six of them have been found in Egypt (Elhalawany 2022; Flechtmann and de Moraes 2022; Elhalawany *et al.* 2023; Situngu *et al.* 2023; personal communication with Amrine and de Lillo 2023).

The genus *Oziella* includes nine species worldwide; four of them are recorded on plant species of the family Cyperaceae. Only *Oziella niloticus* (Abou-Awad, 1981) on *Imperata cylindrica* (L.) P. Beauv. has been found in Egypt (Chetverikov 2016; Chetverikov and Petanović 2016; Chetverikov *et al.* 2009, 2012; Flechtmann and de Moraes 2022).

Oziella gigantea was described by Mohanasundaram (1981) based on adult females and *Eriophyes rotundae* was described by Mohanasundaram (1983) based on adult females adding a brief description of adult males. These species have been found in Egypt for the first time and the aim of this study is to provide their complementary morphological characterization, comparing them with the original descriptions. In particular, males and immature stages of *O. gigantea* and immature stages of *E. rotundae* are described for the first time, whereas a more detailed description of males of *E. rotundae* is given. An updated key for the world's eriophyoid mite species associated with *Cyperus* plants is also provided.

MATERIALS AND METHODS

Mites were collected from *C. rotundus*, at Qalubiya governorate, Egypt, in 2021 and 2023. Eriophyid specimens were collected from plant samples by direct examination under stereo-microscope, were cleared in Keifer's booster solution at room temperature, mounted on microscope slides in Keifer's F-medium (Amrine and Manson 1996) and slides were kept in an oven at 70–80 °C for 6–8 hrs. The specimens were examined under a phase contrast microscope (Carl Zeiss, Germany). Illustrations were made with the use of a drawing tube attached to the phase contrast microscope and processed using Adobe Illustrator® CS6 (Adobe Systems Inc.). Microphotographs were taken with a Zeiss A2 (microphoto camera AxioCamMRc) research microscope with phase contrast or differential interference using 10× eyepieces at 100× oil magnification, connected to a computer using Axiovision image analysis software. Identification to genus level was conducted using Amrine *et al.* (2003). Morphological terminology is based on Lindquist (1996) and data measurements follow Amrine and Manson (1996) and de Lillo *et al.* (2010). All measurements were made using Compu Eye (Baker 2005), are given in micrometers (µm) and refer to the length unless stated otherwise. For females, the average measurements are followed by range values of specimens (n) set between parentheses in the description. For males and immatures, only the measurement ranges of “n” specimens are given. Asterisks (*) in descriptions mean “no variation”. Specimens are deposited in the mite reference collection of Fruit Trees Mites Department, Plant Protection Research Institute, Agricultural Research Centre, Egypt, and in the mite reference collection of the Egyptian Society of Acarology Museum (ESAM), Zoology and Agricultural Nematology Department, the Faculty of Agriculture, Cairo University, Giza governorate, Egypt. All mite specimens were collected by the senior author.

RESULTS

Family Phytoptidae Murray, 1877

Subfamily Phytoptinae Murray, 1877

Genus *Oziella* Amrine, Stasny & Flechtmann, 2003

***Oziella gigantea* (Mohanasundaram, 1981) (Figs. 1–3)**

Anhchiphytoptus giganticus Mohanasundaram, 1981: 11, Fig. 1

Female ($n = 15$)

Body vermiform, 360 (337–380) including gnathosoma, 70 (45–71) wide, and 50 (40–55) thick; white in life. **Gnathosoma** 26 (24–28), projecting obliquely downwards, basal setae *ep* 2 (1–2), antapical setae *d* 11 (9–12), palp tarsal setae *v* 1, cheliceral stylets 26 (23–28). **Prodorsal shield** 35 (31–36) without frontal lobe, 53 (50–54) wide; semicircular, with anterior margin weakly rounded and slightly indented medially, ornamentation consisting of median and two admedian lines on posterior third of shield, faint sub-median line forming curving line around scapular tubercles, and short arc-like lines ahead of scapular tubercles. Tubercles of anterior setae *ve* 30 (28–33) apart, setae *ve* 16 (14–18), directed forward and slightly laterally; scapular tubercles close to rear shield margin, 23 (23–27) apart, setae *sc* 13 (12–14), projecting backwards. **Coxigenital area** smooth, with four semiannuli between coxae and genitalia; anterolateral setae on coxisternum I *lb* 15 (13–15), 20 (18–22) apart; proximal setae on coxisternum I *la* 25 (23–26), 14 (14–15) apart; proximal setae on coxisternum II *2a* 40 (38–43), 32 (30–36) apart. **Leg I** 36 (35–39), femur and genu fused 15 (11–16), basiventral femoral setae *bv* 8 (8–9), antaxial genual setae *l''* 40 (35–41); tibia 10 (8–10), paraxial tibial setae *l'* 3 (2–3), tibial solenidion ϕ 4 (3–4); tarsus 8 (8–9); tarsal empodium simple *em* 15 (13–17), 5/6 or 6/6-rayed, tarsal solenidion ω slightly tapered, 11 (11–12), paraxial fastigial tarsal setae *ft'* 9 (9–11), antaxial fastigial tarsal setae *ft''* 33 (30–34), tarsal setae *u'* 3–4. **Leg II** 35 (33–37), femur and genu fused 15 (13–17), setae *bv* 8 (7–9), setae *l''* 10 (10–11); tibia 9 (8–9), tibial solenidion ϕ 4 (3–5); tarsus 8 (8–9); *em* 13 (12–14), 5/6 or 6/6-rayed, ω slightly tapered, 11 (11–12), tarsal setae *ft'* 5 (5–7), setae *ft''* 32 (30–34), setae *u'* 3–4. **Opisthosoma** with 92 (90–93) annuli, dorso-ventrally subequal, with linear-elongate microtubercles on rear annular margins, the last 8th dorsal microtubercles pointed. Setae *c1* 141 (91–155), 35 (32–36) apart, on annulus 12 (11–12) from rear shield margin; lateral setae *c2* 44 (40–54), 60 (58–63) apart, on annulus 10 (10–11) from coxae II; ventral setae *d* 64 (58–71), 48 (45–52) apart, on annulus 29 (29–30); ventral setae *e* 17 (17–19), 25 (25–27) apart, on annulus 50 (50–51); ventral setae III *f* 62 (57–71), 45 (43–45) apart, on 13–14th annulus from rear. Setae *h1* 4 (3–4); setae *h2* 95 (90–100). **External genitalia** 20 (20–22), 27 (27–29) wide, coverflap smooth, proximal setae on coxisternum III *3a* 22 (19–23), 20 (18–20) apart. **Internal genitalia**, spermathecae ellipsoid, oriented posterolaterally; proximal part of spermathecal tube short with margins hard to distinguish; a spherical prespermathecal swelling. Anterior genital apodeme trapezoidal. Genital apodeme forming a curved and lateroposterad transverse plate.

Male ($n = 6$)

Similar to adult female. Body vermiform, 258–364 including gnathosoma, 63–68 wide, and 37–40 thick; white in life. **Gnathosoma** 21–23, cheliceral stylets 18–20, setae *ep* 1–2, setae *d* 5–7, palp tarsal setae *v* 1. **Prodorsal shield** pattern similar to that of adult female, 36–40, 44–49 wide; tubercles of setae *ve* 26–33 apart, setae *ve* 13–15, directed forward and slightly laterally; scapular tubercles close to rear shield margin, 25–28 apart, setae *sc* 14–17, projecting backwards. **Coxigenital area** smooth; setae *lb* 13–15, 20–23 apart; setae *la* 20–24, 18–19 apart; setae *2a* 40–42, 39–40 apart. **Leg I** 33–35, femur and genu fused 13–15, setae *bv* 7–8, setae *l''* 33–37; tibia 6–7, setae *l'* 2–3, tibial solenidion ϕ 3–5; tarsus 6–7; *em* 9–11, 5/6 or 6/6-rayed, ω slightly tapered, 9–10, tarsal setae *ft'* 7–10, setae *ft''* 22–24, setae *u'* 3–4. **Leg II** 31–32, femur and genu fused 13–15, setae *bv* 7–9, setae *l''* 9–11; tibia 6–7, tibial solenidion ϕ 3–4; tarsus 6–7; *em* 10–11, 5/6 or 6/6-rayed, ω slightly tapered 10–11, tarsal setae *ft'* 5–7, setae *ft''* 21–24, setae *u'* 3–4. **Opisthosoma** with 73–77 annuli, dorso-ventrally subequal, microtubercle shape similar to that of adult female. Setae *c1* 100 (90–120), 40 (35–43) apart, on annulus 11 (10–11) from rear shield margin; lateral setae *c2* 37–42, 61–65 apart, on annulus 10 from coxae II; ventral setae *d* 29–35, 51–52 apart, on annulus 20–22; setae *e* 14–16,

27–34 apart, on annulus 38–39; setae *f* 30–32, 38–40 apart, on 10–11th annulus from rear. Setae *h* 1 2–4; setae *h* 2 70–85. **External genitalia** 15–18, 28–30 wide, setae *3a* 14–17, 19–21 apart.

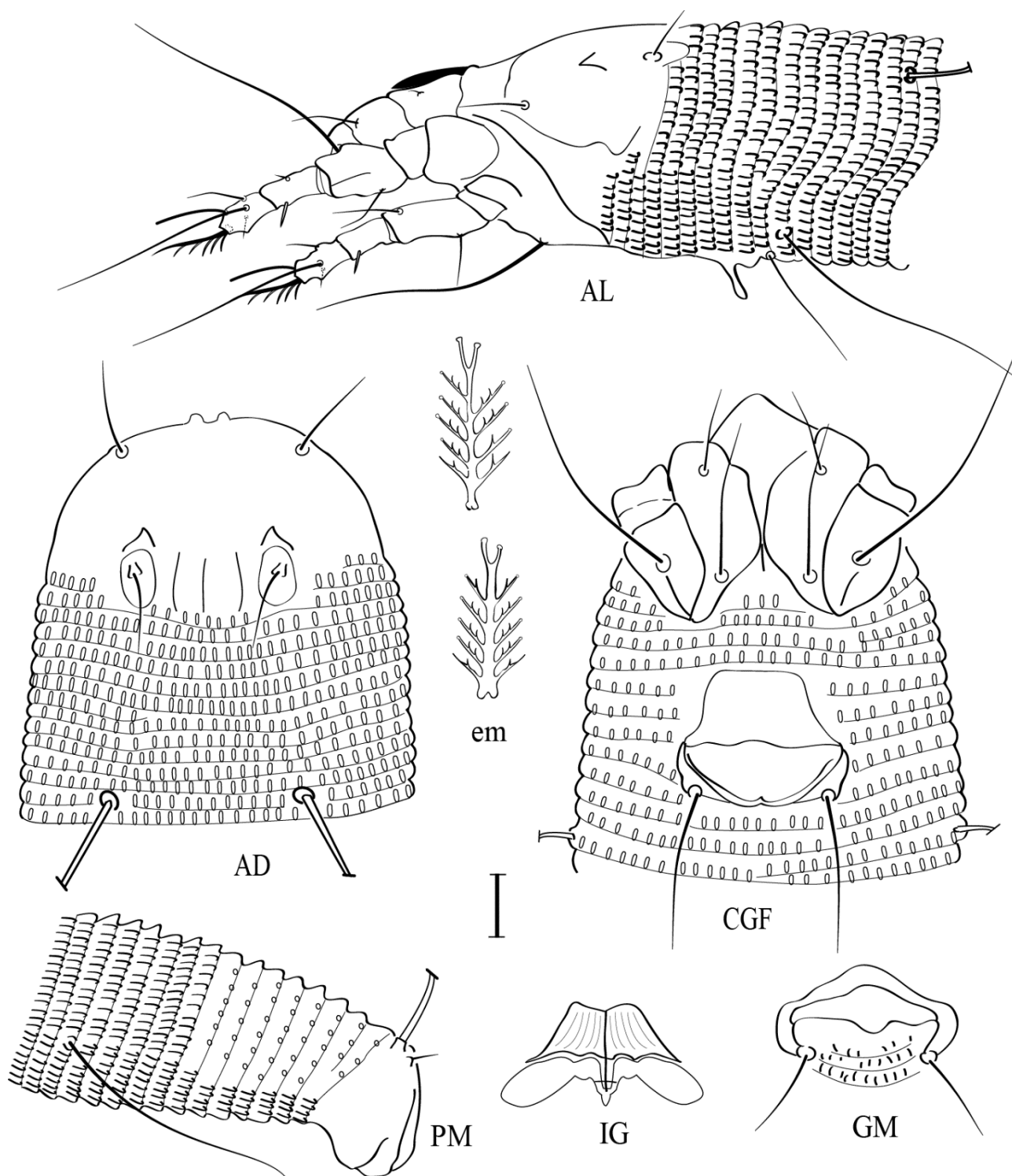


Figure 1. Line drawings of *Oziella gigantea* (adults) – AD. Antero-dorsal view of mite; AL. Antero-lateral view of mite; CGF. Coxi-genital region of female; em. Empodium; GM. Genital region of male; IG. Internal female genitalia; PM. Postero-lateral view of mite; L1. Leg I. Scale bar: 10 μ m for AD, AL, CGF, GM, IG, and PM; 5 μ m for em.

Nymph (n = 4)

Body vermiform, 250–302 including gnathosoma and 57–65 wide. **Gnathosoma** 23–25, cheliceral stylets 20–23, setae *ep* 1–2, setae *d* 5–6, palp tarsal setae *v* 1. **Prodorsal shield** semicircular, pattern similar to that of adult female, 33–34 and 44–51 wide; tubercles of setae *ve* 26–29 apart, setae *ve* 10–11, directed forward and slightly laterally; scapular tubercles close to rear shield margin, 21–23 apart, setae *sc* 10–12, projecting backwards. **Coxigenital area** smooth; setae *lb* 8–9, 20–21 apart; setae *la* 17–19, 16–17 apart; setae *2a* 30–32, 35–37 apart; setae *3a* 4–5, 13–14 apart. **Leg I** 24–26, femur and genu fused 9–10, setae *bv* 4–5, setae *l''* 20–23; tibia 4–5, setae *l'* 1–2, tibial solenidion ϕ 2–3; tarsus 5–6; *em* 9–10, 5-rayed, ω slightly tapered, 8–9, tarsal setae *ft'* 7–10, setae *ft''* 17–19, setae *u'* 1–2. **Leg II** 23–24, femur and genu fused 9–10, setae *bv* 3–4, setae *l''* 9–11; tibia 4, tibial solenidion ϕ 2–3; tarsus 4–5; *em* 9–10, 5-rayed, ω slightly tapered 8–9, tarsal setae *ft'* 4–5, setae *ft''* 19–21, setae *u'* 1–2. **Opisthosoma** with 73–77 annuli, dorso-ventrally subequal, with elongate microtubercles situated on rear margin of semiannuli, smooth on last eight dorsal semiannuli. Setae *c1* 60 (60–65), 35 (33–38) apart, on annulus 11 (10–11) from rear shield margin; lateral setae *c2* 35–38, 50–55 apart, on annulus 10 from coxae II; ventral setae *d* 20–25, 45–49 apart, on annulus 27–28; setae *e* 10–11, 27–28 apart, on annulus 41–42; setae *f* 37–40, 38–39 apart, on 10th annulus from rear. Setae *h1* 2–3; setae *h2* 55–59.

Larva (n = 3)

Body vermiform, 210–255 including gnathosoma and 45–52 wide. **Gnathosoma** 20–22, cheliceral stylets 18–22, setae *ep* 1–2, setae *d* 2–4, palp tarsal setae *v* 1. **Prodorsal shield** semicircular, smooth, 23–24 and 45–46 wide. Tubercles of setae *ve* 26–29 apart, setae *ve* 10–11, directed forward and slightly laterally; scapular tubercles on rear shield margin, 21–23 apart, setae *sc* 10–12, projecting backwards. **Coxigenital area** smooth; setae *lb* 4–5, 15–16 apart; setae *la* 6–8, 14–17 apart; setae *2a* 15–17, 25–27 apart; setae *3a* 2–3, 6–7 apart. **Leg I** 17–18, femur and genu fused 7–8, setae *bv* 3–4, setae *l''* 18–20; tibia 2–3, setae *l'* 1–2, solenidion ϕ 1–2; tarsus 4–5; empodium *em* 5–6 simple, 4-rayed, tarsal solenidion ω 3–4 tapered, setae *ft'* 7–8, setae *ft''* 13–15, setae *u'* 1–2. **Leg II** 14–16, femur and genu fused 6–7, setae *bv* 3–4, setae *l''* 14–17; tibia 2–3, solenidion ϕ 1–2; tarsus 3–4; *em* 5–6, 4-rayed, ω 4 tapered, setae *ft'* 3–4, setae *ft''* 13–15, setae *u'* 1–2. **Opisthosoma** with 87–90 dorsal semiannuli and 57–60 ventral semiannuli, with rounded microtubercles on dorsal semiannuli and oval on ventral semiannuli. Setae *c1* 10 (10–15), 28 (27–28) apart, on annulus 10 from rear shield margin; lateral setae *c2* 8–10, 40–43 apart, on annulus 12 from coxae II; ventral setae *d* 5–10, 30–33 apart, on annulus 23–25; setae *e* 3–4, 23–24 apart, on annulus 32–35; setae *f* 11–13, 23–24 apart, on 6th annulus from rear. Setae *h1* 2–3; setae *h2* 30–33.

Host plants in Egypt

Cyperus rotundus L. (Cyperaceae).

Geographical distribution – Relation to the host plant

Vagrant underneath the inner surface of the leaf sheath surrounding the stem, causing rusted leaves; it leads to drying and death of plants.

Type locality

India.

Material examined

Sixteen females, five males, five nymphs, and four larvae on six slides (slide no. EGYErio123.1-123.6), from Qalube district (30° 17' 21.42" N, 31° 12' 45.82" E), Qalubiya governorate, Egypt, 30 Oct., 2021; all deposited in the mite reference collection of Fruit Trees Mites Department, Plant Protection Research Institute, Agricultural Research Centre, Egypt. In addition, five females and two

males on two slides (slide no. EGYErio123.7-123.8) with the same previous data, deposited in the mite reference collection of the Egyptian Society of Acarology Museum (ESAM), Zoology and Agricultural Nematology Department, the Faculty of Agriculture, Cairo University, Giza governorate, Egypt. Two slides with the previous same data, deposited in Zoological Institute of the Russian Academy of Sciences (ZIN RAS), Russia.

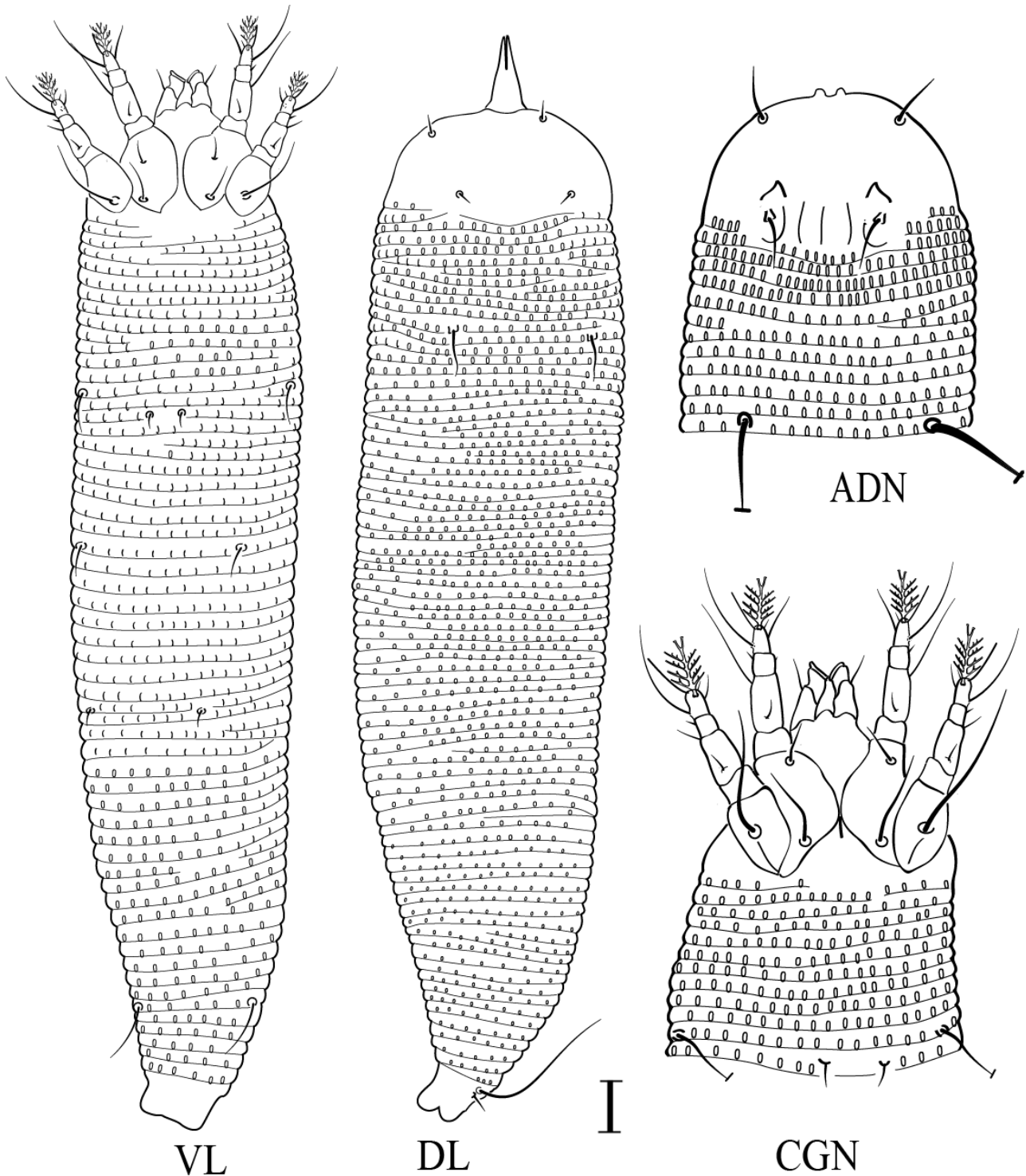


Figure 2. Line drawings of *Oziella gigantica* – AND. Antero-dorsal view of nymph; CGN. Coxi-genital region of nymph; DL. Dorsal view of larva; VL. Ventral view of larva. Scale bar: 10 μ m.

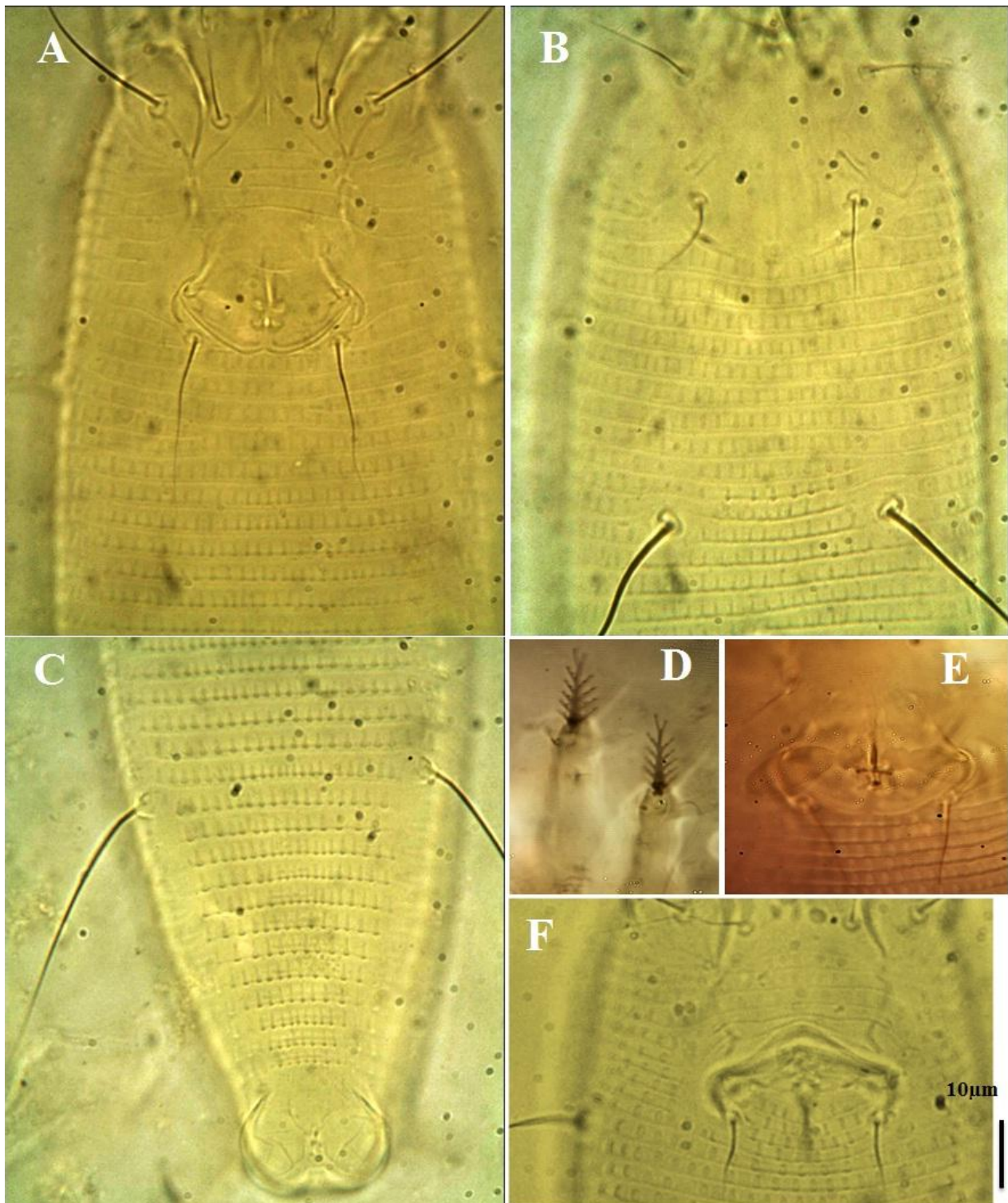


Figure 3. Photographs of *Oziella gigantea* – A. Coxi-genital region of female; B. Antero-dorsal view of mite; C. Postero-ventral of female; D. Empodium; E. Internal female genitalia; F. Coxi-genital region of male.

Remarks

This is the first time *O. gigantea* females and males have been recorded in Egypt, as well as the first description of its male and juvenile stages. Mohanasundaram (1981) described this species based

on adult female from India. The morphometry of the Egyptian female resembles that in the original description with the exception of the following characters: body length, prodorsal shield length and width, number of empodium rays, length of setae *c1*, *d*, *e*, *f* and legs. Setae *c1*, *d*, *e*, *f*, legs are slightly longer and the prodorsal shield slightly larger in the Egyptian specimens than the Indian specimens; body length in the Egyptian specimens is shorter than that of the Indian specimens; and tarsal empodium in Indian specimens is 5-rayed (5/6-rayed in the Egyptian specimens) (Table 1).

Table 1. Measurements of females of *Oziella gigantea* associated with *Cyperus rotundus* in Egypt and India, the average of the measurement precedes the mite corresponding range for different specimens (given in parentheses).

Characters	<i>Oziella gigantea</i>	
	From Egypt	From India
Body length	360 (337–380)	480–500
Body width	70 (45–71)	70
Gnathosoma length	26 (24–28)	25
Cheliceral stylets length	26 (23–28)	-
Setae <i>d</i> length	11 (9–12)	10
Prodorsal shield length	35 (31–36)	30
Prodorsal shield width	53 (50–54)	40
Setae <i>ve</i> length	16 (14–18)	18
Distance between <i>ve</i>	30 (28–33)	30
Setae <i>sc</i> length	13 (12–14)	13
Distance between <i>sc</i>	23 (23–27)	25
Leg I length	36 (35–39)	30
Leg II length	35 (33–37)	30
Number of empodial rays	5/6 or 6/6	5
Setae <i>3a</i> length	22 (19–23)	-
No. of dorsal semiannuli	92 (90–93)	88
No. of ventral semiannuli	92 (90–93)	88
Setae <i>c1</i> length	141 (91–155)	110
Setae <i>c2</i> length	44 (40–54)	50
Setae <i>d</i> length	64 (58–71)	42
Setae <i>e</i> length	17 (17–19)	8
Setae <i>f</i> length	62 (57–71)	58
Setae <i>h1</i> length	4 (3–4)	5
Setae <i>h2</i> length	95 (90–100)	105
Genital coverflap length	20 (20–22)	-
Genital coverflap width	27 (27–29)	-

Eriophyinae Nalepa, 1898

Eriophyini Nalepa, 1898

***Eriophyes* von Siebold, 1851**

***Eriophyes rotundae* Mohanasundaram, 1983 (Figs. 4–6)**

Eriophyes rotundae Mohanasundaram, 1983: 263, Fig. 1.

Female (*n* = 10)

Body vermiform, 240 (234–273) including gnathosoma, 44 (43–50) wide, and 41 (41–43) thick;

white in life. **Gnathosoma** 21 (20–22), projecting obliquely downwards, basal setae *ep* 3 (2–3), antapical setae *d* 7 (7–8), palp tarsal setae *v* 1, cheliceral stylets 17 (16–18). **Prodorsal shield** 38 (33–40) with a short blunt frontal lobe and 36 (36–37) wide; sub-triangular; prodorsal shield ornamentation with lines of granules, median line incomplete reached at $\frac{3}{4}$ from base; admedian lines complete, gently diverging to rear, and parallel; three pairs of submedian lines incomplete on anterior $\frac{2}{3}$ of prodorsal shield ending ahead of scapular tubercles; incomplete lateral lines parallel to lateral shield side. Scapular tubercles near rear shield margin, 18 (15–19) apart, setae *sc* 9 (9–10), projecting upward and medially. **Coxigenital area** with sparse granules, with 5 (5–6) semiannuli between coxae and genitalia, prosternal apodeme present 4 (4–5); setae *lb* 9 (9–10), 14 (14–15) apart; setae *la* 25 (25–27), 9 (8–9) apart; setae *2a* 36 (36–40), 26 (26–27) apart. **Leg I** 35 (32–35), femur 12 (10–12), basiventral femoral setae *bv* 9 (8–10); genu 5 (5–6), antaxial genual setae *l''* 30 (29–32); tibia 7 (7–8), paraxial tibial setae *l'* 7 (6–8), setae located $\frac{1}{3}$ from dorsal base; tarsus 7 (6–8); empodium *em* simple 7 (7–8), 4-rayed, simple, tarsal solenidion ω slightly curved and knobbed, 8 (8–9), tarsal setae *ft'* 17 (14–17), tarsal setae *ft''* 22 (20–23), tarsal setae *u'* 3(2–3). **Leg II** 30 (29–32), femur 9 (9–10), setae *bv* 8 (7–8); genu 5 (4–5), setae *l''* 8 (8–10); tibia 5 (5–6); tarsus 7 (7–8); tarsal *em* simple 6 (5–6), 4-rayed, tarsal solenidion ω 8 (7–8) slightly curved and knobbed, setae *ft'* 8 (7–9), setae *ft''* 20 (20–22), tarsal setae *u'* 3(2–3). **Opisthosoma** dorsally with 70 (68–72) semiannuli, with elongate microtubercles on rear annular margins, last 4th semiannuli with pointed microtubercles; ventrally with 76 (74–77) semiannuli, with oval to round microtubercles on rear annular margins, the last 6th ventral microtubercles linear. Lateral setae *c2* 25 (19–31), 45 (44–47) apart, on annulus 9 (9–10) from coxae II; ventral setae *d* 27 (27–30), 36 (36–38) apart, on annulus 23 (23–24); ventral setae *e* 13 (12–15), 19 (17–19) apart, on annulus 42 (41–42); ventral setae *f* 27 (23–28), 20 (20–21) apart, on 6–7th annulus from rear. Setae *h1* 4 (3–4), setae *h2* 60 (55–70). **External genitalia** 15 (14–15) and 23 (22–24) wide, coverflap with ten longitudinal ridges in a single row plus three transverse lines at the base, proximal setae on coxisternum III *3a*, 8 (8–10), 18 (18–19) apart. **Internal genitalia** spermathecae ovoid, oriented posterolaterad; spermathecal tubes relatively short; transverse genital apodeme trapezoidal, distally folded.

Male (n = 7)

Similar to adult female. Body vermiform, 190–224 including gnathosoma, 38–49 wide, and 42–45 thick; white in life. **Gnathosoma** 20–22, cheliceral stylets 16–18, setae *ep* 2–3, setae *d* 4–5, palp tarsal setae *v* 1. **Prodorsal shield** shape and patterns similar to those of adult females, 33–38 including frontal lobe and 36–37 wide; scapular tubercles near the rear shield margin, 15–19 apart, setae *sc* 9–10, projecting upward and anteriorly. **Coxigenital area** with few granules, prosternal apodeme present 3–4, with 6–7 semiannuli between coxae and genitalia; setae *lb* 7–8, 14–15 apart; setae *la* 12–14, 9–10 apart; setae *2a* 29–32, 25–26 apart. **Leg I** 30–32, femur 9–10, setae *bv* 7–8; genu 4–5, setae *l''* 25–30; tibia 6–7, setae *l'* 6–7; tarsus 6–7; tarsal empodium *em* simple 6–7, 4-rayed, tarsal solenidion ω distally slight knobbed 7–8, setae *ft'* 13–15, setae *ft''* 10–24, setae *u'* 2–34. **Leg II** 28–30, femur 8–9, setae *bv* 7–8; genu 4–5, setae *l''* 7–8; tibia 4–5; tarsus 5–6; tarsal empodium *em* simple 6–7, 4-rayed, tarsal solenidion ω distally slight knobbed 7–8, setae *ft'* 9–10, setae *ft''* 18–21, setae *u'* 2–3. **Opisthosoma** dorsally with 65–67 semiannuli; ventrally with 75–77 semiannuli, shape of microtubercles similar to that of adult females. Lateral setae *c2* 23–25, 37–45 apart, on annulus 9–10 from coxae II; ventral setae *d* 21–23, 31–32 apart, on annulus 22–23; setae *e* 8–10, 17–18 apart, on annulus 40–41; setae *f* 21–25, 17–207 apart, on 6–7th annulus from rear. Setae *h1* 3–4, setae *h2* 40–42. **External genitalia** 11–12 and 23–25 wide, with granules, setae *3a* 7–10, 15–179 apart.

Nymph (n = 6)

Body vermiform, 180–200, 35–40 wide, and 45–48 thick. **Gnathosoma** 17–18, curved downward, setae *ep* 1–2, setae *d* 5–6, palp tarsal setae *v* 1; cheliceral stylets 16–17. **Prodorsal shield** sub-circular, 30–34 including frontal and 30–35 wide, prodorsal shield ornamentation with median

and admedian lines complete; incomplete two submedian lines, parallel on anterior half of prodorsal shield. Tubercles *sc* ahead of rear shield margin, 17–18 apart; *sc* 7–8. **Coxisternal plates** smooth, setae *lb* 4–5, 10–11 apart; setae *la* 9–11, 7–8 apart; setae *2a* 16–18, 24–26 apart; setae *3a* 4–5, 9–10 apart. **Leg I** 19–20; femur 5–6, setae *bv* 6–7; genu 3–4, setae *l''* 17–19; tibia 3–4, setae *l'* 4–5; tarsus 4–5, setae *ft'* 11–13, setae *ft''* 14–17, setae *u'* 1–2; tarsal *ω* 4–5, tapered; *em* 3*, simple, 3-rayed. **Leg II** 15–16; femur 3–4, setae *bv* 5–7; genu 3*, setae *l''* 7–8; tibia 3*; tarsus 3–4, setae *ft'* 5–7, setae *ft''* 14–16, setae *u'* 1–2; *ω* 4–5; *em* 3*, simple, 3-rayed. **Opisthosoma** with 60–63 dorsal semiannuli, with round microtubercles situated on rear margin of each annulus, 59–60 ventral semiannuli with round microtubercles, situated on rear margin of each annulus; elongated on the posterior 5th semiannuli. Setae *c2* 8–10, 42–43 apart, on 12 ventral annuli; setae *d* 15–17, 24–25 apart, on 20–21 ventral annuli; setae *e* 7–8, 16–17 apart, on 33–34 ventral semiannuli; setae *f* 12–13, 19–20 apart, on 5th annulus from rear. Setae *h1* 2–3; setae *h2* 40–45.

Larva (n = 3)

Body vermiform, 148–164, 35–40 wide, and 40* thick. **Gnathosoma** 16–17 curved downward, setae *ep* 1–2, setae *d* 4–5, palp tarsal setae *v* 1, cheliceral stylets 16–17. Prodorsal shield subcircular, 33–37 and 22–25 wide; with incomplete median line on posterior half of prodorsal shield, admedian lines complete, sub-median lines at anterior ½, sub-parallel to admedian line. Tubercles *sc* near the rear shield margin, 12–13 apart; setae *sc* 7–9 directed anteriorly. **Coxisternal plates** smooth, setae *lb* 4–5, 7–8 apart; setae *la* 7–8, 4–5 apart; setae *2a* 15–17, 20–22 apart. Setae *3a* 3–4, 8–10 apart. **Leg I** 17–18; femur 4–5, setae *bv* 4–5; genu 3*, setae *l''* 16–18; tibia 3*, setae *l'* 4–5; tarsus 3–4, setae *ft'* 10–11, setae *ft''* 13–15, setae *u'* 1–2; *ω* 4–5; *em* 3–4, 3-rayed, simple. **Leg II** 15–16; femur 4–5, setae *bv* 4–5; genu 2–3, setae *l''* 7–8; tibia 2–3; tarsus 3–4, setae *ft'* 7–8, setae *ft''* 12–14, setae *u'* 1–2; *ω* 3–4; *em* 3–4, 3-rayed, simple. **Opisthosoma** with 35–37 semiannuli, dorso-ventrally subequal, with minute round microtubercles situated on rear margin of each annulus. Setae *c2* 8–10, 25–28 apart, on 7–8 ventral semiannuli; setae *d* 18–20, 20–21 apart, on 13–14 ventral semiannuli; setae *e* 6–7, 12–13 apart, on 22–23 ventral semiannuli; setae *f* 12–13, 15–17 apart, on 6th annulus from rear; setae *h1* 1–2; setae *h2* 30–32.

Host plants in Egypt

Cyperus rotundus L. (Cyperaceae).

Geographical distribution

India and Egypt.

Relation to the host plant

Vagrant underneath the inner surface of the leaf sheath surrounding the stem, causing rusted leaves; it leads to drying and death of plants.

Type locality

India.

Material examined

Twenty-one females, five males, seven nymphs, and six larvae on eight slides (slide no. EGYErio63.2-63.9), from Qaha district (30° 17' 20.02" N, 31° 14' 51.85" E), Qalyubia governorate, Egypt, 23 July, 2021; all deposited in the mite reference collection of Fruit Trees Mites Department, Plant Protection Research Institute, Agricultural Research Centre, Egypt. Four females and two males on two slides from the same previous plant material, 15 Nov., 2023, deposited in the mite reference collection of the Egyptian Society of Acarology Museum at (ESAM), Zoology and Agricultural Nematology Department, the Faculty of Agriculture, Cairo University, Giza governorate, Egypt. Four

slides (slide no. EgCL01-04) deposited in the mite collection of Department of Plant, Soil and Food Sciences (Di.S.S.P.A.), University of Bari Aldo Moro, Italy. Two slides with the same data, deposited in the College of Agriculture and Forestry, West Virginia University, USA (WVU). Some specimens from the same previous plant material, 15 Nov., 2023, deposited in Zoological Institute of the Russian Academy of Sciences (ZIN RAS), Russia.

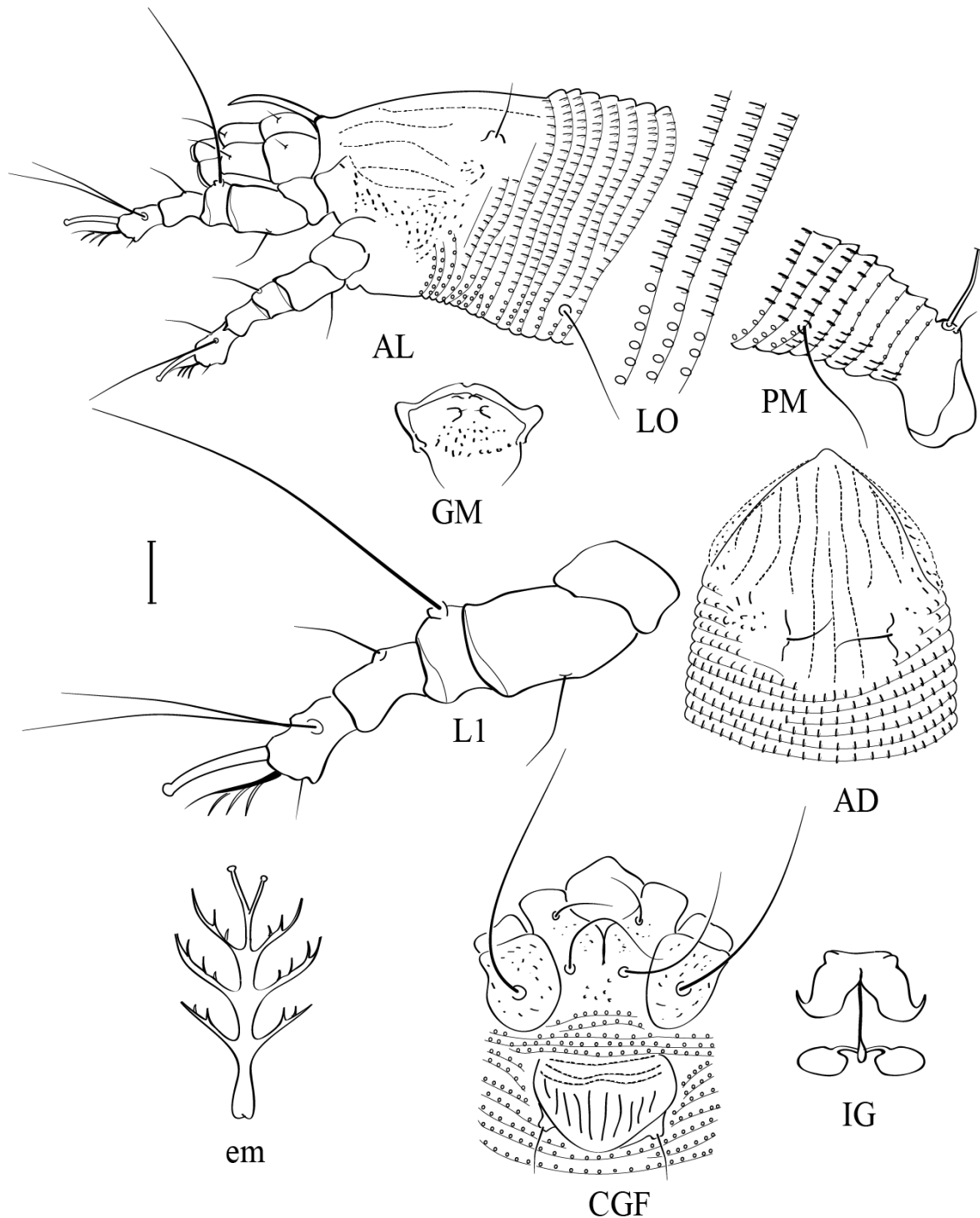


Figure 4. Line drawings of *Eriophyes rotundae* (adults) – **AD**. Antero-dorsal view of mite; **AL**. Anterio-lateral view of mite; **CGF**. Coxi-genital region of female; **em**. Empodium; **GM**. Genital region of male; **IG**. Internal female genitalia; **PM**. Postero-lateral view of mite; **LO**. Lateral view of semiannuli; **L1**. Leg I. Scale bar: 10 μm for AD, AL, CGF, GM, IG, and PM; 5 μm for L1 and LO; 2.5 μm for em.

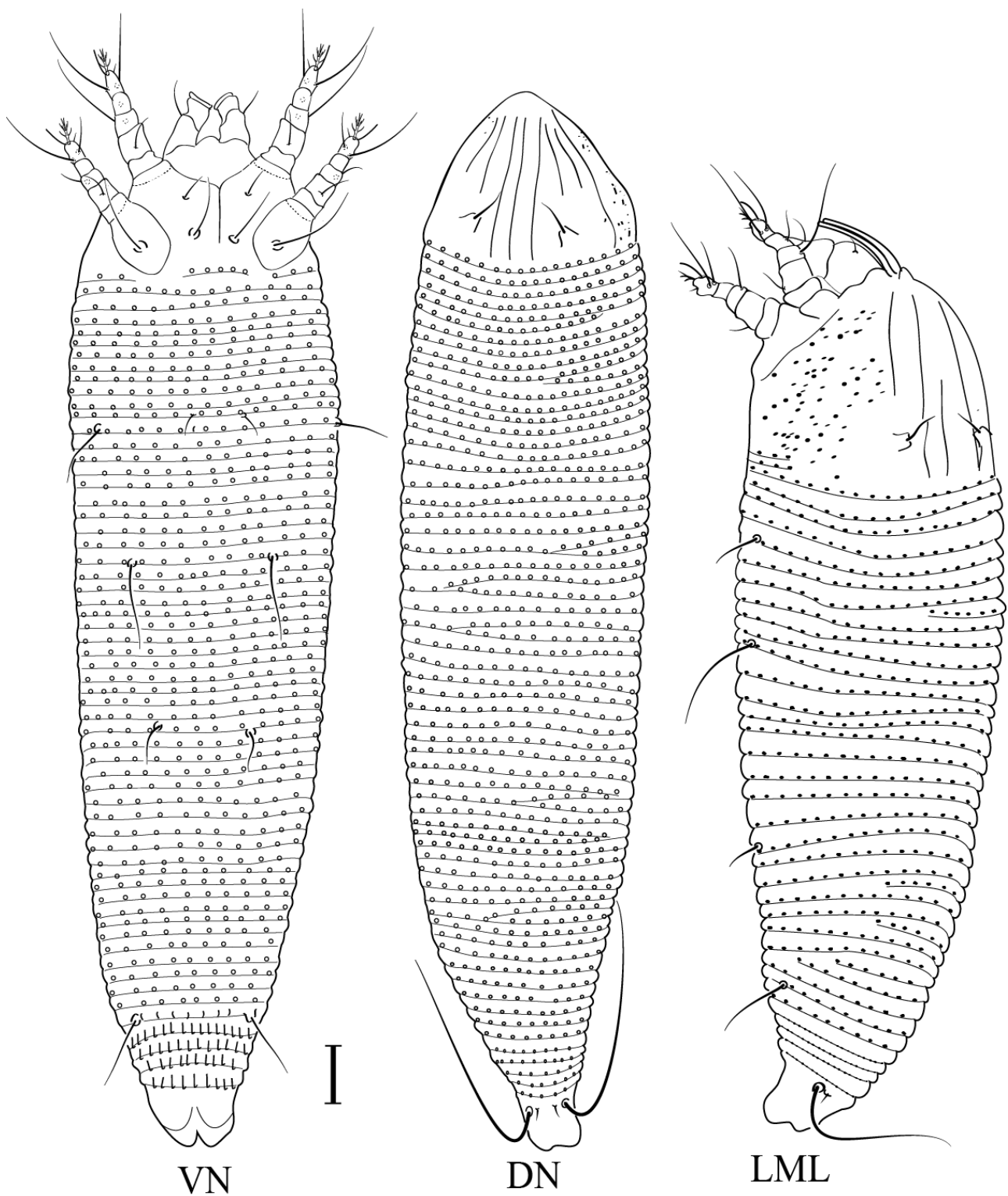


Figure 5. Line drawings of *Eriophyes rotundae* – **DN**. Dorsal view of nymph; **VN**. Ventral view of nymph; **LML**. Lateral view of larva. Scale bar: 10 μ m.

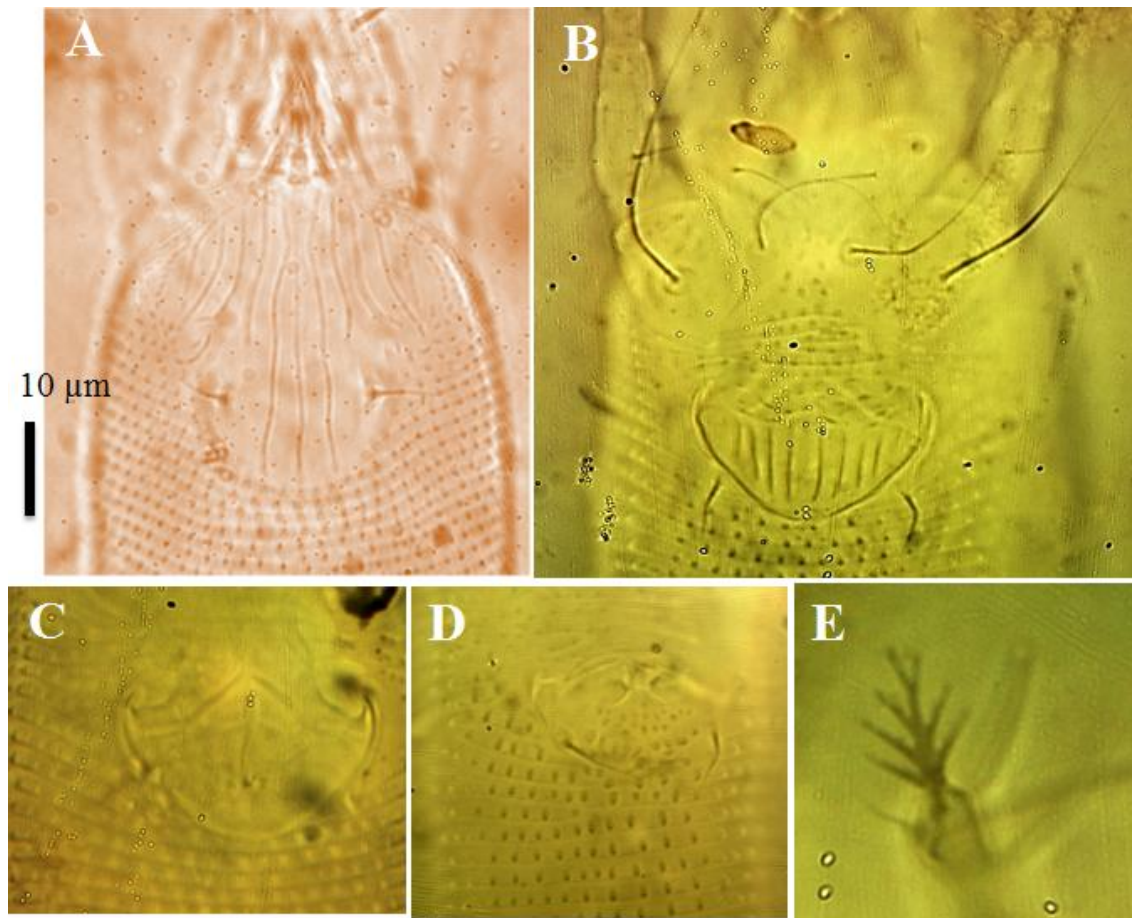


Figure 6. Photographs of *Eriophyes rotunda* – **A.** Antero-dorsal view of mite; **B.** Coxi-genital region of female; **C.** Genital region of male; **D.** Internal female genitalia; **E.** Empodium. Scale bar: 10 μm for A, B, C, and D; 5 μm for E.

Table 2. Measurements of females of *Eriophyes rotundae* associated with *Cyperus rotundus* in Egypt and India, the average of the measurement precedes the mite corresponding range for different specimens (given in parentheses).

Characters	<i>Eriophyes rotundae</i>	
	From Egypt	From India
Body length	240 (234–273)	180–190
Body width	44 (43–50)	40
Gnathosoma length	21 (20–22)	15
Cheliceral stylets length	17 (16–18)	–
Setae <i>d</i> length	7 (7–8)	5
Prodorsal shield length	38 (33–40)	–
Prodorsal shield width	36 (36–37)	–
Setae <i>sc</i> length	9 (9–10)	7
Distance between <i>sc</i>	18 (15–19)	15
Leg I length	35 (32–35)	22
Leg II length	30 (29–32)	22
Number of empodial rays	4	4
Setae <i>3a</i> length	8 (8–10)	6
No. of dorsal semiannuli	70 (68–72)	70
No. of ventral semiannuli	76 (74–77)	70
Setae <i>c2</i> length	25 (19–31)	20
Setae <i>d</i> length	27 (27–30)	15

Table 2. Continued.

Characters	<i>Eriophyes rotundae</i>	
	From Egypt	From India
Setae <i>e</i> length	13 (12–15)	10
Setae <i>f</i> length	27 (23–28)	27
Setae <i>h1</i> length	4 (3–4)	3
Setae <i>h2</i> length	60 (55–70)	60
Longitudinal ribs	10	10
Genital coverflap length	15 (14–15)	12
Genital coverflap width	23 (22–24)	14

Remarks

Eriophyes rotundae was described by Mohanasundaram (1983) on *C. rotundus*. The description of the male of this species was brief whereas immatures were never described. Therefore a detailed description for males and immatures are given herein. The Egyptian females differ from the India specimens in the following: number of ventral semiannuli 70 (74–77 in the Egyptian specimens); length of legs I and II 22 and 22, respectively (32–35 and 29–32, respectively in Egyptian specimens); opisthosomal setae are shorter for setae *c2* 20 (25 in the Egyptian specimens), *d* 15 (27 in the Egyptian specimens), and *e* 10 (13 in the Egyptian specimens); length and width of genital coverflap (Table 2). A careful examination of Mohanasundaram's drawings shows that Setae *d* of Indian specimens is longer than setae *c2*. So probably Mohanasundaram made a typo and this difference is negligible. The remaining differences may be because of the difference in environmental conditions, (genotype of the host plant, climatic conditions, plant physiology) at which slide preparation technique, operator skills, microscope quality, or the quality of the microscope equipment used.

Key to eriophyoid mite species associated with *Cyperus* spp. worldwide based on the most detailed published descriptions

1. Prodorsal shield with anterior setae (*ve*), apicoventral solenidion (ϕ) on tibia I
Phytoptidae 2
- Prodorsal shield without anterior setae (*ve*), apicoventral solenidion (ϕ) on tibia I absent
Eriophyidae 3
2. Tibia I without solenidion; opisthosoma without setae *c1*, genitalia moved caudally from coxa II, spermathecal tube elongate, setae *bv* I, II absent *Novophytoptus silvai* Flechtmann, 2004
- Tibia I with solenidion; opisthosoma setae *c1* present, genitalia close to coxa II, separated by fewer or smaller annuli, spermathecal tube short, setae *bv* I, II present
..... *Oziella gigantea* (Mohanasundaram, 1981)
3. Body vermiform, annuli subequal dorso-ventrally, at least on anterior $\frac{1}{2}$ to $\frac{2}{3}$ of opisthosoma
Eriophyinae 4
- Body usually fusiform, opisthosoma divided into broad dorsal annuli and narrow ventral annuli .
Phyllocoptinae 6
4. Prodorsal shield without granules, genital coverflap with 10 longitudinal ribs
..... *Eriophyes rotundae* Mohanasundaram, 1983
- Prodorsal shield with granules, genital coverflap with more than 10 longitudinal ribs 5
5. Coxae with granules, genital coverflap with 10–12 longitudinal ribs plus three transverse lines at base, genital setae *3a* 13–14 long *Eriophyes cyperinus* Flechtmann, 2004

- Coxae with elongate dashes, genital coverflap with 10–13 longitudinal ribs plus one transverse lines at base, genital setae *3a* 6–9 long *Eriophyes cyperi* ChannaBasavanna, 1966
- 6. Empodium simple; all opisthosomal setae present
..... *Leipothrix bangkokus* (Chandrapatya, in Boczek & Chandrapatya, 1996)
- Empodium divided; opisthosomal setae *d* and *e* absent *Moraesia tau* Flechtmann, 2004

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نخستین گزارش دو کنه اریوفیوئید (Acari: Eriophyoidea) روی *Cyperus rotundus* L. (Cyperaceae) از مصر

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چکیده

کنه‌های اریوفیوئید خدمات زیادی در اکوسیستم با کنترل علف‌های هرز ارایه می‌دهند. این هرناها ناهنجاری‌ها (پیچیدگی برگ، نمدی شدن، گال‌ها، توقف رشد، تاول زدن)، زنگ‌زدگی، برنزه شدن، آسیب به دانه‌ها و انتقال ویروس‌ها را به گیاهان میزبان خود القا می‌کنند. طی یک بررسی در مصر، دو گونه اریوفیوئید برای نخستین بار در کشور روی *Cyperus rotundus* L. (Cyperaceae) که به عنوان علف هرز در سراسر جهان اهمیت دارد، گزارش می‌شود: *Eriophyes rotundae* Mohanasundaram (Eriophyidae) و *Oziella gigantea* (Mohanasundaram) (Phytoptidae). هر دو گونه در زیر سطح داخلی غلاف برگ در اطراف ساقه آزاد هستند، حتی می‌توانند باعث زنگ‌زدگی برگ شوند که منجر به خشک شدن و مرگ گیاهان شود. توصیف تکمیلی دو گونه بر اساس ماده‌های بالغ مورد نیاز بود. همچنین مراحل نر و نابالغ *O. gigantea* و *E. rotundae* برای نخستین بار به تفصیل شرح داده شد. افزون بر این، فهرست و کلید ریخت‌شناسی برای گونه‌های کنه اریوفیوئید جهان مرتبط با گیاهان *Cyperus* به روز شد.

واژگان کلیدی: *Eriophyes*, *Eriophyidae*, گزارش جدید، *Oziella*, *Phytoptidae*، علف‌های هرز.

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