New Record of Brevipalpus Donnadieu (Acari: Tenuipalpidae) and Illustrated Key to Egyptian Species and Types

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ABSTRACT

First record and re-description of *Brevipalpus plucheae*, Baker, Tuttle & Abbatiello collected from the weed *Conyza dioscoridis* L. in citrus orchards. Illustrated key to the species and types of the genus *Brevipalpus* in Egypt is provided.

Key words: Tenuipalpidae; *Brevipalpus spp.*

INTRODUCTION

The family Tenuipalpidae has a worldwide distribution with over 1100 valid species belonging to 38 genera. Most tenuipalpid species have been described from North America (33% of the total known flat mite fauna) and Africa (13%), whereas little is known in the rest is known from other part of the world (Mesa *et al.* 2009). All tenuipalpid species are phytophagous and damage plants by directly feeding on epidermal cells of the stems, leaves and fruits. Several species are known to vector plant virus (Childers and Eerrick 2003; Kitajima *et al.* 2003; Rodrigues *et al.* 2003) and some species have been collected carrying fungal spores associated with plants (Evans *et al.* 1991, Ochoa *et al.* 1994). The majority of the species that cause economic damage to cultivated plants belongs to the two largest genera, *Brevipalpus* Donnadieu and *Tenuipalpus* Donnadieu. The first is a widespread genus included 282 species (Arabuli *et al.*, 2015). Recently, new species of this genus have been described. In 2013, *Brevipalpus incognitus* Ferragut &Navia was described in Brazil (Navia *et al.*, 2013); while in 2014, *Brevipalpus noranae* Halawa & Fawzy was described from Egypt(Navia *et al.*, 2013; Halawa and Fawzy, 2014). Despite the high diversity of these mites in Egyptian agro-ecosystems, the genus *Brevipalpus* has been poorly studied whereas, several papers on mites of the family Tenuipalpidae were published by Sayed (1942, 1946, 1950), Attiah (1956), and Zaher (1984). Sayed (1942, 1946, 1950) and Attiah (1956) reported seven species in Egyptian fauna that were: *B. lanceolatisetae* Attiah, *B. geisenheyneri* Ruebsaamen, *B. obovatus* Donnadieu, *B. phoenicis* Geijskes, *B. californicus* (Banks), *B. olearius Sayed*, and *B. lewisi* McGregor. However, Zaher (1984) recorded only six species, four of them belonging to the genus *Brevipalpus*: *B. obovatus*, *B. phoenicis*, *B. californicus*, and *B. olearius*; while the other two species were placed in the genus *Cenopalpus*: *C. lanceolatisetae* Attiah and *C. spinosus* (Donnadieu) (= *T. geisenheyneri* Ruebsaamen). Recently, one species: *Brevipalpus noranae* Halawa &Fawzy, 2014 was described as a new species and added to the Egyptian fauna. In this paper, *Brevipalpus plucheae*, Baker, Tuttle & Abbatiello was re-rediscriiped and illustrated for the first time in Egypt and provide an illustrated key to the recorded Egyptian species.

MATERIALS AND METHODS

A survey was conducted in fruit orchards and neighboring plants throughout six provinces of Egypt (Qalubia, Giza, Menufia, Behera, Dakahlia, Sohage). At each locality, sampling was carried out bi-weekly from October 2012 to September 2014. The samples included plant foliages, fruits, buds, branches, and grass individually bagged in tightly-closed plastic bags and transported on the same day to the Fruit Acarology Department, Plant Protection Research Institute, Agricultural Research Center. The elevation and longitude/latitude were recorded for each locality using a hand-held Garmin Global Positioning Device (GPS). Mites were removed using a fine hair brush under dissection stereo-microscope, then preserved in 70% ethanol. Selected mites were cleared in Nesbitt solution for 10–12minutes. Subsequently, mites were mounted on micro-slides in Hoyer's medium, and then dried at 40 °C for one week (Zhang 2003). The terminology used in the key follows Linquist (1985) and Mesa et al. (2009). The measurements are given in micrometers (μm). The type material was deposited as slide-mounted specimens in the mite collection of the Agriculture Research Center, Plant Protection Research Institute, Fruit Acarology Department, Dokki, Egypt (ARC-PPRI).

RESULTS AND DISCUSSION

Family Tenuipalpidae Berlese

Subfamily Brevipalpinae Mitrofanov, 1973

Genus *Brevipalpus* Donnadieu, 1875

***Brevipalpus plucheae*, Baker, Tuttle & Abbatiello, 1975. (Figs. 1&2)**

Re-description: Female (holotype). Dorsal idiosoma (Fig. 1A) (excluding rostrum) 290 long (280-290 in 5 paratypes) and 155 wide (145–160). Rostrum barely

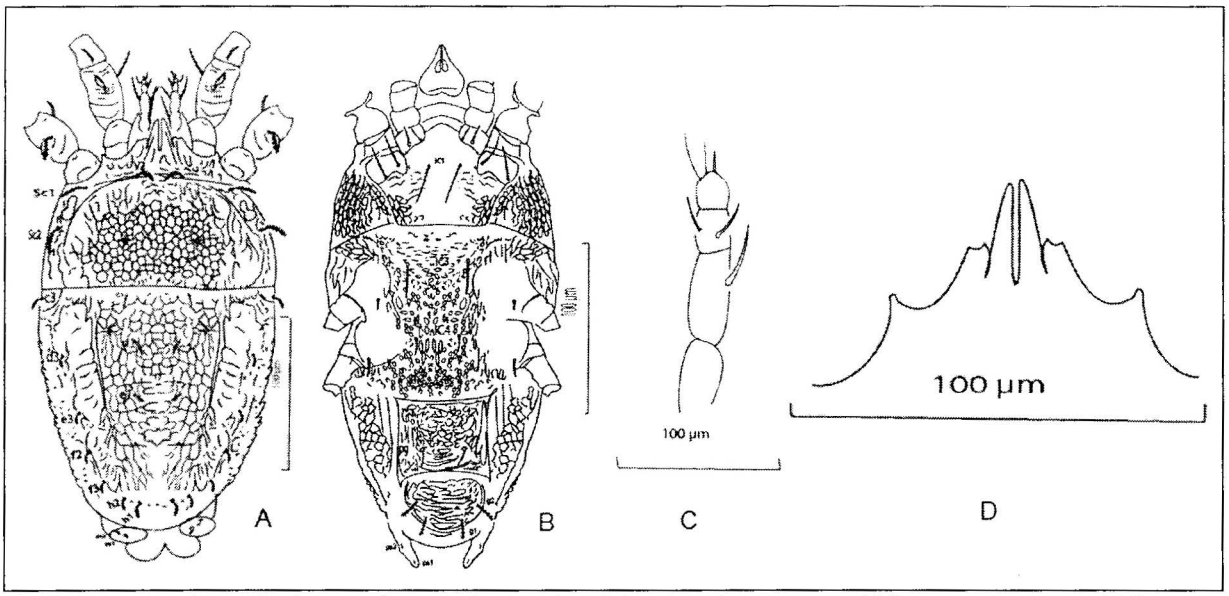

Fig.(1): *Brevipalpus plucheae* Baker, Tuttle & Abbatiello, female. A. Dorsal idiosoma. B. Ventral idiosoma. C. Palpus, D. Rostral shield.

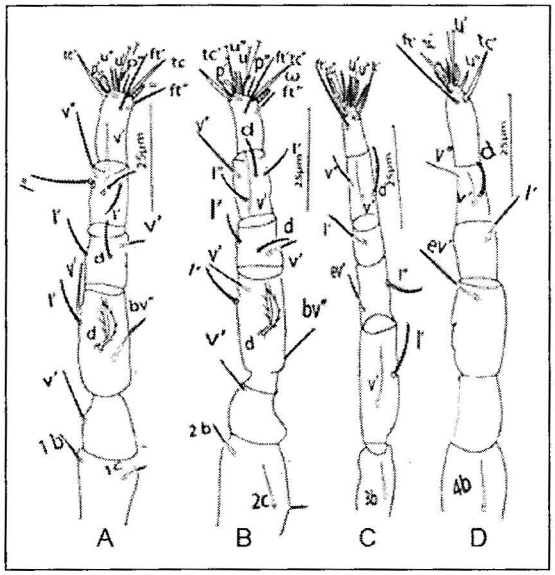

Fig.(2): *Brevipalpus plucheae* Baker, Tuttle & Abbatiello, adult female. A. Leg I; B. Leg II; C. Leg III; D. Leg IV.

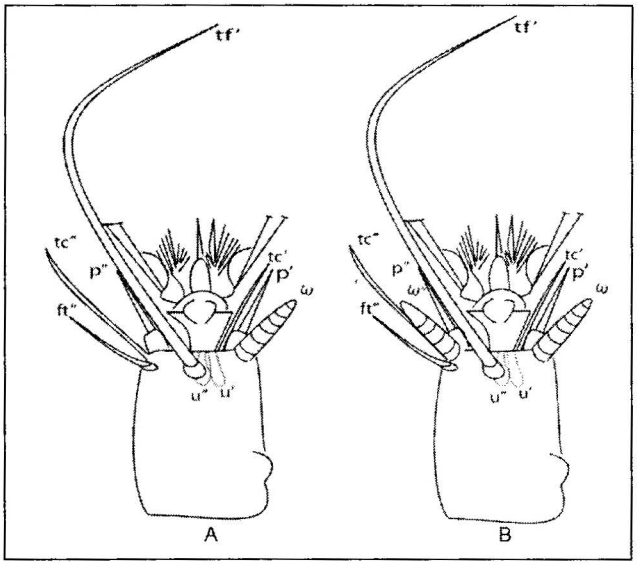

Fig. (3): Semi-schematic line drawing of leg II tarsus, A. *Brevipalpus obovatus* Donnadieu; *Brevipalpus phoenicis* (Geijskes).

extending to middle of femur I. Rostral shield deeply cleft medially with stout, tapered median and dentate ancillary lobes on each side (Fig. 1D). Palps 4 segmented, terminal segment with 3 setae on distal segment (1 solenidion and 2 simple setae) (Fig.1C). Prodorsum with areolate dorsocentral and dorsolateral areas, strongly rugose lateral areas; poes present. Propodosoma with 3 pairs of lanceolate setae; lengths: *v2* 12 (9–16), *sc1* 16 (13–17), and *sc2* 18 (15–18). Eyes 2 pairs, 1 pair on each side (Fig. 1A). Hysterosomal dorsum areolat –rugose with rugos dorsocentral area posterior to *c2* setae and strongly rugose lateral area; longitudinal dorsolateral furrows becoming obscure posteriorly; distinct rugose lateral groves; pores present. Dorsocentral hysterosoma with 3 pairs of narrowly lanceolate setae; length of setae c1 and *d1* 7 (6-9), *e1* 8 (7–8). Seven pairs of slightly lanceolate dorsolateral opisthosomal setae shorter than distance between their bases; lengths: *c3* 11 (11–12), *d3* 9 (9–11), *e3* and *f2* 7 (6–9), *f3* and *h2* 8 (6–8), *h1* 7 (5–7) (Figs.1&2). Venteral idiosoma, the pregenital plate with sides uneven, barely perceptibly widening posteriorly, areolate- rugose; genital flap rugose to subimbricate- rugose; genital setae slender, slightly longer than pregenitals, paired laterally; area posterior to *IC4* and intercoxal setal area pebbly areolate (Fig1B). All ventral setae smooth; lengths of

setae: IC1 21 (19–21), *IC3* 17 (15–17), *IC4* 13 (11–14), *pg* 11 (9– 13), *g1* 10 (8–11), *g2* 14 (14–16), *ps*1 6 (4–6), *ps2* 7 (7–7) (Fig. 1B). Leg segments wrinkled; number of setae on leg segments as follows: coxae 2-2-1-1, trochanters 1-1-2-1, femora 4-4-2-1, genua 3-3-1-1, tibiae 5-5-3-3, tarsi 8(ω) -8(ω)-5-5. Dorsal setae of femora I and II leaf like lanceolate serrate. Tarsi I and II with 1 sensory rods each; leg chaetotaxy as follows: coxae I–II *b*, *c*; co.III–IV *b*; trochanters I, II, IV *v'*; tr. III I', *v'*; femora I–II, *d*, *v'*, *bv"*, *l'*; *fe*. III *ev"*, *l"*; *fe*.IV *ev'*; genua I–II l', *d*, *v"*; ge. III–IV *l'*; tibia I–II *d*, *l'-l"*, *v'-v"*; ti III–IV *d*, *v'-v"*; tarsus I–II *u'-u"*, *p'-p'*, *tc'-tc"*, *ft'-ft"*, ω; ta. III–IV *u'-u"*, *tc'-tc"*, *ft* (Fig. 2 A, b C,d).

Male: Not known.

Type material: Holotype female and 5 paratype females, ex *Conyza dioscoridis* L. (Asteraceae) in citrus farm: Giza province, 30◦02'6"N, 31◦12'18"E, 20 September 2014, coll. Hassan zynhom.

Type depositions: Holotype and 5 paratype females deposited at Plant Protection Research Institute-Agricultural Research Center - Fruit Acarology Department, Dokki, Cairo, Egypt.

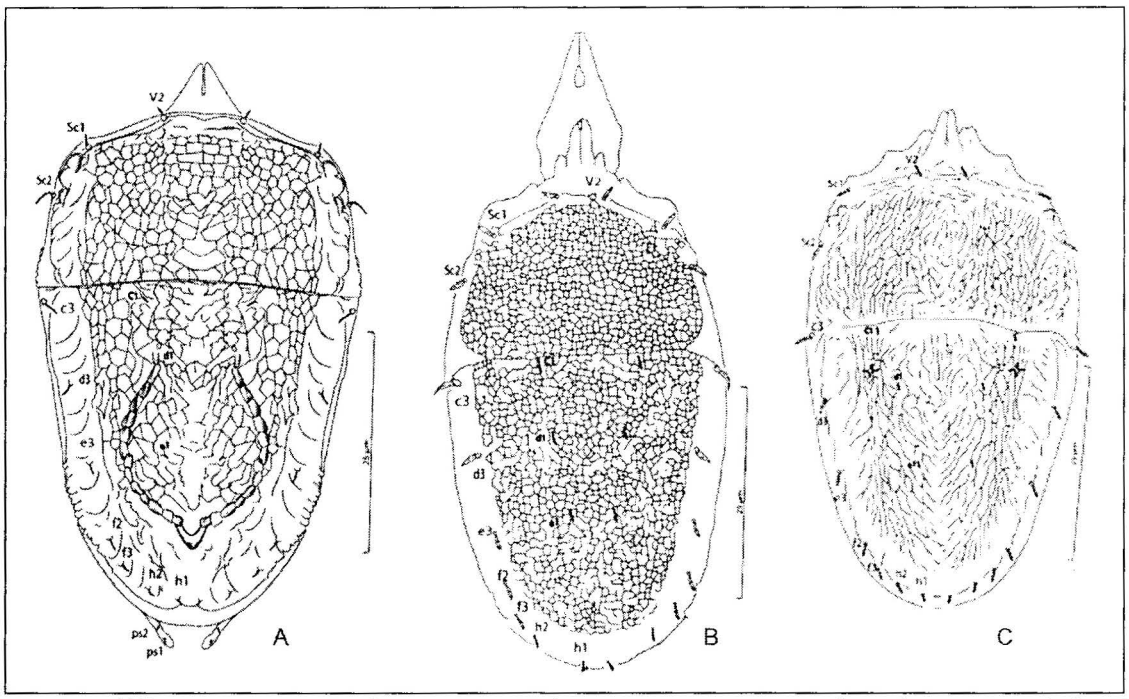

Fig.(4): Dorsal idiosoma, A. *Brevipalpus noranae* Halawa &Fawzy; B. *Brevipalpus olearius* Sayed after Zaher (1984), C. *Brevipalpus lewisi* McGregor after Attiah (1956).

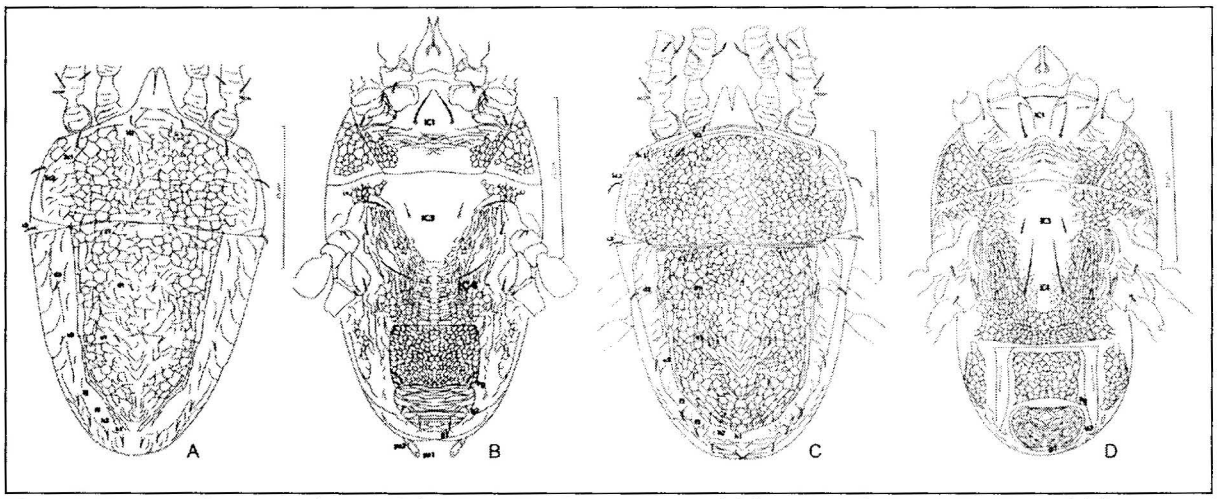

Fig. (5): Types of *Brevipalpus californicus* (Banks): A, Dorsal idiosoma of Type1.B, Ventral idiosoma of Type1. C, Dorsal idiosoma of Type2.D. Ventral idiosoma of Type1.

Key to the Egyptian species of *Brevipalpus* in Egypt

Females

1. Hysterosoma with 6 pairs of dorso-lateral setae 2
- Hysterosoma with 7 pairs of dorso-lateral setae 3
2. Tarsus II with 1 solenidion .....*B. obovatus Donnadieu* (Fig.3A)
- Tarsus II with 2 solenidia ..... *B. phoenicis* (Geijskes) (Fig.3B)
3. Tarsus II with 1 solenidion. 4
- Tarsus II with 2 solenidia; propodosoma with irregular striae medio-dorsally, reticulated elements occur medio-laterally ..... *B. californicus* (Banks) 5
4. Hysterosomal dorsum with large vase (urn) shaped pattern, with small v-shaped extension posteriorly ..... *B. noranae* Halawa &Fawzy (Fig. 4A)
- Hysterosomal dorsum without vase shape pattern 6
5. Propodosoma cuticle smooth to wrinkled (rugose) centrally with large closed cells laterally, forming reticulation; dorsal opisthosoma with cuticle between c1-c1 and e1-e1smooth wrinkled; cuticle posterior e1-e1with few short, diagonal lines to weak V-shaped folds .....*B. californicus* (Banks) **type 1** (Figs.5A& B)
- Prodorsum cuticle entirely reticulate with weaker and faint reticulation centrally, but cells usually closed, some cells fused to form larger irregular cells; cuticle between c1-c1 and d1-d1 with weak reticulation wrinkled; dorsal opisthosoma with cuticle between d1-d1and e1-e1wrinkled to irregularly folded; cuticle posterior e1-e1 irregularly folded with few short transverse folds (V-shaped) ..... *B. californicus* (Banks) **type 2** (Figs.5C& D)
6. Rostrum elongate, extending to the distal end of genu I; reticulate pattern covers almost entire surface of propodosoma and hysterosoma ..... *B. olearius* Sayed (Fig.4B)
- Rrostrum not elongate, extending to middle of femur I 7
7- Propodosoma with rugose dorsocentral area, subareolate- rugose dorsolateral and rugose lateral area ..... *B. lewisi* McGregor (Fig. 4C)
- Propodosoma with areolate dorsocentral and dorsolateral area, strongly rugose lateral area ... *B. plucheae* Baker, Tuttle & Abbatiello (Figs.1 & 2)

***Brevipalpus obovatus* Donnadieu, 1875** (Fig. 3A)

Brevipalpus obovatus Donnadieu, 1875:144; Pritchard and Baker 1958: 231; Meyer and Ryke 1959:319.

Brevipalpus preger Donnadieu, 1875: 117.

Brevipalpus amicus Chaudhri. 1972: 65

Brevipalpus origanum Baker. Tuttle and Abbatiello. 1975: 18.

Brevipalpus assamensis Sadana and Gupta, 1983: 1.

Tenuipalpus inornatus Banks, 1912: 97.

Tenuipalpus bioculatus McGregor, 1914: 354.

Tenuipalpus pseudocuneatus Blanchard, 1940: 11.

Material examined: 12 females ex *Citrus aurantium* L (Rutaceae) Sohage, Shandawil regioncoll. Hassan Zynhom 15 August 2013; Giza province, 30◦02'6"N, 31◦12'18"E, 17 July 2014 coll. Hassan Zynhom; Menufia province, El-Bagour30◦26'6"N, 31◦02'6"E, 25 September 2013, coll. Hassan Zynhom ; 5 females ex *Pyrus communis* L (Rosaceae), 4females ex *Plumeria acutifolia* Poir (Apocynaceae),: Menufia province, El-Bagour district, 30◦28'30" N, 30◦58'30" E, 25 September 2013, coll. Hassan Zynhom.

Remark: This species was re-described in Egypt by Attiah (1956) and Zaher (1984), and has been on *Pyrus communis* L., *Citrus aurantium* L.; *Pelargonium zonalle* Ait, *Clerodendrum* sp., *Hibiscus rosa-sinensis* L., *Gerbera jamesonii* Bolus, *Mentha* sp. and *Rosa* sp.

Type depositions: Holotype and paratypes deposited at Plant Protection Research Institute- Agricultural Research Center - Fruit Acarology Department, Dokki, Cairo, Egypt (ARC-PPRI).

Relation to host: The mites live on lower surface of leaves and fruits causing brown scars.

***Brevipalpus phoenicis* (Geijskes, 1939)** (Fig. 3B)

Tenuipalpus phoenicis Geijskes, 1939: 230.

Brevipalpus phoenicis, Sayed 1946: 360; Baker 1949: 360.

Brevipalpus mcbridei Baker, 1949: 374.

Brevipalpus papayensis Baker, 1949: 375.

Brevipalpus yothersi Baker, 1949: 373.

Brevipalpus phoenicoides Gonzalez, 1975: 86.

Material examined: 9 females and 2 males ex *Citrus spp.* (Rutaceae), 2 females ex *Psidium guajava* L. (Myrtaceae), Sohage, Shandawil region, 20 july 2014, coll. Hassan Zynhom: Giza province, 30◦02'6"N, 31◦12'18"E, 15 June 2014 coll. Hassan Zynhom; 3 females ex *Pyrus communis* L. (Rosaceae): Qalubia province, Toukh district, 3◦21'18"N, 31◦13'30"E, coll. Hassan Zynhom. 6 females ex *Pyrus communis* L. (Rosaceae) Egypt: Behera province, Behera, 30◦36'54"N, 30◦41'6"E, 28 June 2014, coll. Hassan Zynhom.

Remark: The holotype of *Brevipalpus phoenicis* was collected from *Phoenix* sp. (Arecaceae) in the

Netherlands. The Egyptian specimens were reported and described by Sayed (1946), Attiah (1956), and Zaher (1984). Our study completely agrees with the description of *B. phoenicis* given by Geijskes (1939) and Halawa & Fazy (2014).

Type depositions: Holotype and paratypes deposited at Plant Protection Research Institute- Agricultural Research Center - Fruit Acarology Department, Dokki, Cairo, Egypt.

Relation to host: The mites live on lower surface of leaves and fruits causing brown scars.

***Brevipalpus noranae* Halawa & Fawzy, 2014** (Fig. 4A).
No synonyms.

Type material: Holotype female and 3 paratype females, *Citrus aurantium* L. (Rutaceae) as mixed plantations: Qalyubia province, Tukh district, Moshtohor village, 30°21'18" N, 31°13'30" E, 20 July 2014, coll. Hassan Zynhom.

Remark: The holotype of *Brevipalpus noranae* was collected on *Citrus aurantium* L. (Rutaceae) and *Malus domestica* Borkh (Rosaceae) and described by Halawa & Fawzy (2014). Our study completely agrees with the description of *B. noranae* given by Halawa & Fazy (2014).

Type depositions: Holotype and 4 paratype females deposited at Plant Protection Research Institute- Agricultural Research Center - Fruit Acarology Department, Dokki, Cairo, Egypt .

Relation to host: The mites live on lower surface of leaves and fruits causing brown scars.

***Brevipalpus olearius* Sayed, 1950** (Fig. 4B).

Material examined: 4 females ex Olea europea L.(Oleaceae) Menufia province, El-Bagour30°26'6"N, 31°02'6"E, 20 july 2014, coll. Hassan Zynhom: Qalubia province; 3 females ex Olea europea L.(Oleaceae) Egypt: Giza province, Dokki, 30°02'6"N, 31°13'30"E, 28 Dec. 2012.

Remark: The flat mite *Brevipalpus olearius* was found on *Olea europea* L. in Egypt by Sayed (1950). Specimens collected in this study were compared with the holotype deposited at Plant Protection Research Institute, Agricultural Research Center, Egypt.

Type depositions.Holotype and 4 paratype females deposited at Plant Protection Research Institute- Agricultural Research Center - Fruit Acarology Department, Dokki, Cairo, Egypt (ARC-PPRI).

Relation to host. The mites live on lower surface of leaves.

***Brevipalpus lewisi* McGregor, 1949** (Fig. 4C).
No synonyms.

Material examined: 3 females and one male ex *Citrus spp.* (Rutaceae): Menufia province, El-Bagour30°26'6"N, 31°02'6"E, 25 August, coll. Hassan Zynhom.

Remark: In Egypt, this species was described by Attiah (1956), from specimens collected at El-Bagour, Menufia. Since then this species was not recorded again in Egypt until 2014 when recorded again by Halawa and Fawzy were recorded again on the same host plant and at the same place. During our study this species was recorded in the same place and on same host plant. Specimens collected in this study were compared with the holotype deposited at Plant Protection Research Institute, Agricultural Research Center , Egypt.

Type depositions: Holotype and 2 paratype females deposited at Plant Protection Research Institute- Agricultural Research Center - Fruit Acarology Department, Dokki, Cairo, Egypt.

Relation to host: The mites live on lower surface of leaves and fruits causing brown scars.

***Brevipalpus californicus* (Banks, 1904)**(Fig.4)
Tenuipalpus californicus Banks, 1904: 55.
Tenuipalpus australis Tucker, 1926: 3.
Tenuipalpus vitis Womersley, 1940: 241.
Brevipalpus confusus Baker, 1949: 380.
Brevipalpus browningi Baker, 1949: 382.
Brevipalpus woglumi McGregor, 1949: 19.
Brevipalpus californicus, Pritchard and Baker 1951: 30; Meyer and Ryke 1959:319.

Type 1 (Fig. 4 A & B).

Material examined: 7 females and 1males ex *Citrus* spp. (Rutaceae), 5 females ex *Psidium guajava* L. (Myrtaceae): Qalubia province, El- Marg, 30°21'18"N, 31°13'30"E, 20 July 2014, *Citrus aurantium* L (Rutaceae): Giza province, Nikla village, 30°02'6"N, 31°12'18"E, 25 August 2014.

Remark:. Type 1 of *Brevipalpus californicus* (Banks) was recorded and described for first time in USA by Ochoa *et al.* (2013); while the same type was recorded and described in Egypt for first time by Halawa *et al.*(2013). Our study agrees with description this type by the mentioned authored.

Type depositions: Holotype and 2 paratype females deposited at Plant Protection Research Institute-Agricultural Research Center - Fruit Acarology Department, Dokki, Cairo, Egypt.

Relation to host: The mites live on lower surface of leaves and fruits causing brown scars.
Type 2 (Fig. 4C & D).

Material examined: 5 females ex *Citrus spp.* (Rutaceae); Menufia province, El-Bagour 30°26'6"N, 31°02'6"E, 20 july 2014, 5 females ex *Pyrus communis* L. (Rosaceae): Behera province, Behera, 30°36'54"N, 30°41'6"E, 25 August 2014, 3 females ex *Citrus* spp. (Rutaceae): Dakahlia province, Tonamel village, 30°50' 6"N, 31°15'18"E.

Remark: Type 2 of *Brevipalpus californicus* (Banks) was recorded and described for first time in USA by Ochoa *et al.* (2013); while the same type was recorded and described in Egypt for first time by Halawa et al. (2013). Our study agrees with description this type by the mentioned authored.

Type depositions: Holotype and 2 paratype females deposited at Plant Protection Research Institute-Agricultural Research Center - Fruit Acarology Department, Dokki, Cairo, Egypt.

Relation to host: The mites live on lower surface of leaves and fruits causing brown scars.

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