# A new species and new record of eriophyoid mites (Trombidiformes: Eriophyoidea) from mango in Egypt with a note on the population dynamics of four eriophyoid species

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## ABSTRACT

During surveys of eriophyoid mites on *Mangifera indica* L. (Anacardiaceae) in Egypt, a new species, *Aceria aegyptindicae* **sp. nov.**, was collected and is here described and illustrated. This species was found in colonies as an inquiline, under waxy coatings on both leaf surfaces, usually along the midribs, in association with *Cisaberoptus kenyae* Keifer, 1966. *Neocalacarus mangiferae* ChannaBasavanna, 1966 is recorded for the first time from Egypt and a supplementary morphological description and illustrations are given. All stages of *C. kenyae* are re-described, and information about other eriophyoid mites collected from mango orchards is provided. The population fluctuation of the four eriophyid mites: *C. kenyae, A. aegyptindicae* **sp. nov.**, *N. mangiferae* and *Vareeboona mangiferae* (Keifer, 1946) was studied during the 2020 season in the Egyptian Governorate, Qalyubia on mango orchards "Alphonso" cultivar. Populations of *C. kenyae* and *A. aegyptindicae* had three peaks in January, May and November. On the other hand, *N. mangiferae* had two peaks, in February and August, and *V. mangiferae* had two peaks in February and November.
**Keywords**: Aceriini, systematics, taxonomy, *Cisaberoptus, Neocalacarus, Mangifera indica*, ecology.

## INTRODUCTION

Mango (*Mangifera indica* L., Anacardiaceae) is one of the most important tropical and subtropical fruits worldwide. The earliest known record of the cultivation of mangoes can be traced to India up to 2000 BCE (Sauer 1993). Portuguese explorers transported it to Africa and Brazil. It was introduced to the Americas in the 18th Century, and from western Mexico it was brought to Hawaii in the early 19th Century. Mango was introduced to Egypt in the 18th Century from Ceylon by the Egyptian leader Ahmed Orabi upon his release from internment (Ibrahim and Khalef 1999).

Presently, 14 eriophyoid species have been described from mango worldwide (Table 1). In Egypt, five of these species have been recorded namely: *Aceria mangiferae* Sayed, 1946; *Cisaberoptus kenyae* Keifer, 1966; *Metaculus mangiferae* (Attiah, 1955); *Spinacus pagonis* Keifer, 1979 (=*Vasates aegyptiacus* Abou-Awad, 1979) and *Vareeboona mangiferae* (Keifer, 1946) (Zaher 1984; Abou-Awad 1981a,b; El-Halawany 2003; Elhalawany et al. 2014, 2015, 2018; Elhalawany and Ueckermann 2015, 2018; Chandrapatya et al. 2017).

Here is a list of species reported to occur on *Mangifera indica*: 1) *Aceria mangiferae* (Hassan, 1944), incomplete description. 2) *Diptilomiopus alagarmalaiensis* Mohanasundaram, 1986, host is *Spondias mangifera* Willd., now *Spondias pinnata*; does not occur on mango. 3) *Diptilomiopus mangiferae* Sarkar, 2011, junior homonym. 4) *Diptilomiopus pamithus* (Boczek & Chandrapatya, 1989), now *D. panithus* (emendation). 4) *Eriophyes mangiferae* Kuang & Cheng, 1992; the description was based on only four females on one date; host is not proven, the mites were probably accidental. Need to find the correct host and redescribe the mite. 5) *Kropczynella mangiferae* Boczek, 1997 [belongs in *Quadriporca*]. 6) *Metaculus mangiferae* (Chandrapatya, 1991) junior homonym. 7) *Phyllocoptes laniger* Nalepa, 1899; it is similar to *Spinacus pagonis* K., but the tibial seta is prominent, absent in pagonis; we regard it as insertae sedis. 8) *Quadriporca mangiferae*

(Boczek, 1997), junior homonym. 9) *Quadriporca samphran* Xue & Zhang, 2009, junior homonym.

Many researchers studied population fluctuation of mites inhabiting mango orchards in Egypt (Abdallah 2001, 2007; El-Halawany 2003; Al-Azzazy 2005).

The current study presents the morphological description of a new eriophyoid species, *Aceria aegyptindicae* **sp. nov.** infesting *M. indica* as well as complementary descriptions of female, male and immature stages of *C. kenyae* Keifer and the first record of *Neocalacarus mangiferae* ChannaBasavanna, 1966 in Egypt. Also, information on other eriophyoid mites collected from mango orchards in Egypt is provided. In addition, the population fluctuation of four eriophyid mites: *C. kenyae*, *A. aegyptindicae* **sp. nov.**, *N. mangiferae* and *V. mangiferae* during the 2020 season are reported.

With this study, the total number of Eriophyoidea of Egypt increases to 103 species; among them, 40 species belonging to the genus *Aceria*.

## MATERIALS AND METHODS

Samples were collected from *M. indica* for study of species diversity, presence and taxonomic description in three different Governorates (Qalyubia, Giza and Fayoum) in Egypt during the years 2015 to 2021. Eriophyoid specimens were collected from mango orchards (including leaves, stems, buds and flowers) by direct examination under a stereo-microscope. Specimens were cleared in Keifer's solution at room temperature and mounted on glass-microscope slides in Keifer's F-medium (Amrine and Manson 1996). A phase contrast microscope (BX46, Olympus) was used to examine the specimens. Line drawings were hand-drawn with a drawing tube attached to the phase contrast microscope according to de Lillo et al. (2010). Adobe illustrator® CS6 was used to edit all the illustrations. Identification to genus level was carried out using a key to the world genera of the Eriophyoidea (Amrine et al. 2003). Morphological terminology is based on Lindquist (1996) and measurements follow that of Amrine and Manson (1996) and de Lillo et al. (2010). All measurements were made using the software computer program compuEye (Bakr 2005) and are given in micrometers (μm). The measurements of the holotype are followed by the range of paratypes in parentheses. The measurements of males and immature stages are given in range only. For Scanning Electron Microscope (SEM) images, mites were collected from a laboratory culture under a dissecting microscope using a fine brush (00). About 50 individual specimens were placed on aluminum stubs for examination under a low vacuum SEM (JEOL/EO-JSM-5200). Live specimens were mounted on the specimen stubs using double-sided sticky tape then sputter-coated with gold-palladium. Scanning Electron Microscopy was performed at the Applied Centre of Entomonematodes, the Faculty of Agriculture Cairo University, Egypt. They were transferred to the low vacuum chamber of the Electron Microscope, then examined and imaged.

Ten mango orchards of 20-year-old, "Alphonso" cultivar were selected at Qalyubia Governorate for eriophyoid population studies during the 2020 season. Samples of 40 leaves and ten lateral and terminal buds were chosen randomly and collected fortnightly. Collected leaves and buds were examined for estimating mite populations.

Type materials are deposited at the mite reference collection of the Fruit Trees Mites Department, Plant Protection Research Institute, Agricultural Research Centre, Dokki, Giza Governorate, Egypt (ARC-PPRI). Also, some paratypes are deposited at 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; at Agriculture Research Council, Plant Health Protection, Biosystematics Division, Pretoria, South Africa (ARC-PHP); at the College of Agriculture and Forestry, West Virginia University, USA (WVU) and the mite reference collection of the Dipartimento di Scienze del Suolo, della Pianta e degli Alimenti (Di.S.S.P.A.), and Università degli Studi di Bari Aldo Moro, Bari, Italy (UNIBA) (Zhang 2018). All mite specimens were collected by the senior author of this work.

**Statistical analysis**

Simple correlation was calculated to determine the relationship between prevailing temperature, relative humidity and population dynamics of eriophyid mites. Correlation analysis was conducted using the SAS program (Anonymous 2003).

**Table 1.** Eriophyoid mite species collected from mango orchards worldwide and their type locality and habitus.

| Subfamily | Species | Type locality | Habitus | References |
|---|---|---|---|---|
| Aberoptinae | *Aberoptus samoae* Keifer, 1951 | Samoa | Leaf vagrant | Keifer 1951 |
| | *Cisaberoptus kenyae* Keifer, 1966 | Kenya | Leaf miner under waxy coatings | Hassan and Keifer 1978 |
| Eriophyinae, Aceriini | *Aceria aegyptindicae* Elhalawany, Amrine & Ueckermann **sp. nov.** | Egypt | Inquiline, under waxy coatings on both leaf surfaces | This study |
| | *Aceria mangiferae* Sayed, 1946 | Egypt | Causing big bud and mango malformation | Sayed 1946 |
| | *Keiferophyes guamensis* Mohanasundaram & Muniappan, 1988 | Guam. | Mango bud bracts and damage to vegetative and flower buds | Mohanasundaram and Muniappan, 1988 |
| Phyllocoptinae, Tegonotini | *Spinacus pagonis* Keifer, 1979 | Samoa | Leaf vagrant | Keifer 1979 |
| | *Vareeboona mangiferae* (Keifer, 1946) | USA | Rust | Keifer 1946 |
| Phyllocoptinae, Phyllocoptini | *Mangophyes siami* Chandrapatya & Boczek, 2001 | Thailand | Leaf vagrant | Chandrapatya and Boczek 2001 |
| | *Metaculus mangiferae* (Attiah, 1955) | Egypt | Bud and inflorescence deformation; rust and leaf drop | Attiah 1955 |
| Phyllocoptinae, Anthocoptini | *Neocalacarus mangiferae* ChannaBasavanna, 1966 | India | Vagrant on tender stems, buds and leaves | ChannaBasavanna 1966 |
| Diptilomiopinae | *Diptilomiopus mohanasundarami* Chakrabarti, Sur & Sarkar, 2019 | India | Leaf vagrant | Chakrabarti et al. 2019 |
| | *Diptilomiopus panithus* (Boczek & Chandrapatya, 1989) | Thailand | Leaf vagrant | Boczek and Chandrapatya 1989 |
| Rhyncaphytoptinae | *Quadriporca indicae* Boczek, in Chandrapatya and Boczek 2002 | Thailand | Leaf vagrant | Chandrapatya and Boczek 2002 |
| | *Quadriporca mangiferae* Kuang & Cheng, 1991 | China | Leaf vagrant | Kuang et al. 1991 |

## RESULTS AND DISCUSSION

### Taxonomy

### Family Eriophyidae Nalepa, 1898

### Subfamily Eriophyinae Nalepa, 1898

### Tribe Aceriini Amrine and Stasny, 1994

### *Aceria aegyptindicae* Elhalawany, Amrine & Ueckermann sp. nov. (Figures 1–4).

***Description***

**Diagnosis.** Body spindle form narrowed posteriorly, truncated anteriorly; prodorsal shield ornamented with faint lines, median line short, present at 1/4 from rear, admedian lines present at 2/3 from rear; sub-median lines sinuate, starting from rear of prodorsal shield and forked anteriorly forming a Y-shape; short longitudinal lines present laterally to tubercles of setae *sc*. Scapular setae *sc* projecting divergent posteriorly. Legs with all usual segments and setae present; tarsal empodium simple, 7-rayed. Opisthosoma with all usual setae and genital coverflap with longitudinal ridges broken into two ranks**.**

***Female*** (n = 10) **(Figures 1–2)**.

Body spindle-form, narrowed posteriorly, 174 (165–184) long including gnathosoma, 50 (48–54) wide and 48 (46–51) thick; white. **Gnathosoma** 25 (22–26), projecting obliquely down, pedipalp coxal setae *ep* 3 (2–3), dorsal pedipalp genual setae *d* 5 (4–5), unbranched, cheliceral stylets 24 (22–25).

**Prodorsal shield** 30 (27–31) long, and 35 (32–40) wide; emarginated anteriorly; with triangular frontal lobe, prodorsal shield ornamented with faint lines, median line short present at 1/4 from rear, admedian lines present at 2/3 from rear; sub-median lines, sinuate, started from rear of prodorsal shield and forked anteriorly forming a Y-shape; short longitudinal lines present laterally to tubercles of setae *sc*. Scapular tubercles on rear shield margin, 26 (25–28) apart, scapular setae *sc* 15 (14–20), projecting divergent posteriorly, extending over 6–7 dorsal annuli. **Coxigenital region.** With three annuli between coxae and genital coverflap. Coxae smooth, prosternal apodeme absent, anterolateral setae on coxisternum I *1b* 5 (4–5), 10 (9–10) apart; proximal setae on coxisternum I *1a* 8 (7–8), 11 (10–12) apart; proximal setae on coxisternum II *2a* 17 (17–19), 25 (23–25) apart. **Legs.** Have all the expected segments and setae. Leg I, 25 (24–26); femur 8 (7–8), basiventral femoral setae *bv* 5 (5–6); genu 3 (3–3.5), antaxial genual setae *l″* 16 (14–17); tibia 4 (4–5), paraxial tibial setae *l′* 5 (4–5), located in middle of tibia; tarsus 5 (5–6), paraxial, fastigial, tarsal setae *ft′* 8 (7–9), antaxial, fastigial, tarsal setae *ft″* 10 (10–12), setae *u′* 2 (2–3); tarsal empodium simple *em* 5 (5–6), 7-rayed, tarsal solenidion *ω* 7 (6–7), distally knobbed. Leg II, 22 (21–23), femur 7 (7–8), *bv* 5 (4–6); genu 3 (3–4), *l″* 9 (8–10); tibia 4 (4–5), tarsus 5 (5–6), *ft′* 7 (7–9), *ft″* 12 (10–12), *u′* 2 (2–3); *em* 5 (5–6), 7-rayed, *ω* 8 (7–8), distally knobbed. **Opisthosoma.** With 55 (52–57) dorsal annuli and 60 (56–62) ventral annuli. Dorsal annuli with elongate microtubercles set on rear margin, ten caudal dorsal annuli without microtubercles and on last five dorsal annuli, before setae *h2*, the dorsal microtubercles are pointed; ventral annuli with oval-elongate microtubercles; the last 5–6 ventral annuli with elongated and linear microtubercles; in lateral view annuli from level of *c2* to posterior level of *e* are bare. Setae *c2* 12 (11–13), 45 (44–46) apart, on ventral annulus 8 (8–9); *d* 30 (28–35), 34 (33–35) apart, on ventral annulus 19 (18–20); *e* 26 (24–32), 22 (21–23) apart, on ventral annulus 34 (32–35); *f* 14 (13–15), 16 (15–17) apart, on sixth ventral annulus from rear; *h1* absent, *h2* 29 (25–35). **External genitalia** 15 (14–15) long, and 20 (20–21) wide, genital coverflap with longitudinal ridges in two ranks, anterior rank with 14 (14–16) markings and posterior with 11 (10–13) markings, proximal setae on coxisternum III *3a* 4 (3–5), 12 (12–13) apart.

***Male*** (n = 5) **(Figure 1).**
Smaller than female, body spindle form, 143–155 long, 40–44 wide and 40–43 thick; white in colour. **Gnathosoma** 21–23, *ep* 2–3, *d* 3–4; cheliceral stylets 20–23. **Prodorsal shield** 22–24 long, and 32–36 wide; pattern similar to that of female, scapular tubercles on rear margin, 22–24 apart, scapular setae *sc* 9–12, projecting divergent posteriorly. **Legs.** Leg I 18–21; femur 5–6, *bv* 4–5; genu 3–4, *l″* 15–17; tibia 3–4, *l′* 3–4; tarsus 4–5, setae *ft′* 9–12, *ft″* 10–12, *u′* 2–3; solenidion *ω* 5–6 knobbed; *em* 4–5, simple, 6–7-rayed. Leg II 19–21; femur 5–6, *bv* 4–5; genu 3, *l″* 8–9; tibia 4–4.5; tarsus 4–5, *ft′* 8–10, *ft″* 10–12, *u′* 2–3; *ω* 7–8 knobbed; *em* 4–5, 6-rayed. **Coxisternal plates.** Smooth, *1b* 2–3, 8–9 apart; *1a* 6–7, 9–10 apart; *2a* 10–12, 20–21 apart. **Opisthosoma.** With 45–50 subequal dorsal and ventral annuli, with microtubercles similar to that of female. Setae *c2* 10–11, 39–41 apart, on 7–8$^{th}$ ventral annulus; *d* 20–23, 28–29 apart, on 19–20$^{th}$ ventral annulus; *e* 15–16, 17–19 apart, on 26–29$^{th}$ ventral annulus; *f* 10–11, 15–16 apart, on 43–46$^{th}$ ventral annulus, 6$^{th}$ annulus from rear. Setae *h1* absent, *h2* 28–31. **Male genitalia** 8–10 long, and 16–18 wide, proximal setae on coxisternum III *3a* 2 (2–3), 10 (10–11) apart.

***Nymph*** (n = 5) **(Figure 2).**
Body vermiform 135–145 long including gnathosoma, and 35–42 wide. **Gnathosoma** 24–26, projecting slightly downwards, *d* 3–4, *ep* 1–2; chelicerae 19–21. **Prodorsal shield** 20–23 long, and 27–32 wide; ornamented with five lines, faint, median, admedian and submedian lines present at rear half, transverse curved line ahead of rear margin connected with admedian and submedian lines; *sc* 14–15, directed posterior divergently, reaching 5–6$^{th}$ dorsal annulus, scapular tubercles 20–21 apart. **Legs.** Leg I 16–18; femur 4–5, *bv* 3–4; genu 2–3, *l″* 10–11; tibia 2–3, *l′* 2–3; tarsus 3–4, *ft′* 5–7, *ft″* 11–12, *u′* 1, *ω* 4–5, distally knobbed; empodium 4–5 including portion inside tarsus, 5–6-rayed. Leg II 13–15; femur 3–5, *bv* 2–3; genu 2–3, *l″* 2–4; tibia 2–3; tarsus 3–4, *ft* ′4–5, *ft″* 9–10, *u′* 1, *ω* 5–6, distally knobbed; empodium 4–5 including portion inside tarsus, 5–6-rayed. **Coxisternal region.** Smooth, sternal line absent; *1b* 1–2, 10–12 apart; *1a* 6–7, 8–9 apart; *2a* 10–12, 18–20 apart; *3a* 1–2, 5–6 apart. **Opisthosoma.** With 39–43 annuli, dorsoventrally subequal. Microtubercles elongated and linear on the first 13$^{th}$ to 15$^{th}$ dorsal

annuli behind prodorsal shield and other dorsal annuli smooth, microtubercles pointed on last five dorsal annuli; few rounded microtubercles on the 5–6 ventral annuli, other ventral annuli smooth; microtubercles linear elongated on last six ventral annuli. Setae *c2* 6–7, on annulus 6–7, 27–29 apart; *d* 20–23, on annulus 13–15, 20–23 apart; *e* 10–13, on annulus 22–25, 13–15 apart; *f* 10–12, on annulus 35–39, 10–12 apart; *h1* absent, *h2* 15–20.

***Larva*** (n = 4) **(Figure 2).**
Smaller than nymphs and generally similar to them. Body vermiform 117–137 long including gnathosoma, and 30–40 wide. **Gnathosoma** 24–25, projecting slightly downwards, *d* 3–4; *ep* 1–2; chelicerae 18–20. **Prodorsal shield** 18–21 long, and 23–27 wide; smooth, only transverse curved line ahead of rear margin between scapular tubercles; *sc* 7–10, directed posterior divergently, reaching 5th dorsal annulus, scapular tubercles 20–21 apart. **Legs.** Leg I 14–15 without empodium; femur 3–4, *bv*3–4; genu 2, *l″* 9–10; tibia 2–3, *l′* 2–3; tarsus 3–4, *ft′* 5–7, *ft″* 10–11, *ω* 4–5, distally knobbed; empodium 3–4 including portion inside tarsus, 4-rayed. Leg II 10–14 without empodium; femur 3–4, *bv* 2–3; genu 2–3, *l″* 2–4; tibia 2–3; tarsus 3–4, *ft′* 4–5, *ft″* 9–10, *u′* 1, *ω* 4–5, distally knobbed; empodium 3–4-rayed. **Coxisternal region.** Smooth, sternal line absent; *1b* 1–2, 10–11 apart; *1a* 3–5, 10–11 apart; *2a* 6–8, 18–20 apart; *3a* absent. **Opisthosoma.** With 30–43 annuli dorsoventrally subequal. Microtubercles similar as in nymph; *c2* 6–7, on annulus 6–7, 27–31 apart; *d* 12–15, on annulus 11–13, 21–26 apart; *e* 8–9, on annulus 18–20, 14–17 apart; *f* 6–10, on annulus 5th from rear; *h1* absent, *h2* 13–17.

**Type material.** Holotype female on a slide (slide no. EGYErio109.1) from *M. indica*, Giza Governorate (30°1'5.4"N, 31°12'29.33"E), 1 October 2020. Paratypes: 30 females, ten males, seven nymphs and six larvae on ten slides (slides no. EGPErio109.2–109.11), 10 February 2020, with the same data as for holotype. Five females and two males on two slides (slides no. EGPErio109.12–109.13) with the same data as for holotype; deposited at (ESAM), Egypt. Four females and two males on four slides; deposited at (ARC-PHP), South Africa. Four females and two males with the same data as for holotype; deposited at (WVU), USA.

**Relation to the host plant.** The mites are found in colonies as inquilines, under waxy coatings on both leaf surfaces, usually along the midribs, associated with *Cisaberoptus kenyae* Keifer, 1966 (Figure 4).

**Etymology.** The species name "*aegyptindicae*", is a composition of *egypt* (from Egypt), the country where type specimens were collected and + *indicae*, referring to the specific name of the host plant.

**Differential diagnosis.** The new species herein described shows some similarities with *C. kenyae.* Differences between these two species, other than those related to the fact that they belong to two different genera are: the presence of faint admedian and submedian lines in prodorsal shield (absent in *C. kenyae*), shape of legs and empodium (all segments present and empodium 7-rayed in the new species) versus stout with femur to genu and tibia to tarsus fused and empodium laterally 17-rayed in *C. kenyae plus 2-4 rows of plantar, ray-like hairs*; in lateral view bare annuli from level of *c2* to posterior level of *e* in the new species (versus with completely microtuberclulate laterally in *C. kenyae*).

Up to now, only one species of *Aceria*, *A. mangiferae* Sayed, 1946 was known from *Mangifera indica* L. (Anacardiaceae). The new species is somewhat similar to *A. mangiferae*, by the presence of admedian lines on prodorsal shield, coxae smooth and microtubercles on dorsal annuli, in shape and length of body, spindle-shapeed and shorter length of body 174 (165–184) long in new species (cylindrical shape and longer in *A. mangiferae*, 225–250 long), prodorsal shield design with short median line and many short lines laterally in the new species (median line complete, broken and submedians lines laterally absent in *A. mangiferae*); in shorter setae *c2* 12 (11–13) (longer, 25 in *A. mangiferae*); in number of empodial rays, 7 in new species (6-rays in *A. mangiferae*) and setae *h1* absent in new species (present in *A. mangiferae*). Moreover, *A. mangiferae* causes malformation of buds, but the new species is found in colonies under white leaf coating.

**Remarks.**
*Cisaberoptus kenyae* originally was described from only females from Kenya (Keifer 1966). Subsequently, Hassan and Keifer (1978) described and illustrated what they thought was the protogyne as a typical *Aceria*. Navia and

Flechtmann (2000) described the *C. kenyae* protogyne that is a typical *Aceria*, just like the male, as earlier referred to by Hassan and Keifer (1978). They thought that the deutogyne was the basis for the genus *Cisaberoptus*; Amrine et al. (2003) treated *Cisaberoptus* Keifer, 1966 as a junior synonym of *Aceria* due to the apparent generic assignment based on the deutogyne. We also disagree in using the deutogyne or other alternate form of the female for erecting any new genus. According to the collection data in Taiwan, *C. kenyae* Keifer occurs through the year, while *A. kenyae* Amrine, 1996 was not present through the year. Therefore, if *A. kenyae* is a protogyne type, it should be easier to find than *C. kenyae*. The senior author thinks that since *C. kenyae* and *A. kenyae* coexisted on the same host plant, *M. indica*, in Thailand, *C. kenyae* is not the deutogyne of *A. kenyae*, and *Cisaberoptus* is a valid genus (Huang 2005).

In January 2017, Chandrapatya sent leaves of *M. indica* to Prof. Amrine who found males and females of an *Aceria* species and both sexes of *C. kenyae*. In the Catalog of Thai Eriophyoidea (Chandrapatya et al. 2017), they considered the name, *Aceria kenyae*, to be a junior synonym of *C. kenyae* and *Cisaberoptus* was then restored to valid genus having both males and females. The *Aceria*-like "protogyne" mentioned in Hassan and Keifer (1978), and described in Navia and Flechtmann (2000), appear to be inquilines under the webs of *C. kenyae*, and to be a separate species of *Aceria*, and possibly needs a new name.

***Aceria mangiferae* Sayed, 1946**

***Taxonomic history:***

*Eriophyes mangiferae* Hassan, 1944: 179.

*Aceria mangiferae* Sayed, 1946: 7; Figs. 1–6.

*Aceria mangiferae* Sayed, 1946—Amrine and Stasny 1994: 62.

**Habit.** Shoot and inflorescence malformations, in association with *Fusarium* spp., causing big bud and mango malformations.

**Type host.** *Mangifera indica* L. Anacardiaceae.

**Type locality.** Sharkia Governorate, Egypt.

**Distribution in Egypt.** Sharkia, Qalyubia, Menoufia, Esmailia, Dakhahlia, Giza, Fayoum and Beni-Suef Governorates.

**Geographic distribution.** Angola, Australia, Brazil, Costa Rica, El Salvador, Guatemala, Honduras, India, Iran, Israel, Mexico, Nicaragua, Panama, Puerto Rico, Spain, South Africa, Thailand, USA, Venezuela (Chandrapatya et al. 2017).

**Materials examined.** Ten females, five males and five nymphs on five slides (slides no. EGYErio70.1–70.5) from *M. indica*, Giza Governorate (30°1'5.4"N, 31°12'29.33"E), 1 October 2020. Ten females and two males on two slides (slides no. EGYErio70.6–70.7), 10 February 2018, Qalyubia Governorate (30°10'59.89N, 31°7'39.52"E); deposited at (ARC-PPRI), Egypt. Eight females and three males on two slides (slides no. EGYErio70.8–70.9), Fayoum Governorate (29°20'0.48"N, 31°42'18.23"E), 10 October 2020; deposited at (ESAM), Egypt. Two slides (slides no. EgMI05–06), Qalyubia Governorate (30°10'59.89N, 31°7'39.52"E), 10 February 2018, deposited at (UNIBA), Italy. Two slides, Giza Governorate (30°1'5.4"N, 31°12'29.33"E), 1 October 2020, deposited at (WVU), USA.

**Subfamily Aberoptinae Keifer, 1966**

***Cisaberoptus kenyae* Keifer, 1966 (Figures 5–7).**

***Taxonomlc history:***

*Cisaberoptus kenyae* Keifer, 1966: 2, Fig.1.

*Cisaberoptus kenyae*.—Hassan and Keifer 1978: 185; Keifer and Knorr 1978: 16; Keifer et al. 1982: 156, Fig. 71; Amrine and Stasny 1994: 163; Amrine 1996: 20, Figs 22, 23; Navia and Flechtmann 2000: 19; Chandrapatya et al. 2016: 88.

*Aceria kenyae* (Keifer, 1966).—Amrine et al. 2003: 2; Xue and Zhang 2009: 36; Craemer 2010: 191. Error, based on concept of Hassan & Keifer, 1978.

Note: males of this species were first found by Prof. Philipp E. Chetverikov and Dr. C. Craemer, in March, 2016, in S. Africa; slides shared with J Amrine.

**Supplementary description**

***Female*** (n = 15) **(Figures 5, 7a, b, d, e, f)**.

Body flattened fusiform, 200 (195–212) long including gnathosoma, 55 (54–58) wide and 40 (38–42) thick; light yellow in colour. **Gnathosoma** 30 (28–35), projecting obliquely down, pedipalp tarsus broad and rigid for spreading silk as it makes silk patches on the leaves, palp coxal setae *ep* and *v* small, difficult to see, almost micro-setae, dorsal pedipalp genual setae *d* 4 (4–5) with rounded tubercles at the base, cheliceral stylets 23 (20–24).

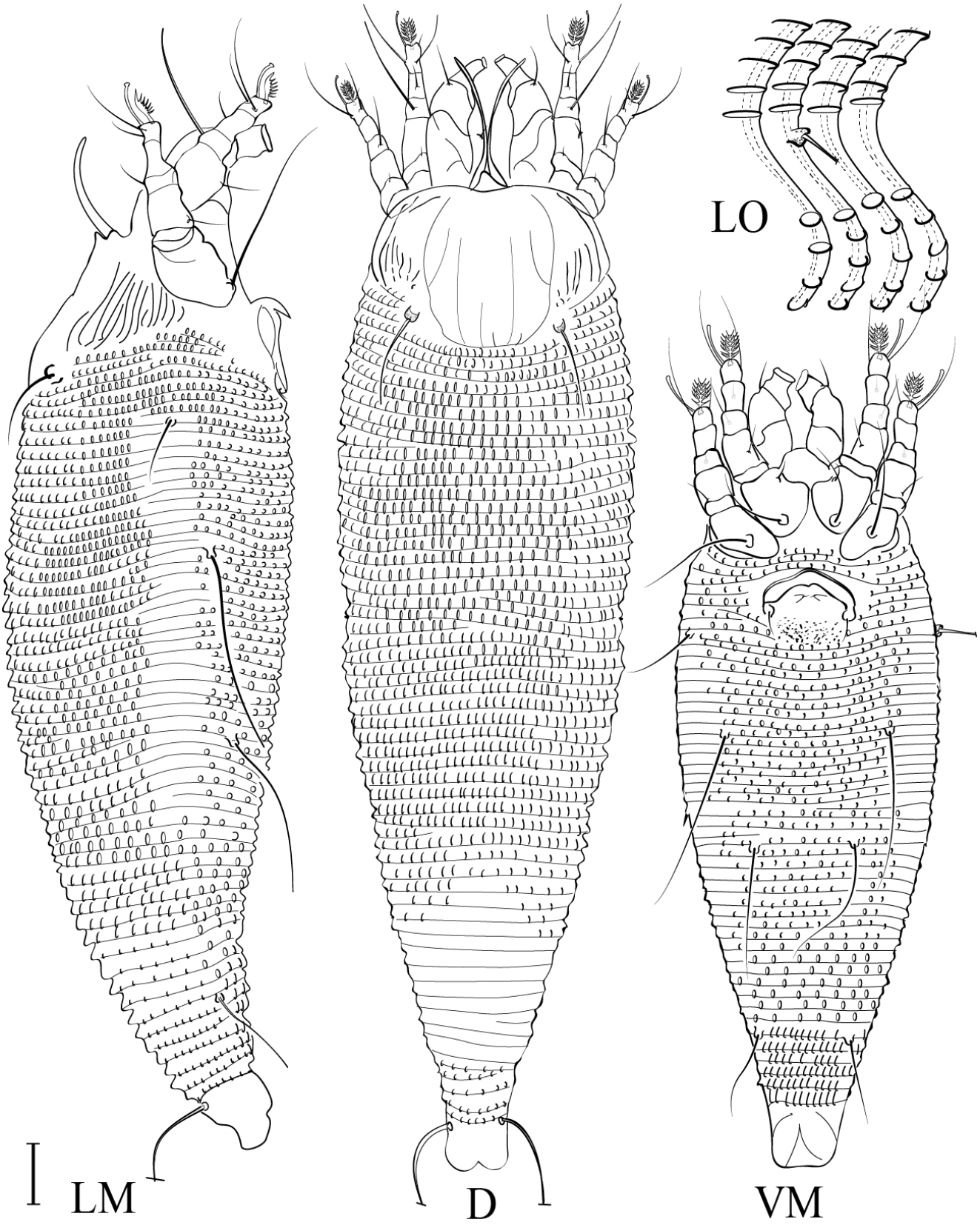


**Figure 1.** Line drawings of *Aceria aegyptindicae* sp. nov.: D. Dorsal view of mite; LO. Lateral view of annuli; LM. Lateral view of mite; VM. ventral view of male. Scale bar: 10 µm.

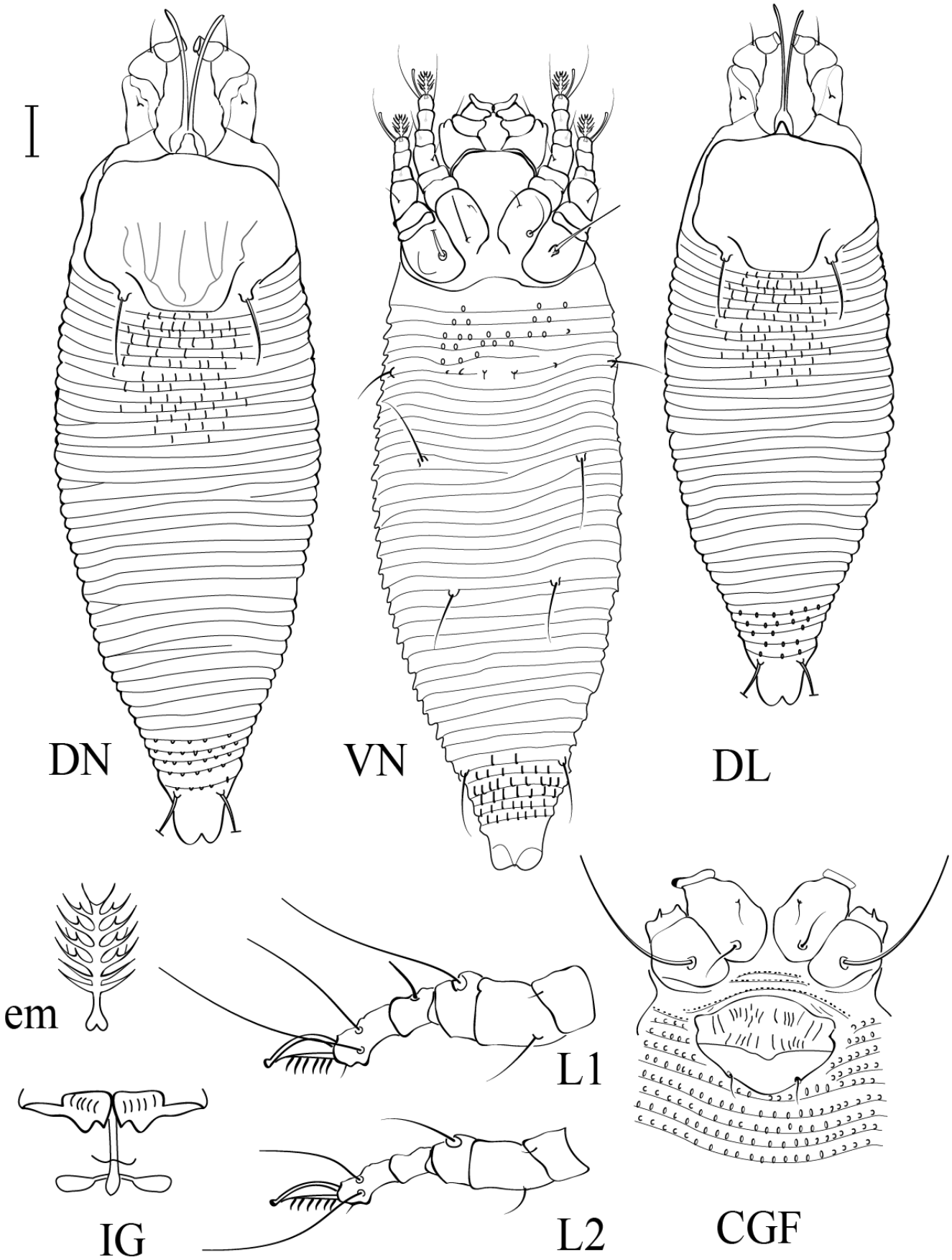


**Figure 2.** Line drawings of *Aceria aegyptindicae* sp. nov.: DN. Dorsal view of nymph; VN. Ventral view of nymph; DL. Dorsal view of larva; CGF. Coxigenital region of female; IG. Internal female genitalia; em. Empodium; L1, Leg I; L2, Leg II. Scale bar: 10 µm for DN, VN, DL, CGF; 5 µm for IG, L1, L2; 2.5 µm for em.

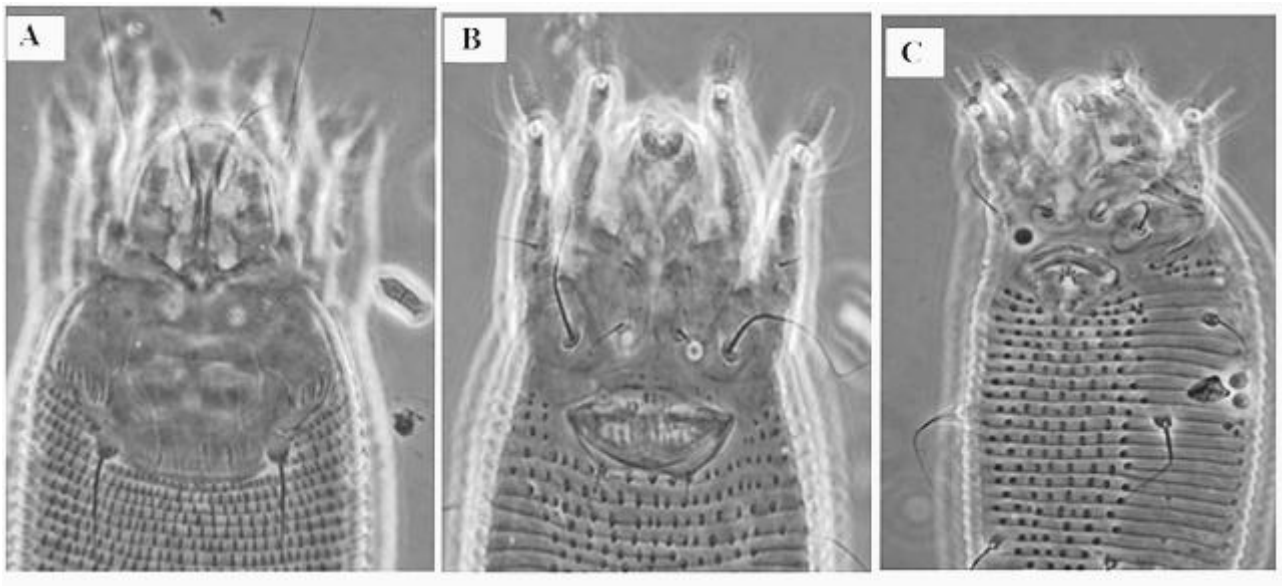


**Figure 3.** Phase microphotographs of *Aceria aegyptindicae* sp. nov.: A. Anterior dorsal view of mite; B. Ventral view of female; C. Ventral view of male.

**Figure 4.** White leaf coatings on the upper leaf surfaces under which both *Aceria aegyptindicae* sp. nov. and *Cisaberoptus kenyae* were found.

**Prodorsal shield** 32 (30–33) long, and 39 (35–45) wide; semi-circular; prodorsal shield without ornamentation, lateral shield with short lines and anterior lobe, apparently with a flexible, bifurcate frontal lobe. Scapular tubercles on rear shield margin, 32 (30–35) apart, scapular setae *sc* 17 (15–18), projecting posteriorly and diverging, extending over five dorsal annuli.

**Coxigenital region.** With three annuli between coxae and genital coverflap. Coxae smooth, broad and divergent, prosternal apodeme absent, *1b* 4 (3–5), 14 (13–14) apart; *1a* 10 (8–11), 14 (14–15) apart; *2a* 25 (23–25), 32 (30–35) apart.

**Legs.** With stout and fused segments and paraxial tibial setae *l′* absent. Leg I, 21 (19–21); femur and genu fused 10 (9–11), *bv* 4 (4–5), *l″* 19 (19–21); tibia and tarsus fused 4 (4–5), *l′* absent, tarsal setae *ft′* 10 (8–11), *ft″* 12 (10–12), tarsal empodium large, complex *em* 10 (9–11), laterally, 17-rayed, plantar surface with 2 to 4 rows of ray-like setae, tarsal *ω* 12 (11–12), distally knobbed. Leg II, 19 (18–20); femur and genu fused 9 (9–10), *bv* 4 (4–5), *l″* 9 (9–10); tibia and tarsus fused 4 (4–5), tarsal setae *ft′* 5 (5–7), *ft″* 12 (10–12), empodium large complex, similar to that of leg I, *em* 10 (9–11), 17-rayed, *ω* 12 (11–12), distally knobbed. **Opisthosoma.** With 47 (45–48) dorsal annuli and 57 (55–58) ventral

annuli. First 12 dorsal annuli with elongate microtubercles set on rear margin, followed by rounded microtubercles and last 13 annuli without microtubercles; ventral annuli with oval-elongate microtubercles; the last seven ventral annuli with linear microtubercles. Setae *c2* 14 (12–16), 53 (50–55) apart, on ventral annulus 7 (7–8); *d* 42 (40–45), 38 (35–39) apart, on ventral annulus 20 (19–21); *e* 28 (25–28), 23 (22–24) apart, on ventral annulus 32 (31–34); *f* 20 (18–21), 20 (20–21) apart, on seventh ventral annulus from rear; *h1* absent, *h2* 35 (30–37). **External genitalia** 15 (14–15) long, and 29 (28–30) wide, genital coverflap with longitudinal ridges broken in two ranks, with 15 (14–16) markings, *3a* 5 (3–5), 14 (13–14) apart.

***Male*** (n = 6) **(Figure 5)**
Smaller than female, body flattened fusiform, 135–145 long, 43–47 wide and 42–45 thick; white in colour. **Gnathosoma** 24–27, *ep* 2–3, *d* 3 3–4; cheliceral stylets 15–16. **Prodorsal shield** 25–26 long, and 37–38 wide; pattern similar to that of female, scapular tubercles on rear margin, 23–25 apart, scapular setae *sc* 10–12, projecting divergent posteriorly. **Legs.** With stout and fused segments. Leg I, 16–17; femur and genu fused 8–9, *bv* 4–5, *l″* 14–16; tibia and tarsus fused 4–5, *l′* absent, tarsal setae *ft′* 13–15, *ft″* 16–18, tarsal empodium large complex *em* 5–6, 9-rayed, tarsal *ω* 8–9, distally knobbed. Leg II, 15–16; femur and genu fused 7–8, *bv* 4–5, *l″* 5–7; tibia and tarsus fused 4–5, tarsal setae *ft′* 5–7, *ft″* 15–18, *em* 5–6, 8–9-rayed, tarsal *ω* 8–9, distally knobbed. **Coxisternal plates.** Smooth, *1b* 2–3, 11–12 apart; *1a* 9–10, 10–11 apart; *2a* 14–16, 24–26 apart. **Opisthosoma.** With 37–39 dorsal annuli and 45–47 ventral annuli, with microtubercles similar to that of female. Setae *c2* 10–11, 42–44 apart, on ventral annulus 7; *d* 20–23, 30–31 apart, on ventral annulus 15; *e* 14–15, 16–17 apart, on ventral annulus 25; *f* 16–17, 16–17 apart, on 5$^{th}$ annulus from rear. Setae *h1* absent, *h2* 25–28. **Male genitalia.** With granules 8–9, 14–15 wide, *3a* 5–6, 8–9 apart.

***Nymph*** (n = 4) **(Figure 6).**
Body vermiform 120–135 long excluding gnathosoma, and 54–60 wide. **Gnathosoma** 22–24, projecting slightly downwards, *d* 3–4; *ep* 1–2; chelicerae 20–22. **Prodorsal shield** 25–26 long, and 42–47 wide; median line absent, admedian and submedian lines present at rear 2/3, forming a U-shape, each admedian and submedian line connected by transverse curved line ahead of rear margin; *sc* 10–13, directed posterior divergently, reaching 4$^{th}$ dorsal annulus, scapular tubercles 24–26 apart. **Legs.** Leg I 13–14 without empodium; femur and genu fused 6–7; tibia and tarsus fused 4–5, *ω* 6–7, knobbed; empodium 5–6, 8-rayed. Leg II 12–13. **Coxisternal region.** Smooth; *1b* 1–2, 12–14 apart; *1a* 6–7, 8–9 apart; *2a* 10–12, 22–25 apart; *3a* absent. **Opisthosoma.** With 39–42 dorsal annuli and 46–60 ventral annuli. Microtubercles elongated on the first 5–6$^{th}$ dorsal annulus behind prodorsal shield and other dorsal annuli smooth, microtubercles pointed on last five dorsal annuli; few, rounded microtubercles on ventral annuli and smooth on the last 12 annuli. Setae *c2* 5–6, on annulus 6, 53–55 apart; *d* 9–10, on annulus 18, 36–37 apart; *e* 6–7, on annulus 27–28, 22–23 apart; *f* 12–13, on 6$^{th}$ from rear, 19–20 apart; *h1* absent, *h2* 18–22.

***Larva*** (n = 3) **(Figure 6).**
Smaller than nymph and generally similar to it. Body vermiform 100–108 long, and 42–45 wide. **Gnathosoma** 22–25; chelicerae 20–21. **Prodorsal shield** 21–24 long, and 37–39 wide; smooth, only transverse curved line ahead of rear margin between scapular tubercles; tubercles of *sc* setae 21–23 apart, *sc* 6–7, directed backward. **Coxisternal region.** Smooth, sternal line absent; *1b* 1–2, 10–11 apart; *1a* 5–6, 8–9 apart; *2a* 9–10, 19–20 apart; *3a* absent. **Opisthosoma.** With 37–39 dorsal annuli and 40–43 ventral annuli. Dorsal microtubercles similar as in nymph, while venter with only a few. Setae *c2* 3–4, on annulus 5, 40 apart; *d* 7–8, on annulus 14, 31–32 apart; *e* 3–4, on annulus 20–21, 18–20 apart; *f* 10–12, on annulus 5$^{th}$ from rear; *h2* 14.

**Type host.** *Mangifera indica* L., Anacardiaceae.
**Relation to the host plant**. The mites are found in colonies, under waxy coatings formed by the mites, usually along the midribs, sometimes associated with *Aceria aegyptindicae* **sp. nov.** (Figure 4). The white coating consists of irregular strands of webbing and agrees with findings of (Hassan and Keifer 1978).

**Type Locality.** Kitambala, Kenya.
**Geographic distribution.** Australia; Brazil (Brasilia, Piaui, Rio Grande do Norte, São Paulo); China (Taiwan); Costa Rica; Egypt; India; Kenya; South Africa (Craemer, 2010);

Sudan; Thailand (Bangkok); USA (Florida, Hawaii) (Chandrapatya et al. 2017).

**Materials examined.** Twenty females, 15 males, seven nymphs and five larvae on ten slides (slides no. EGYErio71.1–71.11) from *M. indica*, Giza Governorate (30°1'5.4"N, 31°12'29.33"E), 1 October 2020. Five females and two males on two slides (slides no. EGYErio71.12–71.13), 10 February 2021, Qalyubia Governorate (30°10'59.89N, 31°7'39.52"E); deposited at (ARC-PPRI), Egypt. Four females and two males on two slides (slides no. EGYErio71.14–71.15), Giza Governorate (30°1'5.4"N, 31°12'29.33"E), 1 October 2020; deposited at (ESAM), Egypt. Two females and one male on two slides, Giza Governorate (30°1'5.4"N, 31°12'29.33"E), 1 October 2020; deposited at (ARC-PHP), South Africa. Two slides, Qalyubia Governorate (30°10'59.89N, 31°7'39.52"E), 10 February 2021; slides of males and females from S. Africa by Chetverikov and Craemer. deposited at (WVU), USA.

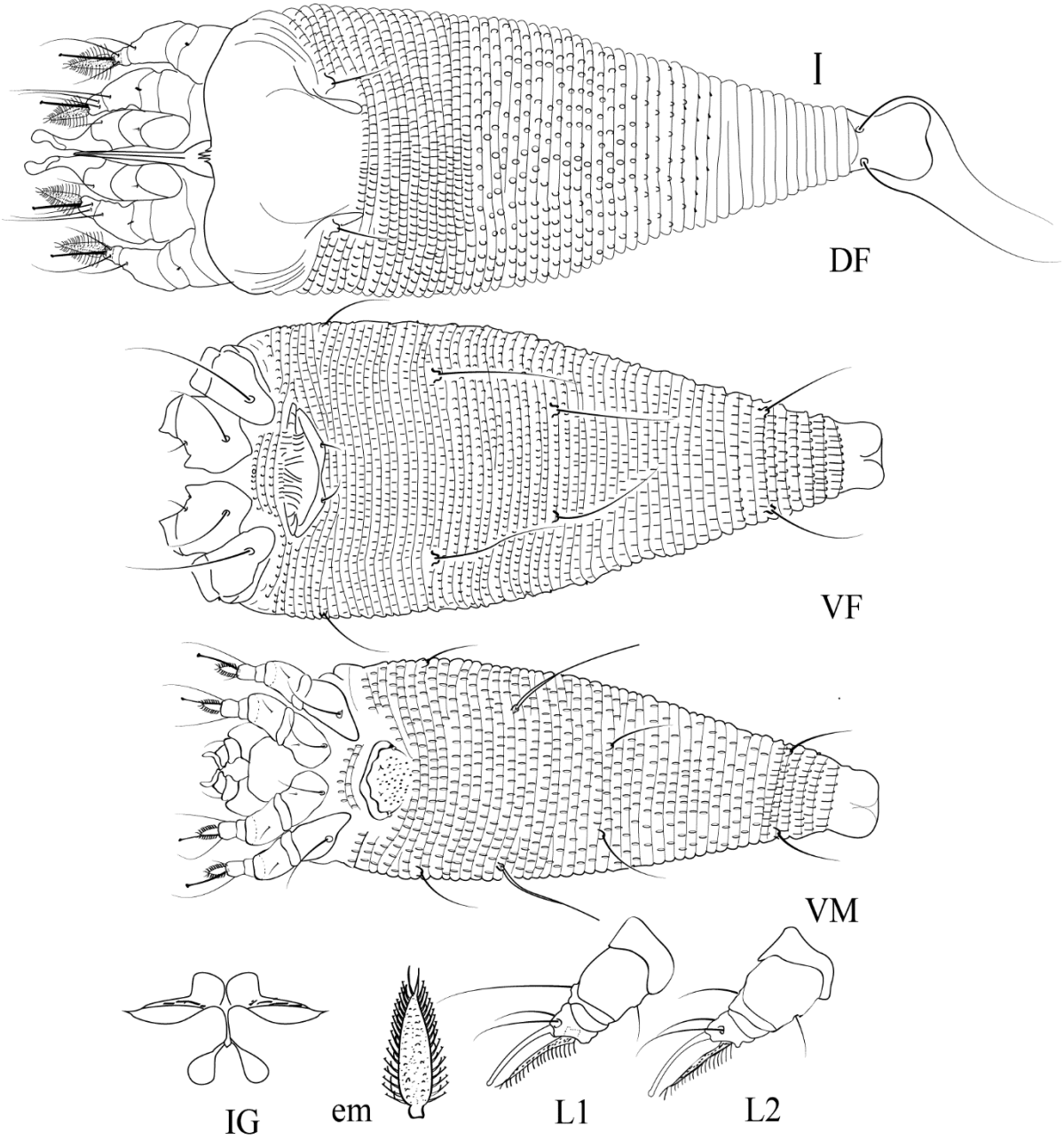


**Figure 5.** Line drawings of *Cisaberoptus kenyae*: DF. Dorsal view of female; VF. Ventral view of female; VM. Ventral view of male; IG. Internal female genitalia; em. Empodium; L1. Leg I; L2. Leg II. Scale bar: 10 µm for DF, VF, VM; 5 µm for IG, L1, L2; 2.5µm for em, all from female.

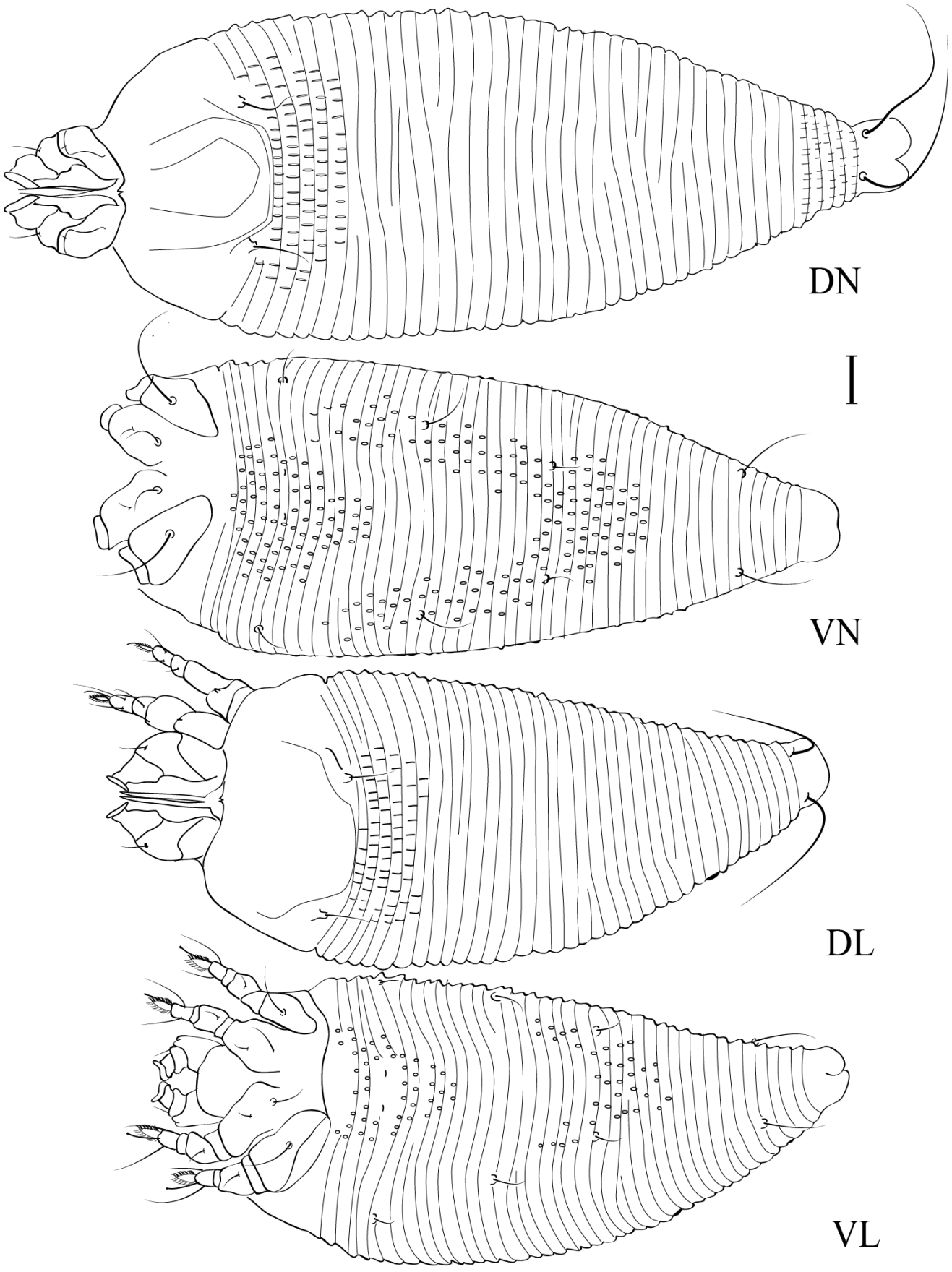


**Figure 6.** Line drawings of *Cisaberoptus kenyae*: DN. Dorsal view of nymph; VN. Ventral view of nymph; DL. Dorsal view of larva; VL. Ventral view of larva; Scale bar: 10 µm.

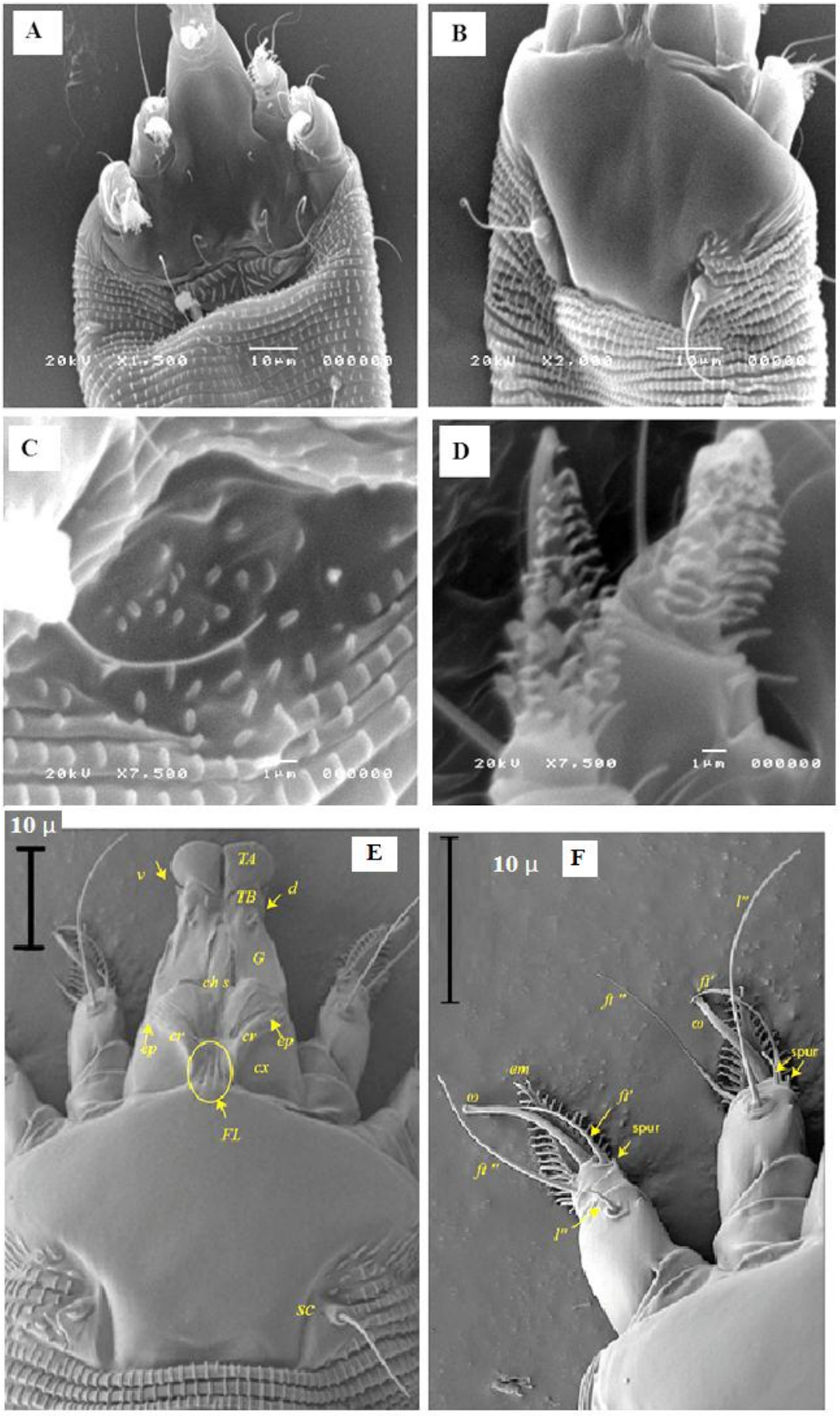


**Figure 7.** SEM micrographs of *Cisaberoptus kenyae*: A. Coxigenital region of female; B, E. Anterior dorsal view of mite; C. Genital region of male; D. Empodium of female; F. Legs. Notations: *TA*- Apical tarsus, *TB*- (images E and F made by Charnie Craemer). Basial tarsus, *ep*-Epicoxal seta, *v*-Subapical tarsal seta, *G*-Pedipalp genua, *FL*-Frontal lobe of prodorsal shield, *cr*- cheliceral retainer, *ch s*-cheliceral sheath, *cx*- distal palp coxa.

**Remarks.**
This species was reported from East Africa, South East Asia (Keifer et al. 1982), Costa Rica (Ochoa et al. 1994) and Campinas, São Paulo, Brazil (Rosseto 1972). Several developing stages were collected from mango leaves in Brasilia, DF, Central Brazil; in Mossoró, Rio Grande do Norte and Teresina, Piaui, Northeastern Brazil (Návia and Flechtmann 2000).

**Subfamily Phyllocoptinae Nalepa, 1892**
**Tribe Tegonotini Bagdasarian, 1978**
***Vareeboona mangiferae* (Keifer, 1946)**
***Taxonomic history:***
*Oxypleurites mangiferae* Keifer, 1946: 43, Fig. 203.
*Tegonotus mangiferae* (Keifer, 1946): 43.—Newkirk and Keifer 1971: 7; Amrine and Stasny 1994: 81; Hong and Zhang 1996: 195, Fig. 82; Navia and Flechtmann 2000: 3; Amrine et al. 2003: 57.
*Tegonotus paramangiferae* Huang, An and Huang, 1989, new **junior synonym.**
*Flechtmannia mangiferae* Chandrapatya, 1997 in Chandrapatya and Boczek 1997: 15.
*Leipothrix mangiferae* (Chandrapatya, 1997) in Chandrapatya and Boczek 1997—Xue and Zhang 2009: 70.
*Tegonotus fisus* Chakrabarti and Sarkar, 2011 new **junior synonym.**
*Vareeboona mangiferae* (Chandrapatya, 1997).—Chandrapatya et al. 2015: 96.
*Vareeboona mangiferae* (Keifer, 1946: 43).—Chandrapatya et al. 2017: 176.

**Relation to the host plant.** Vagrant on lower leaf surface causing rust.
**Type host.** *Mangifera indica* L. Anacardiaceae.
**Type locality.** Hilo, Hawaii, USA (Keifer, 1946).
**Distribution in Egypt.** Sharkia, Qalyubia, Menoufia, Ismailia, Giza, Fayoum and Beni-Suef Governorates.
**Geographic distribution.** Australia, Brazil, China, India (Chandrapatya et al. 2017).

**Materials examined.** Fifteen females and five males on five slides (slides no. EGYErio72.1–72.5) from *M. indica*, Giza Governorate (30°1'5.4"N, 31°12'29.33"E), 1 October 2020. Five females and two males on two slides (slides no. EGYErio72.6–72.7), Qalyubia Governorate (30°10'59.89N, 31°7'39.52"E), 10 February 2021; deposited at (ARC-PPRI), Egypt. Four females and three males on two slides (slides no. EGYErio72.8–72.9), Fayoum Governorate (29°20'0.48"N, 31°42'18.23"E), 10 October 2015; deposited at (ESAM), Egypt. Two slides (slides no. EgMI09–10), Giza Governorate (30°1'5.4"N, 31°12'29.33"E), 1 October 2020; deposited at (UNIBA), Italy. Two slides, Giza Governorate (30°1'5.4"N, 31°12'29.33"E), 1 October 2020; deposited at (WVU), USA.

***Spinacus pagonis* Keifer, 1979**
*Vasates aegyptiacus* Abou-Awad, 1979: 389, Fig. 1.
*Spinacus aegyptiacus* (Abou-Awad, 1979) New synonymy, was *Vasates*, described in fall 1979, now *Spinacus pagonis* Keifer, 1979.

This species was described from Egypt by Abou-Awad (1979) on mango terminal buds associated with *Metaculus mangiferae* (Attiah, 1955) causing malformation and stunting inflorescences. No additional specimens of this species were recorded during this study.

**Tribe Anthocoptini Amrine & Stasny, 1994**
***Neocalacarus mangiferae*** ChannaBasavanna, 1966: 101, Fig. 52–2.
(Figures 8–9).

**Supplementary description**
***Female*** (n = 10) **(Figure 8).**
Body fusiform, 150 (130–161) long excluding gnathosoma, 50 (50–56) wide, and 48 (47–60) thick; pinkish in colour. **Gnathosoma** 38 (35–40), projecting obliquely down, arched, *ep* 2, *d* 4 (4–5), cheliceral stylets 29 (29–30). **Prodorsal shield** 42 (40–44) long, and 50 (47–51) wide; with broad, round frontal lobe 12(12–14); sub-triangular with a pattern of wax; median line absent; admedian lines arising near apex of frontal lobe, sinuate, slightly diverging, end ahead of rear shield margin, connected by a convex line; submedian lines shorter than admedians, linked to them by diagonal lines; a diagonal transverse line extends from the posterior end of the submedian lines to posterior shield corners; prodorsal shield laterally with broad wax bands. Scapular tubercles finger-like on rear shield margin, 6 (5–6), 32 (32–34) apart, scapular setae *sc* 20 (19–21), projecting posteriorly and diverging, extending over 4–5 dorsal annuli. **Coxigenital region.** With 8–9 annuli between coxae and genital coverflap plus at most six transversal rows of lined granules at the base of the coverflap. Coxae with coarse

granules, *1b* 10 (9–11), 11 (10–11) apart; *1a* 17 (16–18), 9 (8–9) apart; *2a* 35 (33–35), 22 (20–22) apart. **Legs.** Leg I, 34 (32–35); femur 12 (11–12), *bv* 13 (13–14); genu 4, *l″* 18 (17–20); tibia 9 (8–9), paraxial tibial setae *l′* absent; tarsus 6 (6–7), *ft′* 15 (14–16), *ft″* 21 (20–22), *u′* 4 (4–5); tarsal *em* 5 (5–6), simple, 6-rayed, tarsal *ω* 7 (6–7), distally knobbed. Leg II, 32 (31–32), femur 11 (10–11), *bv* 12 (11–13); genu 4, *l″* 9 (8–9); tibia 7 (6–7), tarsus 6 (5–6), *ft′* 7 (6–7), *ft″* 20 (19–22), *u′* 4 (4–5); *em* 5 (5–6), 6-rayed, *ω* 7 (6–7), distally knobbed. **Opisthosoma.** With 27 (27–28) dorsal annuli and 57 (55–58) ventral annuli. Dorsal annuli with five wax bearing longitudinal ridges, from rear shield margin, but fading caudally, with elongate microtubercles set on rear margin; ventral annuli microtuberculate; rounded on 1/3 of anterior opisthosoma, gradually becoming more elongate, the last 7–10 ventral annuli with linear microtubercles. Setae *c2* 30 (25–31), 46 (44–50) apart, on ventral annulus 12 (11–12); setae *d* 42 (40–45), 31 (30–33) apart, on ventral annulus 24 (24–26); *e* 11 (10–12), 17 (16–17) apart, on ventral annulus 38 (38–39); *f* 22 (21–23), 19 (19–20) apart, on sixth ventral annulus from rear; *h1* absent, *h2* 50 (45–60). **External genitalia** 17 (16–18) long, and 21 (20–21) wide, genital coverflap with 10 (10–12) longitudinal ridges, *3a* 28 (26–29), 15 (14–15) apart.

***Male*** (n = 7) **(Figure 9)**

Smaller than female, body fusiform, 132–140 long, and 43–45 wide; pinkish in colour. **Gnathosoma** 27–30, *ep* 2, *d* 8–9; cheliceral stylets 25–26. **Prodorsal shield** 39–41 long, and 39–40 wide; with broad and round frontal lobe 12–13; pattern similar to that of female, scapular tubercles on rear margin, 23–25 apart, scapular setae *sc* 16–17, directed backwards divergently. **Legs.** Leg I 32–34; femur 11–12, *bv* 13–14; genu 4, *l″* 17–21; tibia 8–9, *l′* absent; tarsus 6–7, *ft′* 14–16, *ft″* 19–21, *u′* 4–5; tarsal *em* 5–6, simple, 6-rayed, tarsal *ω* 6–7, distally knobbed. Leg II 30–32, femur 10–11, *bv* 11–13; genu 4, *l″* 8–9; tibia 6–7, tarsus 5–6, *ft′* 5–7, *ft″* 19–22, *u′* 4–5; *em* 5–6, 6-rayed, *ω* 6–7, distally knobbed. **Coxisternal plates.** With granules, *1b* 7–8, 8–9 apart; *1a* 17–18, 7–8 apart; *2a* 29–32, 19–20 apart. **Opisthosoma.** With 26–28 dorsal annuli and 46–48 ventral annuli. Dorsal annuli with five wax bearing longitudinal ridges, from rear shield margin, but fading caudally, with microtubercles similar to that of female. Setae *c2* 23–25, 39–40 apart, on 12$^{th}$ ventral annulus; *d* 27–33, 25–26 apart, on 21$^{st}$ ventral annulus; *e* 9–10, 14–15 apart, on 31–32$^{nd}$ ventral annulus; *f* 19–20, 16–17 apart, on 6$^{th}$ annulus from rear. Setae *h1* absent, *h2* 32–35. **Male genitalia.** With granules, 9–10, 14–15 wide, *3a* 22–24.

***Nymph*** (n = 3) **(Figure 9).**

Body fusiform 125–145 long excluding gnathosoma, and 49–52 wide. **Gnathosoma** 25–29, projecting slightly downwards, *d* 3–4, *ep* 2; chelicerae 17–18. **Prodorsal shield** 40–42 long, and 38–40 wide; pattern similar to that of female; *sc* 13–15, directed posterior divergently, scapular tubercles 16 apart. **Legs.** Leg I 24–25; femur 8–9, *bv* 6–7; genu 4, *l″* 13–15; tibia 5–6, *l′* absent; tarsus 5, *ft′* 10–11, *ft″* 14–15, *u′* 3; tarsal *em* 4, simple, 5-rayed, tarsal *ω* 5–6, distally knobbed. Leg II 21–22; femur 7–8, *bv* 5–7; genu 3, *l″* 9–10; tibia 5; tarsus 4, *ft′* 10–11, *ft″* 15–17, *u′* 3; tarsal *em* 4, simple, 5-rayed, tarsal *ω* 5–6, distally knobbed. **Coxisternal region.** With granules; *1b* 6–7, 7–8 apart; *1a* 10–11, 7–8 apart; *2a* 17–18, 17–19 apart; *3a* 15–16 on 9 annuli from coxae. **Opisthosoma.** With 48–50 dorsal annuli and 44–46 ventral annuli. Dorsal annuli without wax ridges, with microtubercles pointed on the rear margin; microtubercles rounded on ventral annuli and linear on the last 8–10 annuli from end. Setae *c2* 19–20, on annulus10; *d* 28–35, on annulus 19; *e* 23–26, on annulus 27–28; *f* 13–14, on annulus 5$^{th}$ from rear; *h1* absent, *h2* 20–25.

**Type host** *Mangifera indica* L. Anacardiaceae.

**Relation to the host plant**. Vagrant on tender stem and buds of mango associated with *Aceria mangiferae* (Sayed), no apparent damage was observed.

**Type locality** India: Delhi.

**Geographic distribution.** Australia, Brazil, Egypt (Chandrapatya et al. 2017).

**Materials examined.** Fifteen females, seven males and five nymphs on five slides (slides no. EGYErio68.1–68.5) from *M. indica*, Giza Governorate (30°1'5.4"N, 31°12'29.33"E), 1 October 2020. Five females and two males on two slides (slides no. EGYErio68.6–68.7), Qalyubia Governorate (30°10'59.89N, 31°7'39.52"E), 10 February 2018; deposited at (ARC-PPRI), Egypt. Four females and two males on two slides (slide no. EGYErio68.8–68.9), Fayoum Governorate (29°20'0.48"N, 31°42'18.23"E), 10 October 2020; deposited at (ESAM), Egypt.

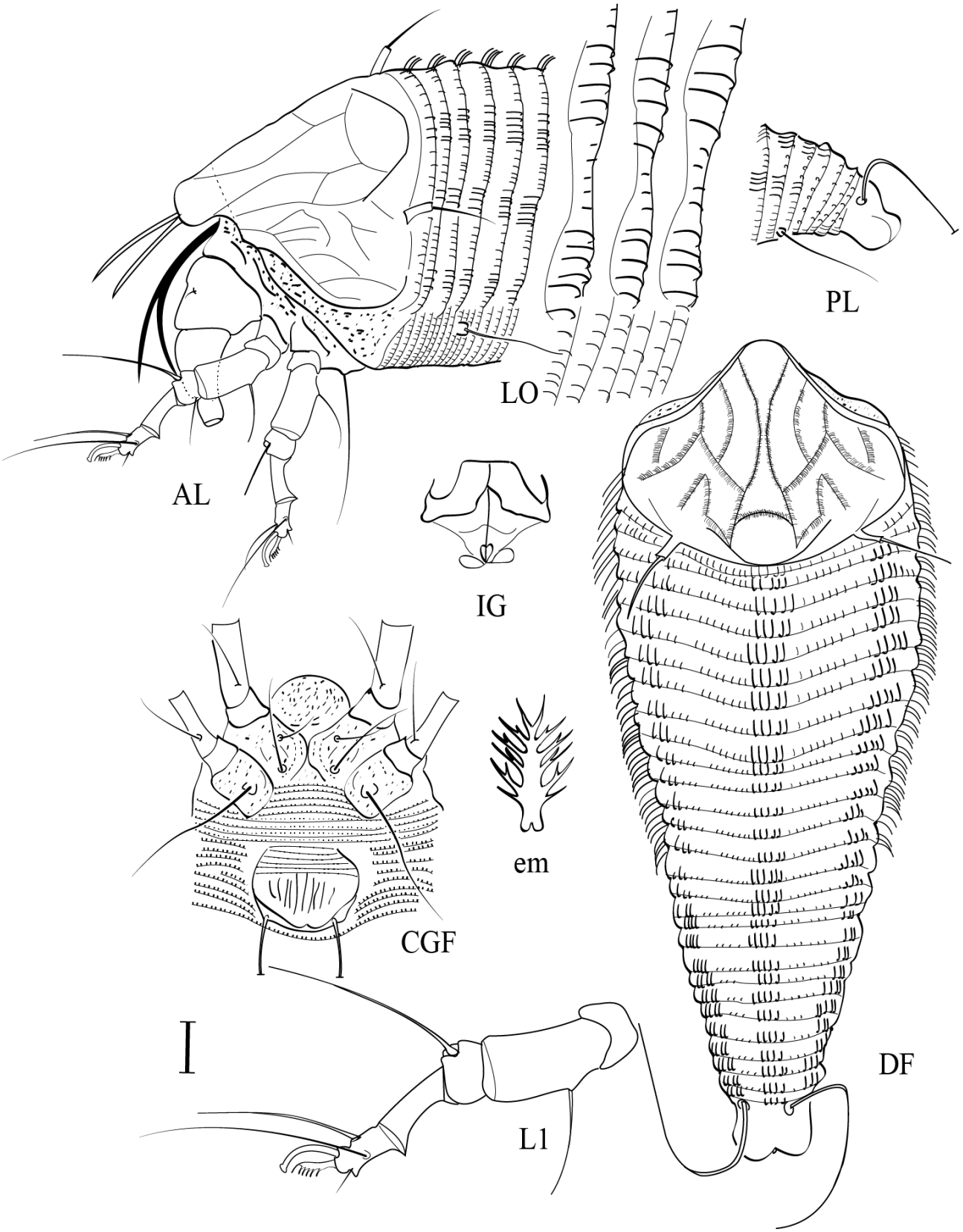


**Figure 8.** Line drawings of *Neocalacarus mangiferae*: DF. dorsal view of female; AL. Anterior view of mite; LO. Lateral view of annuli; PL. Lateral view of posterior opisthosoma; IG. Internal female genitalia; em. Empodium; CGF. Female coxigenital region; L1. Leg I. Scale bar: 10 µm for DF, Al, PL, CGF; 5 µm for IG, L1; 2.5µm for em.

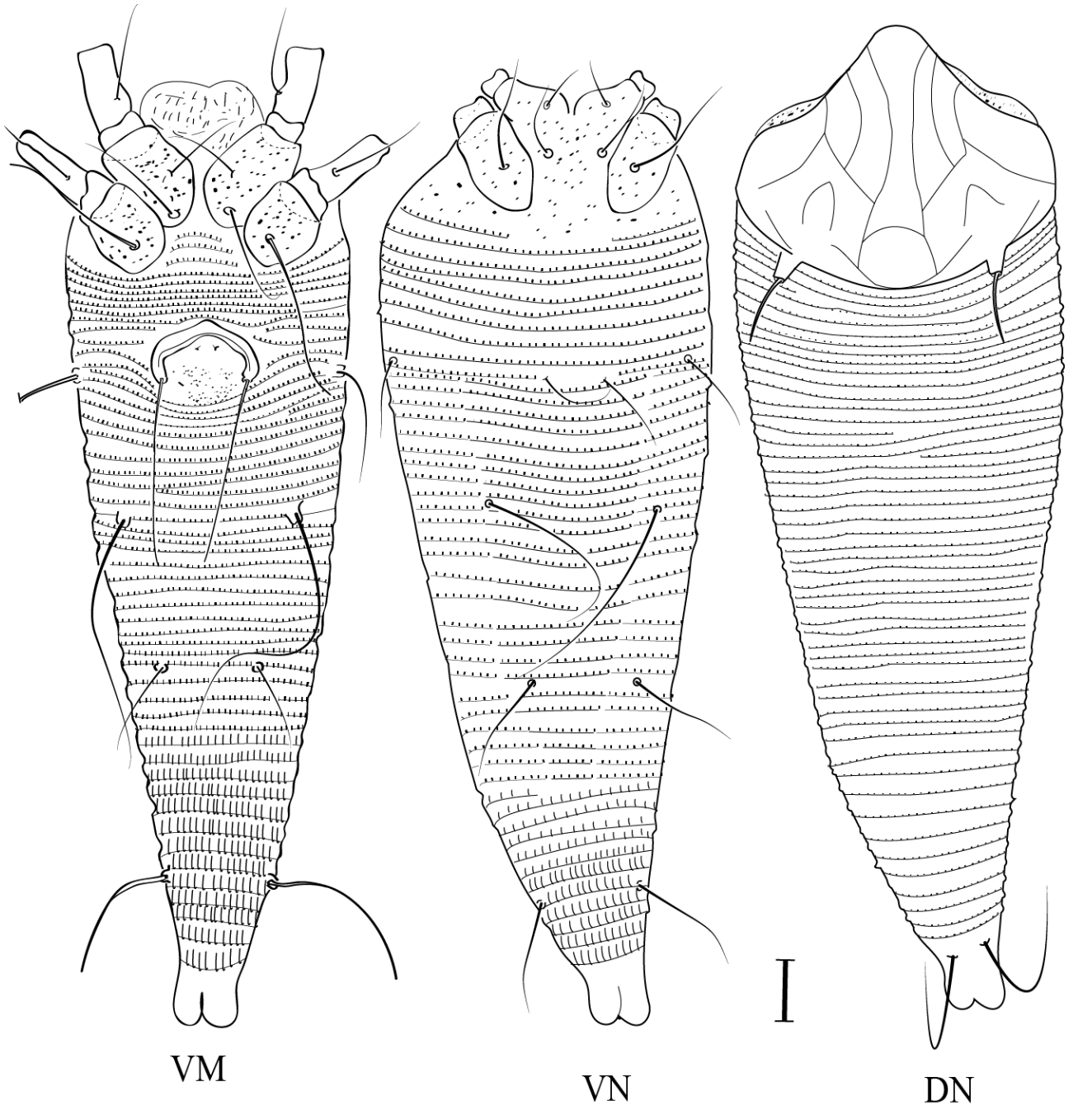


**Figure 9.** Line drawings of *Neocalacarus mangiferae*: DN. Dorsal view of nymph; VN. Ventral view of nymph; VM. Ventral view of male. Scale bar: 10 µm.

Two slides (slides no. EgMI01–02), Giza Governorate (30°1'5.4"N, 31°12'29.33"E), 1 October 2020; deposited at (UNIBA), Italy. One female and one male on one slide, Giza Governorate (30°1'5.4"N, 31°12'29.33"E), 1 October 2020; deposited at (ARC-PPRI), South Africa. Two slides, Giza Governorate (30°1'5.4"N, 31°12'29.33"E), 1 October 2020; deposited at (WVU), USA.

***Metaculus mangiferae* (Attiah, 1955)**
***Taxonomic history:***
*Vasates mangiferae* Attiah, 1955: 379.
*Metaculus mangiferae*.—Amrine and Stasny 1994: 225; Chandrapatya et al. 2017: 122, Fig. 144.

**Habit:** Bud and inflorescence deformation; rust and leaf drop, vagrant on lower leaf surface.
**Type host:** *Mangifera indica* L. Anacardiaceae.
**Type locality:** Giza, Egypt.
**Distribution in Egypt:** Sharkia, Qalyubia, Menoufia, Esmailia, Giza, Fayoum and Beni-Suef Governorates (Al-Azzazy 2005).
**Geographic distribution.** Angola, India, Pakistan, South Africa, Thailand, USA (Chandrapatya et al. 2017).

**Materials examined.** Ten females and five males on five slides (slides no. EGYErio69.1–69.5) from *M. indica*, Giza Governorate (30°1'5.4"N, 31°12'29.33"E), 1 October 2020. Ten females and two males on two slides (slides no. EGYErio69.6–69.7), Qalyubia Governorate (30°10'59.89N, 31°7'39.52"E), 10 February 2021; deposited at (ARC-PPRI), Egypt. Five females and two males on two slides (slides no. EGYErio69.8–69.9), Fayoum Governorate (29°20'0.48"N, 31°42'18.23"E), 10 October 2020; deposited at (ESAM), Egypt. Two slides (slides no. EgMI03–04), Giza Governorate (30°1'5.4"N, 31°12'29.33"E), 1 October 2020, deposited at (UNIBA), Italy. Two slides, Giza Governorate (30°1'5.4"N, 31°12'29.33"E), 1 October 2020, deposited at (WVU), USA.

**Ecological study**

**Population fluctuation of eriophyid mites on mango orchards** "**Alphonso" cultivar during the growing season 2020**

The results of the studies on population dynamics of four eriophyids, *C. kenyae*, *A. aegyptindicae* **sp. nov.**, *N. mangiferae* and *V. mangiferae* are presented in Figure (10). There are three annual seasonal peaks in the population of *C. kenyae* on "Alphonso" cultivar. *Cisaberoptus kenyae* was recorded in early January 2020 in high numbers. The populations gradually decreased in mid-January to early April. Subsequently the population gradually increased again and reached the second peak in mid-May with 171 individuals per 40 leaves. After that the population fluctuated and reached the third peak during the 3rd week of November with 432 individuals per 40 leaves.

Similar results were observed for, *A. aegyptindicae* **sp. nov.** which has also three annul peaks, the first peak; in early January (138 ind. per 40 leaves), the second peak in early May (133 ind.), and the third peak in 2nd week of November (148 ind. per 40 leaves). This species was not present from late June to late August.

The mango bud mite, *N. mangiferae*, was recorded in buds in moderate numbers in early January and gradually increased in number and reached the first peak in mid-February with 73 individuals per 10 buds. Then the population decreased from early March to Mid-July and increased again and reached the second peak in late August (55 individuals per 10 buds), where after the population started to decline sharply from early September to mid-December. No infestation on fruit by the three eriophyid mites was observed during the growing season.

The mango rust mite, *V. mangiferae*, was recorded on leaves with high numbers in early January, gradually increased in number and reached the first peak in mid-February with 214 individuals per 40 leaves. Subsequently, the population decreased from early March to late August and increased again and reached the second peak in second week of November (279 individuals/ 40 leaves), afterwards the population started to decline till the end of the season (Figure 10).

**Effect of temperature and relative humidity on the population fluctuation**

The effect of temperature and relative humidity on the population fluctuations of *C. kenyae, A. aegyptindicae* sp. nov., *N. mangiferae* and *V. mangiferae* infesting "Alfonso" cultivar during season 2020 are presented in Table (2). Data indicated MaxT and MinT had insignificant negative correlation with these four species (r values were –0.20 & –0.12; –0.08 & –0.04; –0.52 & –0.54 and –0.51 & –0.42, respectively). Whereas, RH% had insignificant positive correlation with the same mites species (r = 0.31, 0.24, 0.11 and 0.54, respectively).

These results are relatively similar to those recorded by Abdallah (2001) and El-Halawany (2003). They studied the ecology on "Taimour", "Hindi" and "Zebda" cultivars at Giza Governorate and indicated that *C. kenyae* and *T. mangiferae* have one annual peak of seasonal abundance in November, but for "Alphonso" cultivar, the peak was in December. The leaf coating mite, *C. kenyae* showed three peaks of seasonal abundance occurred in January, August and December on "Hindi" cultivar. According to Al-Azzazy (2005), *C. kenyae* had four annual peaks on "Alphonso" cultivar in January, August, November and December. The population fluctuation of *V. mangiferae* has one annual peak of seasonal abundance in October, while *C. kenyae* has one annual peak of seasonal abundance in November on different mango cultivars at Fayoum Governorate. The population fluctuation of *T. mangiferae* and *C. kenyae* were positively affected with the relative humidity, while the correlation was negative with the temperature degree (Abdallah 2007).

**Table 2.** Simple correlation values for the effect of temperature and relative humidity on four eriophyid mite populations on mango orchards "Alphonso" cultivar during the growing season 2020.

| Eriophyid mite | MaxT | MinT | RH% |
|---|---|---|---|
| *A. egyptindicae* | –0.08 | –0.04 | 0.24 |
| *C.kenyae* | –0.20 | –0.01 | 0.31 |
| *N.mangiferae* | –0.52 | –0.54 | 0.11 |
| *V. mangiferae* | –0.51 | –0.42 | 0.54 |

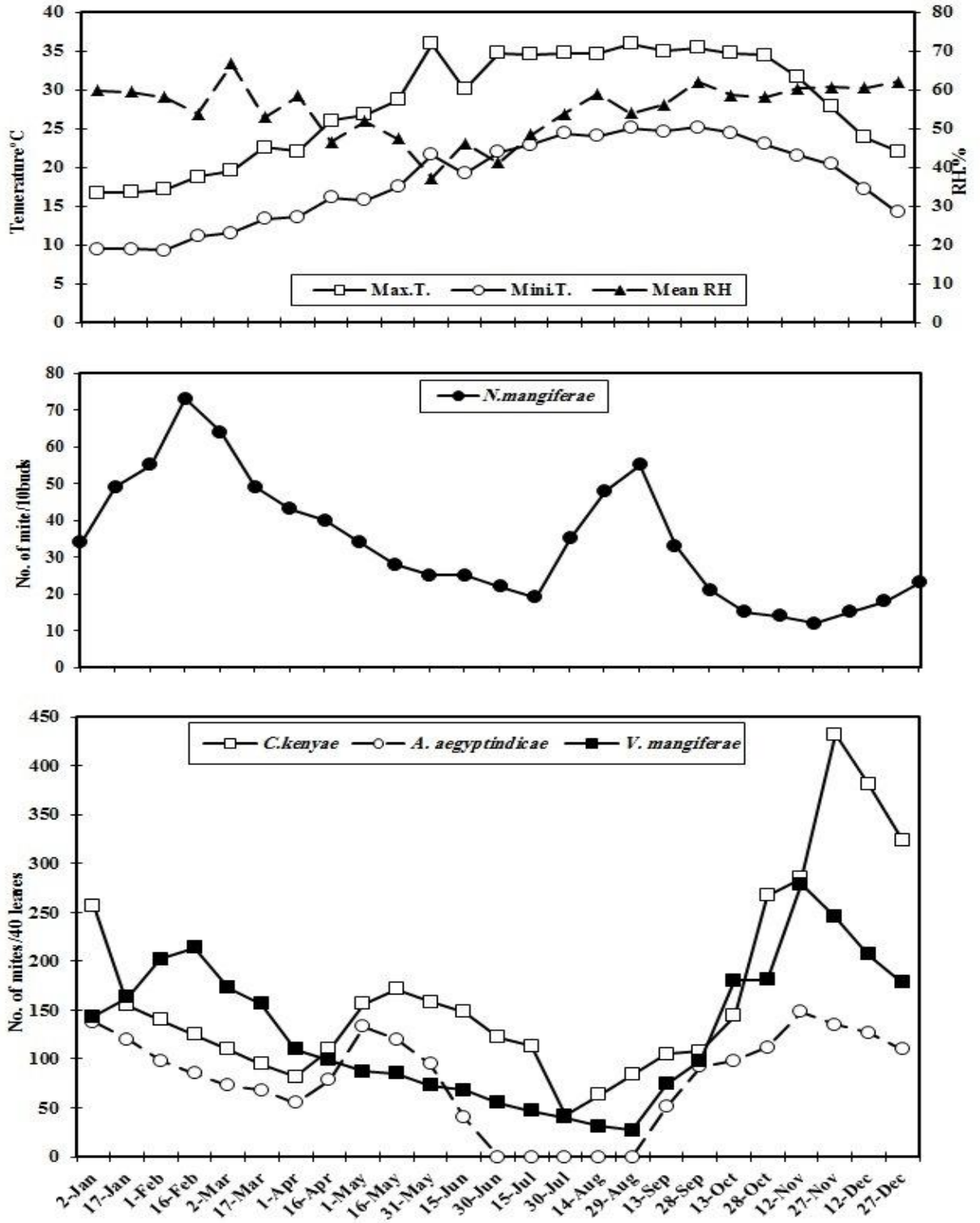


**Figure 10.** Population fluctuation of eriophyid mites on mango orchards "Alphonso" cultivar during the growing season 2020.

**Acknowledgements**

We are grateful to Dr. Philipp E. Chetverikov (Saint-Petersburg State University, Universitetskaya nab., Russia), Charnie Craemer (Forestry and Agricultural Biotechnology Institute (FABI), University of Pretoria, South Africa) for providing two SEM micrographs for *Cisaberoptus kenyae* (Figs. 7E & 7F) and to anonymous reviewers for valuable comments and suggestions.

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