A New Species and Record of *Aceria* (Acari: Prostigmata: Eriophyoidea) on Weeds from Egypt

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**ABSTRACT**

Eriophyoid mites are of great economic importance as pests of weeds, particularly in causing sometimes deformities such as bud galls, stunting, rusting, bronzing, leaf rolling, erineum, blisters, galls, coating, damaged seeds and mosaic virus disease. During the survey of eriophyoid mite fauna from Qualyubia, Cairo and Gharbia governorates in Egypt from 2014 to 2018. One new species and one new record of the genus *Aceria* from weeds are described and illustrated. *Aceria lividus* sp. nov., was collected from *Amaranthus lividus* L. (Amaranthaceae), vagrant on buds and flowers causing stunt and deformation. This species is the first record of eriophyoid mite from the family Amaranthaceae from Egypt. A supplementary description of the first record of *Aceria malherbae* Nuzzaci, 1985 infested *Convolvulus arvensis* L. (Convolvulaceae) in Egypt based on females, males and immature. This mite found on upper leaf surface alongside the midrib, causes leaf folding, deformation of flowers and plants and prevent plant reproduction. The two *Aceria* species indicate that is a promising candidate for the biological control of *C. lividus* and *C. arvensis*.

**Key words: Eriophyidae, Aceria, Amaranthus lividus, Convolvulus arvensis, weeds, taxonomy.**

**INTRODUCTION**

Eriophyoid mites are an economically important group because the direct damage they can cause to their hosts, their ability to transmit serious plant diseases, and also due to the possibility of using them as biological agents for weed control (Lindquist *et al.*, 1996). Nearly 80% have been reported on a single host species, 95% on one host genus and 99% on one host family (Skoracka *et al.*, 2010).

*Amaranthus* is a cosmopolitan genus compresses almost 65 species, distributed in the tropical, subtropical and warm region of the world (Boulos, 1999). It is a serious problem weed in several field crops as well as in vegetables and orchards. It is an annual spreading by seeds which have a long viability and are dispersed principally by wind and water, but also by machinery (Zaki, 2000).

Along with the current new records, more than 28 named eriophyoid species have been collected and described from plants of the family Amaranthaceae, 20 of them belong to genus *Aceria* and none of them has been found in Egypt. Only two *Aceria* species collected up to now from *Amaranthus*: *Aceria amaranthi* Abou–Awad & El–Banhayw, 1992 collected from numerous galls on both leaf surfaces, causing malformation of the leaves of *Amaranthus* sp. from Tanzania and *Aceria vanensis* Denizhan & Kiedrowicz, 2016 vagrant on leaves of *Amaranthus retroflexus* L. in Turkey (Zaher 1984; Abou–Awad & El–Banhayw, 1992; Elhalawany 2012; Denizhan *et al.*, 2016 & Amrine and de Lillo personal communication) Table 1.

Field bindweed, *Convolvulus arvensis* L. (Convolvulaceae) is an aggressive perennial weed of Mediterranean and Middle East origin, found throughout temperate regions of the world. It is distributed from 44 countries and in 2 different crops, and it’s ranked as the 12th most important weed in the world (Holm *et al.*, 1977). "Field bindweed’s long lived seeds and extensive root system make it extremely difficult to control by chemical and mechanical means (Rosenthal, 1983).

*Aceria malherbae* Nuzzaci, 1985 was recorded on *Convolvulus arvensis* L, from Italy, on leaf feeding starts on the upper surface alongside the midrib, usually towards the distal end of the leaf. Galled leaves become yellow–green or red. When mites attack the bud they also prevent natural stem growth and elongation (Rosenthal, 1996). *A. malherbae* was release against *C. arvensis* in the USA during 1987 (Rosenthal & Platta, 1990), and in South Africa in 1995 (Creamer, 1995) and established in Texas, but the effect on the weeds is not yet known (Boldt & Sobhian, 1993).

The knowledge on eriophyoid mite fauna of Egypt is limited. Reviewing literature showed that up to 2012 only 65 eriophyoid species have been discovered and described from Egypt. Since then more eriophyoid have been recorded and described by several authors (e.g., Zaher 1984, Elhalawany, 2012, 2014a, 2014b, 2015, 2017). As a result of these studies, the list of eriophyoid mites recorded in Egypt has reached up to 101 species belonging to 32 genera. More than 1,000 named species have been assigned to the genus *Aceria* Keifer, 1944 and about 38 of them have been found in Egypt up to now (Elhalawany & Ueckermann 2015 & 2018).

The current contribution is aimed to description of a new eriophyoid mite species, namely *Aceria lividus*.
Table 1. Eriophyoid mite species collected from Amaranthaceae plants worldwide and their type host, habits and, type locality.

<table>
<thead>
<tr>
<th>Species</th>
<th>Type host</th>
<th>Habits</th>
<th>type locality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aceria heimi (Nalepa, 1899a)</td>
<td><em>Atriplex halimus</em> L.</td>
<td>flower deformation and erineum, halophytic</td>
<td>France</td>
</tr>
<tr>
<td>Aceria brevis (Nalepa, 1899c)</td>
<td><em>Atriplex halimus</em> L.</td>
<td>hemispherical indentations in the leaf surface</td>
<td>Italy</td>
</tr>
<tr>
<td>Aceria caulebia (Nalepa, 1900)</td>
<td><em>Suaeda vera</em> J. F. Gmelin in L.</td>
<td>galls</td>
<td>Italy</td>
</tr>
<tr>
<td>Aceria salicorniae (Nalepa, 1902)</td>
<td><em>Arthrocnemum fruticosum</em> (L.) Moq.</td>
<td>witches’ broom</td>
<td>Cyprus</td>
</tr>
<tr>
<td>Aceria obiones (Molliard, 1904)</td>
<td><em>Atriplex pedunculata</em> L.</td>
<td>flower stalk galls</td>
<td>France</td>
</tr>
<tr>
<td>Aceria allentolofae Keifer, 1952</td>
<td><em>Allentolofea occidentalis</em> (Wats.) Kuntze.</td>
<td>the mites inhabit joints and flowers heads</td>
<td>USA</td>
</tr>
<tr>
<td>Aceria rubifaciens Lamb, 1953</td>
<td><em>Salicornia australis</em> Sol. ex Forst. f.</td>
<td>galls on shoot</td>
<td>New Zealand</td>
</tr>
<tr>
<td>Aceria desertorum Roivaen, 1953</td>
<td><em>Suaeda vera</em> J. F. Gmelin in L.</td>
<td>vagrant</td>
<td>Spain</td>
</tr>
<tr>
<td>Aceria sarcoabi Keifer, 1962</td>
<td><em>Sarcobatus vermiculatus</em> (Hook.) Torr.</td>
<td>produce blister–like leaf swellings</td>
<td>USA</td>
</tr>
<tr>
<td>Aceria atriplicis Wilson &amp; Oldfield, 1966</td>
<td><em>Atriplex polycarpa</em> (Torr.) S. Watson</td>
<td>leaf bead galls</td>
<td>USA</td>
</tr>
<tr>
<td>Aceria beniciae Keifer, 1966</td>
<td><em>Salicornia virginica</em> L.</td>
<td>the mites live between stem joints</td>
<td>USA</td>
</tr>
<tr>
<td>Aceria achyranthi Mohanasundaram, 1990</td>
<td><em>Achyranthes aspera</em> L.</td>
<td>undersurface leaf vagrant, slight rusting</td>
<td>India</td>
</tr>
<tr>
<td>Aceria aervae Mohanasundaram, 1990</td>
<td><em>Aerva lanata</em> (L.) Juss. ex Schult.</td>
<td>vagrant</td>
<td>India</td>
</tr>
<tr>
<td>Aceria amaranthi Abou–Awad &amp; El–Banhawy, 1992</td>
<td><em>Amaranthus</em> sp.</td>
<td>numerous galls on both leaf surface, causing malformation of the leaves</td>
<td>Tanzania</td>
</tr>
<tr>
<td>Aceria zutmatei Boczek &amp; Petanovic, 1994</td>
<td><em>Krascheninnikovia ceratoides</em> (L.)</td>
<td>causing small galls on leaves</td>
<td>Spain</td>
</tr>
<tr>
<td>Aceria salsolea de Lillo, 1996</td>
<td><em>Salsola kali</em> L.</td>
<td>infested plants remain stunted and less spiny; seed production is dramatically reduced</td>
<td>Turkey</td>
</tr>
<tr>
<td>Aceria chinopoda Xue, Sadeghi &amp; Hong, 2009</td>
<td><em>Chenopodium lividus</em> L.</td>
<td>vagrant on flowering parts</td>
<td>Iran</td>
</tr>
<tr>
<td>Aceria vanensis Denizhan &amp; Kiedrowicz, 2016</td>
<td><em>Amaranthus retroflexus</em> L.</td>
<td>vagrant</td>
<td>Turkey</td>
</tr>
<tr>
<td>Aceria halocnemii Lotfollahi &amp; Tajaddod, 2018</td>
<td><em>Halocnemum strobilaceum</em> (Pall.) M. Bieb.</td>
<td>vagrant</td>
<td>Iran</td>
</tr>
<tr>
<td>Aceria lividus Elhalawany sp. nov.</td>
<td><em>Amaranthus lividus</em> L. (A. blitum)</td>
<td>vagrant on buds and flowers causes stunted, deformed</td>
<td>Egypt</td>
</tr>
</tbody>
</table>

During the five year period from 2014–2018, random samplings of weeds showing symptoms of mite infestation were carried out in Qalyubia, Cairo and Gharbia governorates in Egypt. Eriophyoid mites were collected from the plant samples by direct examination with the aid of a stereo–microscope and mounted on microscope slides in Keifer’s F–medium (Amrine and Manson 1996). The specimens were examined under a phase contrast microscope (Carl Zeiss Nr. German). Illustrations were made with the use of drawing tube attached to the phase contrast microscope and using the Adobe Illustrator® CS6 program. Identifications to genus level was conducted using a published key to the world genera of the Eriophyoidea (Amrine et al., 2003). Morphological terminology is based on Lindquist (1996) and data measurements follow (Amrine and Manson 1996; de Lillo et al., 2010). All measurements were made using the software computer program (compu Eye) (Baker, 2005) and are given in micrometres (μm) and the number of measured specimens (n) is given within parentheses in the description. For males and immature stages, only the ranges are given.

**RESULTS AND DISCUSSION**

**Family Eriophyidae Nalepa, 1898**

**Subfamily Eriophyinae Nalepa, 1898**

**Tribe Acriini Amrine and Stasny, 1994**

*Aceria lividus* Elhalawany sp. nov. (Figures 1–4)

**Description**

**FEMALE:** (n=15) Body vermiform, 200 (173–213) long without gnathosoma, 52 (50–62) wide, 51 (46–62) thick; whitish in life. **Gnathosoma** 25 (25–28) long, projecting obliquely downwards, basal setae *ep 3* (2–3), antapical setae *d 6* (5–6), ciliereca 17 (16–18) long. **Prodorsal shield** 34 (33–35) long with short frontal lobe acuminate, 45 (42–50) wide; semicircular; prodorsal shield ornamentation with median line complete, broken basal one–third; admedian lines complete, gently diverging to rear, first submedian line from side of admedian at anterior edge ending at 1/2; lateral line from anterior end of submedian soon becoming granular; numerous granules and short dashes in area between median and admedian lines, and lateral sides of prodorsal shield. Scapular tubercles on rear shield margin, 30 (26–30) apart, setae *sc 26* (24–27), projecting posteriorly. **Coxigenital area** with granules, with 5 (5–6) annuli between coxae and genitalia, prosternal apodeme present 6 (5–7); anterolateral setae on coxisternum.


Opisthosoma With 52–56 dorsal annuli, with elliptical microtubercles situated on rear margin of each semiannulus, 46–50 ventral annuli with minute round microtubercles, situated on rear margin of each semiannulus; elongated on the posterior annuli. Setae c2 21–23, 40–42 apart, on 8–9 ventral semiannulus; setae d 30–35, 28–30 apart, on 18–19 ventral semiannulus; setae e 12–14, 17–18 apart, on 27–28 ventral semiannulus; setae f 20–23, 19–20 apart, on 6th semiannulus from rear. Setae h1 2–3; h2 30–44.


Coxisternal plates With granules setae Ib 5–6, 9–10 apart; Ia 11–13, 7–8 apart; 2a 17–20, 19–21 apart. Setae 3a 4–5, 6–7 apart. Leg I 23–25; femur 5–6, bv 5–6; genu 3–4, l” 13–15; tibia 3–4, seta l’ 3–4; tarsus 5–6, ft’ 9–10, ft” 14–15; ω 5–6; em 3–4, simple, 4–rayed. Leg II 18–20; femur 5–6, bv 5–6; genu 3, l” 5–7; tibia 3–3.5; tarsus 4–5, ft’ 4–5, fr” 14–17; ω 5–6; em 3–4, 4–rayed. Opisthosoma With subequal annuli, 30–36 annuli, with minute round microtubercles situated on rear margin of each semiannulus. Seta c2 17–20, 35–37 apart, on 9 ventral semiannulus; setae d 19–23, 19–20 apart, on 14 ventral semiannulus; setae e 7–8, 12–13 apart, on 20 ventral semiannulus; setae f 16–17, 14–15 apart, on 6th semiannulus from rear; h1 1–2; h2 17–22.
Fig. (1): Line drawings of *Aceria lividus* sp. nov.: AD—prodorsal shield of female; CGF—female coxigenital region; GM—male genitalia; IG—internal female genitalia; em—empodium; L1—Leg I; AL—anterio–lateral view of mite; Lo—lateral view of annuli; PM—posterior lateral view of mite. Scale bars: 10µm for AD, CGF, GM, IG, AL, PM; 5µm for L1; 2.5µm for em.

Fig. (2): Line drawings of *Aceria lividus* sp. nov.: DN—dorsal view of nymph; VN—ventral view of nymph; LML—lateral view of larva. Scale bars: 10µm.

Fig. (3): Phase microphotograph of *Aceria lividus* sp. nov.: A—female coxigenital region; B—internal female genitalia; C—prodorsal shield of female; D—Leg I; E—male genitalia.

Fig. (4): Plant damage caused by eriophyoid mite *Aceria lividus* sp. nov.

Relation to the host plant. Vagrant on buds and flowers causes stunted, deformed (Figure 4).


Type material. Holotype, single female on a microscope slide (slide no. EGPERio62.1), deposited in Fruit Trees Mites Dept., Collection, Plant Protection Research Institute (PPRI), Dokki, Egypt. Paratypes: 25 females and 10 males 6 nymph paratypes and 5 larva paratypes on 10 separate microscope slides deposited in Fruit Trees Mites Dept., Collection, Plant Protection Research Institute (PPRI), Dokki, Egypt. Two slides in Plant Protection Research Institute collection. Two paratype slides are deposited at Plant Protection Research Institute collection. Two paratype slide mounts are also deposited in the Department of Soil, Plant and Food Sciences (Di.S.S.P.A.), section of Entomology and Zoology, University of Bari Aldo Moro, Bari, Italy.

Etymology. The species name is based on the host plant species name *lividus*.

Differential diagnosis. The new species herein described was compared with all *Aceria* species found on Amaranthaceae plants and no similarities among any of them were observed. *Aceria lividus* sp. nov. is slightly related to *Aceria amaranthi* Abou–Awad & El–Banawy, 1992 collected from numerous galls on both leaf surfaces, causing malformation of the leaves of *Amaranthus* sp. from Tanzania and *Aceria vanensis* Denizhan & Kiedrowicz, 2016 vagrant on leaves of *Amaranthus retroflexus* L. in Turkey. The new species distinguished from *A. amaranthi* by the length of setae c2, d, and f, shape of dorsal microtubercles, tarsal emподium and ornamentation of prodorsal shield. Females of the newly described species have granules and short dashes in area between median and submedian lines, and lateral sides of prodorsal shield, with elliptical microtubercles on dorsal annulli, tarsal emподium 6–rayed, longest length of c2, d, and f (27–27, 5–60 and 24–0, respectively). In the female of *A. amaranthi* without granules on prodorsal shield, with rounded microtubercles, tarsal emподium 5–rayed, shortest length of c2, d, and f (11, 37 and 16, respectively).

Also, the new species differs from *A. vanensis* by prodorsal shield design, length of e and 3a setae, shape of dorsal microtubercles and number of longitudinal ridges on genitalia, and coxae ornamentation. Prodorsal shield without median line and submedian lines; admedian lines with short lines and without granules in *A. vanensis* (versus median, admedian lines complete and short submedian lines and shield with granules and short dashes in the new species); longer e setae 45–55µ and 3a 21–25 long in *A. vanensis* (versus 9–12 and 15–18 in the new species); with rounded microtubercles dorsally in the new species(versus elliptical in the new species); genital cover flap smooth in *A. vanensis* (versus 12–14 longitudinal ridges in new species), and coxae sooth in *A. vanensis versus* with granules and short lines in the new species.

*Aceria malherbae* Nuzzaci, 1985. First record (Figs 5–8).

*Aceria malherbae* Nuzzaci, 1985: 81–89.

*Aceria malherbae*; Creamer 1993: 53–95.


*Aceria malherbae*; Baker et al., 1996: 114.

*Aceria malherbae*; Xue et al., 2013: 45–47.

Redescription

FEMALE: (n=15) Body vermiform, 200 (180–245) long without gnathosoma, 64 (60–69) wide, 64 (63–67) thick; whitish in life. Gnathosoma 25 (24–30) long, projecting obliquely downwards, basal setae ep 3 (2–3), antapical setae d 6 (6–7), chelicerae 17 (15–18) long. Prodorsal shield 44 (41–46) long with short frontal lobe acuminate, 52 (51–53) wide; semicircular; anterior shield lobe somewhat acuminate; median line indistinct on rear of prodorsal shield forming V-shaped marks, admedian lines incomplete and present only on the posterior half to two third of the prodorsal shield, submedian line i faint present on basal 1/2, curved inwards laterally to reach up to the middle of the prodorsal shield; submedian line II present on the posterior 2/3 on lateral side. Scapular tubercles on rear shield margin, 31 (30–34) apart, setae sc 25 (21–29), projecting posteriorly. Coxigenital area with granules, with 4 annulli between coxae and genitalia, prosternal apodeme present forked; setae lb 8 (7–9), 14 (13–14) apart; setae la 25 (24–27), 10 (9–12) apart; setae 2a 32 (29–40), 28 (28–33) apart. Leg I 35 (31–35), femur 10 (9–10), setae bv 10 (10–12); genua 5 (5–6), setae l’ 25 (24–27); tibiae 8 (8–9), setae l’ 8 (6–8), setae located 1/4 from dorsal base; tarsi 7 (6–7); empodia em simple 5 (4–5), 6–rayed, tarsi solenidia o slightly tapered, 8 (7–8), setae fl’ 17 (17–18), setae fl” 21 (21–24), setae u’ 2–3. Leg II 32 (31–33), femur 9 (8–10), setae bv 11 (10–12); genua 5 (4–5), setae l” 10 (10–12);
Fig. (5): Line drawings of *Aceria malherbae* Nuzzaci, 1985: D– Dorsal view of female; CGF– female coxigenital region; GM– male genitalia; IG– internal female genitalia; em– empodium; L1– Leg I; LM– lateral view of mite. Scale bars: 10µm for D, CGF, GM, IG, LM; 5µm for L1; 2.5µm for em.

Fig. (6): Line drawings of *Aceria malherbae* Nuzzaci, 1985: DN– dorsal view of nymph; VN– ventral view of nymph; DL– dorsal view of larva; VL– ventral view of larva. Scale bars: 10µm.

Fig. (7): Phase microphotograph of *Aceria malherbae* Nuzzaci, 1985: A– male coxigenital region; B– empodium; C– internal female genitalia; D– female coxigenital region; E– prodorsal shield of female.

Fig. (8): Plant damage caused by the eriophyoid mite *Aceria malherbae* Nuzzaci, 1985.
tibiae 7 (6–7); tarsi 7 (6–7); tarsal em simple 5 (4–5), 6-rayed, ω slightly tapered 8 (7–9), setae ft’ 8 (7–10), setae ft” 21 (20–24), tarsal setae u’ 2–3. **Opisthosa** with 46 (45–48) dorsal semiannuli, with small round microtubercles on posterior annular margins, ventrally with 61 (60–63) semiannuli with round microtubercles on rear annular margins, the last 6th ventral microtubercles liner. Lateral setae c2 35 (31–38), 63 (61–63) apart, on annulus 10 (9–10) from coxae II; setae d 55 (53–56), 53 (50–53) apart, on annulus 20 (19–20); setae e 12 (11–15), 28 (28–29) apart, on annulus 34 (33–35); setae f 25 (24–26), 29 (29–30) apart, on 6th annulus from rear. Setae h2 65 (64–67); setae hl 3 (3–4). **External genitalia** 18 (18–20), 28 (23–28) wide, coverflap with 12–14 longitudinal ridges, setae 3a, 23 (22–25), 24 (24–25) apart.


**Nymph** (n=6). Body vermiform, 177–217; width 47–58. **Gnathosoma** 15–18, curved downward, setae d 4–5, ep 2–3, chelicerae 14–16. **Prodorsal shield** semicircular, 38–42 long, 44–46 wide; median line indistinct on rear of prodorsal shield forming V-shaped marks, admedian lines incomplete and present only on the posterior half to two third of the prodorsal shield, submedian lines absent. Tubercles sc on rear shield margin, 28–30 apart; sc 22–24. **Coxisternal plates** With faint granules, 1b 5–6, 11–12 apart; 1a 11–13, 8–9 apart; 2a 21–23, 25–26 apart; 3a 6–7, 9–11 apart. **Leg I** 25–27; femur 7–8, bv 8–10; genu 4–5, l” 12–15; tibia 5–6, l’ 4–5; tarsus 4–5, ft’ 11–15, ft” 15–20, setae u’ 2; solenidion ω 5–6; em 4, simple, 5-rayed. **Leg II** 23–26; femur 6–8, bv 8–10; genu 3–4, l” 5–8; tibia 4–5; tarsus 4–5, ft’ 7–8, ft” 15–20, setae u’ 2; ω 5–6; em 4–5, simple, 5-rayed. **Opisthosa** With 47–49 dorsal semiannuli, with minute round microtubercles situated on rear margin of each semiannulus, 40–43 ventral annuli with minute round microtubercles, situated on rear margin of each semiannulus; elongated on the posterior annuli. Setae c2 18–20, 52–54 apart, on 8–9 ventral semiannulus; setae d 30–33, 45–47 apart, on 17–18 ventral semiannulus; setae e 9–10, 26–27 apart, on 26–27 ventral semiannulus; setae f 20–22, 20–22 apart, on 5th semiannulus from rear. Setae hl 2–3; h2 25–28.


**Host plant from Egypt:** **Convolvulus arvensis** L. (Convolvulaceae).

**Relation to host:** Leaf folding, deformation of flowers and plants; the mites prevent plant reproduction; they cause bud swelling and injury.

**Material examined.** Fifty females, 15 males, 6 nymphs and 7 larvae on a microscope slide (slide no. EGPERio122.1–122.20), Kaha, Qalyubia governorate, Egypt, 30°17’21.42” N, 31°12’45.82” E, 15 October 2015 and 15 September 2018 coll. Ashraf S. Elhalawany deposited in Fruit Trees Mites Dept.,
Collection, Plant Protection Research Institute (PPRI), Dokki, Egypt. Two slides in Plant Protection Research Institute collection. Two paratype slides are deposited at Plant Protection Research Institute collection.

**Distribution:** Canada; Greece; France; Iran; Italy; Mexico; South Africa; Spain; USA, Iran (de Lillo & Amrine, personal communication).

**Remarks:** This is the first record of occurrence of females, males and immature stages of *A. malherbae* in Egypt. The holotype of female was described by Nuzzaci *et al.* 1985 from Italy; short description of the male and immature stages not found. Comparing the morphological characters of *A. malherbae*, as well as the original description given by Nuzzaci (1985), we did not find any regular differences between them. Morphology is similar, except for the length of the following characters: gnathosoma, body length, length and width of prodorsal shield, lengths of setae *c2* and *d*, and the number of genital coverflap. These setae are slightly shorter in mites from Italy than in mites from Egypt. Genital coverflap with 10 longitudinal striae from Italy (versus with 12-14 from Egypt).

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