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The Tenuipalpidae (Acari: Trombidiformes) of Israel

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ABSTRACT

An annotated list and key to the 26 species of phytophagous false spider mites (Trombidiformes: Tenuipalpidae) known from Israel is provided. About two thirds are exotics, having invaded Israel within the last 35 years. Eight species, namely *Brevipalpus californicus*, *B. lewisi*, *B. obovatus*, *B. phoenicis*, *B. yothersi*, *Raoiella indica*, *Tenuipalpus granati* and *T. punicae* are agricultural pests. The others have little economic impact, or are possibly controlled by natural enemies. A key to all the species is given.

Keywords Acari, notated list, flat mites, Israel, phytophagous mites

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Introduction

The flat mite family Tenuipalpidae (Trombidiformes) contains many species that are world-wide major plant pests (Mesa *et al.*, 2009). Studies of the flat mites of Israel were initiated by Bodenheimer (1930, 1937), reporting the first two tenuipalps, *Cenopalpus pulcher* (Canestrini & Fanzago) (= *Tenuipalpus bodenheimeri* Berlese) and *Cenopalpus spinosus* Donnadieu (= *Tenuipalpus geisenheyeri* Ruebsaamen) from Palestine. Twenty-one years later four more species were added, namely *Brevipalpus californicus* (Banks) (= *B. browning* Baker), *B. obovatus* Donnadieu, *Obdulia tamaricis* Pritchard & Baker and *Tenuipalpus punicae* Pritchard & Baker (Pritchard & Baker, 1958). Bytinski-Salz (1966) reported two new species to the Israel fauna, namely *Brevipalpus phoenicis* (Geijskes) and *Brevipalpus lewisi* (McGregor). A year later Sternlicht & Golan (1967) recorded *Tenuipalpus granati* Sayed from Israel. Dosse (1974) reported *Cenopalpus lineola* (Canestrini & Fanzago) from Haifa. After 1980 sixteen species were described or reported as new to the Israel fauna: *Aegyptobia eremia* Meyer & Gerson, *A. salixi* Zaher & Yousef, *Brevipalpus oleae* Baker, *B. olearius* Sayed, *B. recki* Livschits & Mitrofanov, *B. yothersi* Baker, *Cenopalpus halperni* Castagnoli, *C. lanceolatisetae* (Attiah), *C. wainsteini* (Livschits & Mitrofanov), *Capedulia maritima* Gerson & Smith Meyer, *Dolichotetranychus australianus* (Womersley), *Phyllotetranychus aegyptiacus* Sayed, *Tenuipalpus cupressoides* Smith Meyer & Gerson, *T. dubinini* Reck and *T. pareriophyoides* Smith Meyer & Gerson (Gerson & Smith Meyer, 1980; Smith Meyer & Gerson, 1981; Halperin *et al.*, 1989; Klein & Zarabi, 2011; Castagnoli, 1987; Beard *et al.*, 2015). *Brevipalpus yothersi* Baker, synonymized by Pritchard & Baker (1952) with *B. phoenicis*, was one of two species resurrected and redescribed by Beard *et al.* (2015a) after examining two females on guava fruit from Israel, intercepted in Washington DC, in 1985 and in Chicago, USA (no date).

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The number of flat mite species recognized in Israel has grown over the past 35 years, due to the increase in the importation of exotic plant material, along with the introduction and establishment of new crops and of new varieties of traditional crops. Of the local species about 70% are exotics, and 30% are pests of local crops.

This paper presents an annotated list of 26 flat mite species identified from agricultural systems and indigenous plants in Israel. Hosts, distributional data, and biological notes are appended, and a key to the Israeli species is provided.

General information from abroad is based on Mesa *et al.* (2009), whereas additional data on the local fauna is based on Klein & Zarabi (2011). These observations and the fact that many of the indigenous shrubs and trees have not yet been surveyed for tenuipalpids suggest that the species listed here represent only a part of the local flat mite fauna. The species are listed alphabetically, genus and species.

Materials and methods

Seventeen of the 26 species noted here were figured from specimens in the National Collection of the Biosystematics Division, ARC-Plant Protection Research Pretoria, South Africa, namely *Aegyptobia eremica*, *Brevipalpus californicus*, *B. lewisi*, *B. obovatus*, *B. phoenicis*, *B. yothersi*, *Capedulia maritima*, *Cenopalpus lanceolatisetae*, *C. pulcher*, *C. spinosus*, *Dolichotetranychus australianus*, *Raoiella indica*, *Tenuipalpus cupressoides*, *T. granati*, *T. pareriphyoides* and *T. punicae* by the senior author while still in their employ. Some of the latter and *B. lewisi*, *B. olearius* and *C. lineola* were also based on material used for a study on the Turkish Tenuipalpidae (Çobanoğlu *et al.*, 2016). The rest of the species' figures are reconstructions

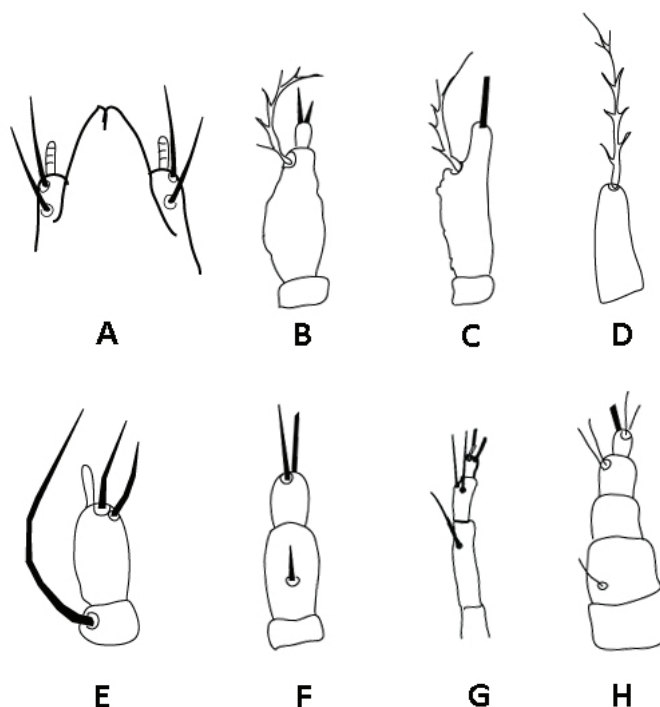


Figure 1 Different types of Tenuipalpidae palpi: A – one-segmented (ex *Capedulia*); B – three-segmented (*Tenuipalpus*); C – two-segmented (*Raoiella*, *Phyllostetranychus*); D – one-segmented (*Tenuipalpus*); E – two-segmented (*Raoiella*, *Phyllostetranychus*); F – three-segmented (*Dolichotetranychus*); G – four-segmented (*Brevipalpus*, *Cenopalpus*); H – five-segmented (*Aegyptobia*)

from the original descriptions. Beard *et al.* (2015b) were also consulted to verify the identity of some species. For all figures photos of specimens and scans of figures from descriptions were taken and illustrated with a Zeiss AxioskopTM Research microscope equipped with a Zen Soft Imaging System. The photos included here are of specimens collected in Israel and where taken at the Plant Protection and Inspection Services, Israel using both a Hirox RH-2000 digital and an Olympus BX62 optical microscope.

Results

Trombidiformes, Reuter, 1909

Prostigmata, Kramer, 1877: 219

Tetranychidae, Donnadieu, 1875: 9

Tenuipalpidae, Berlese, 1913: 17

***Aegyptobia* Sayed, 1950**

Both this genus and *Phytoptipalpus* Trägårdh have 13 pairs of opisthosomal setae (rarely 12), 3 pairs of dorsocentral (*c1*, *d1*, *e1*), 4 pairs of dorsosublateral (*c2*, *d2*, *e2*, *f2*) (Fig 2A) and 6 pairs of marginal setae (*c3*, *d3*, *e3*, *f3*, *h2*, *h1*). However, *Phytoptipalpus* differs from *Aegyptobia* only in that the former has 2 pairs of anal setae (*ps1-2*) (Fig 2C) instead of 3 pairs and in that its adult members have 3-4 pairs of legs, 4 pairs in *Aegyptobia*. Palp 5-segmented (Fig 1H). Leg tarsi with claws either unciniate or padlike. Ventral shields not clearly outlined.

***Aegyptobia eremia* Smith Meyer & Gerson, 1981 (Figure 2)**

Diagnosis (Female) — Dorsum reticulated, anteriorly indented; all dorsal setae smooth, broad and with obscure transverse subdivisions, opisthosoma with one pair of pores posterior to setae *d2* (Figs 2A-B); rostrum reaches to about mid-genu I; femora I-III and genera I-II each with one lanceolate seta, rest setiform; ventral setae *3a* and *4a* short, less than half the distance separating them (Fig 2C); legs with true claws uncinated.

Deutonymph — Dorsal setae as in female; prodorsum with indistinct shield; opisthosoma with transverse striae on anterior half and longitudinal striae on posterior half.

Hosts and locality. Described from *Hammada scoporia* (Pomel) Iljin and *Salsola* sp. (Chenopodiaceae), Yeroham, and Nahal Boqer, Israel.

Symptoms — Unknown.

***Aegyptobia salixi* Zaher & Yousef, 1969 (Figure 3)**

Diagnosis (Female) — Prodorsum with more or less even reticulations medially, rounded anteriorly, opisthosoma provided with a few transverse striae; rostrum extends to about distal end of genu I; dorsal body setae are broadly lanceolate and serrate (Fig 3); femora I-II each with one lanceolate serrate seta as long as width of segment; legs with true claws uncinated.

Host and localities — Described from *Salix alba* L. (Salicaceae), Cairo, Giza, El-Sharkia El-Menia, Egypt; Israel, Lake Galilee, (Smith Meyer & Gerson, 1981), same host.

Symptoms — Unknown.

Genus *Brevipalpus* Donnadieu, 1875

Members of this genus have 3 pairs of prodorsal setae (*v2*, *sc1*, *sc2*), 7-10 pairs of opisthosomal setae consisting of: 1-3 pairs of dorsocentral setae (*c1*, *d1*, *e1*) and 6-7 pairs of dorsolateral

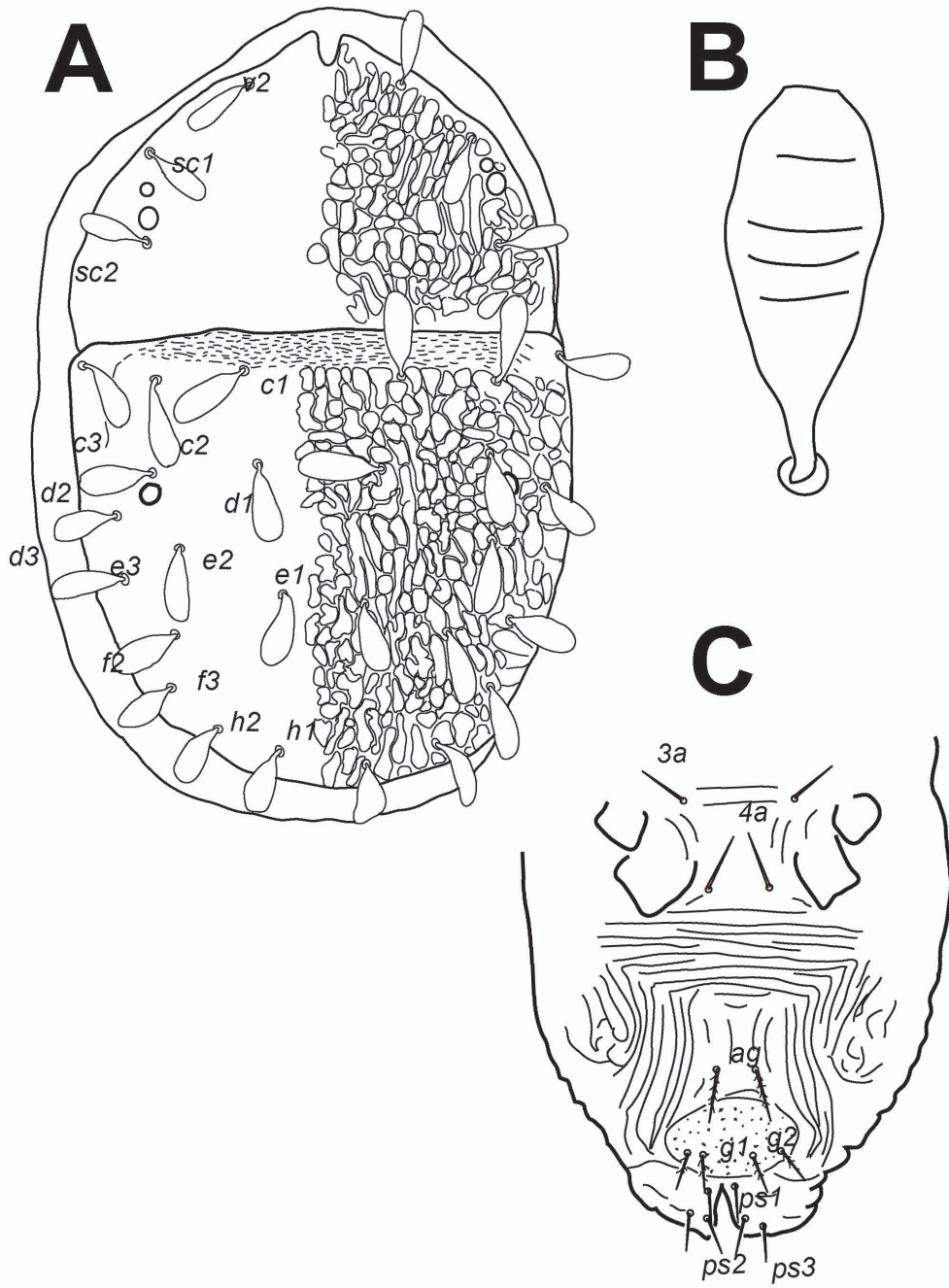


Figure 2 *Aegyptobia eremia* Smith Meyer & Gerson – Female: A – dorsal view; B – dorsal seta *c1*; C – opisthogaster.

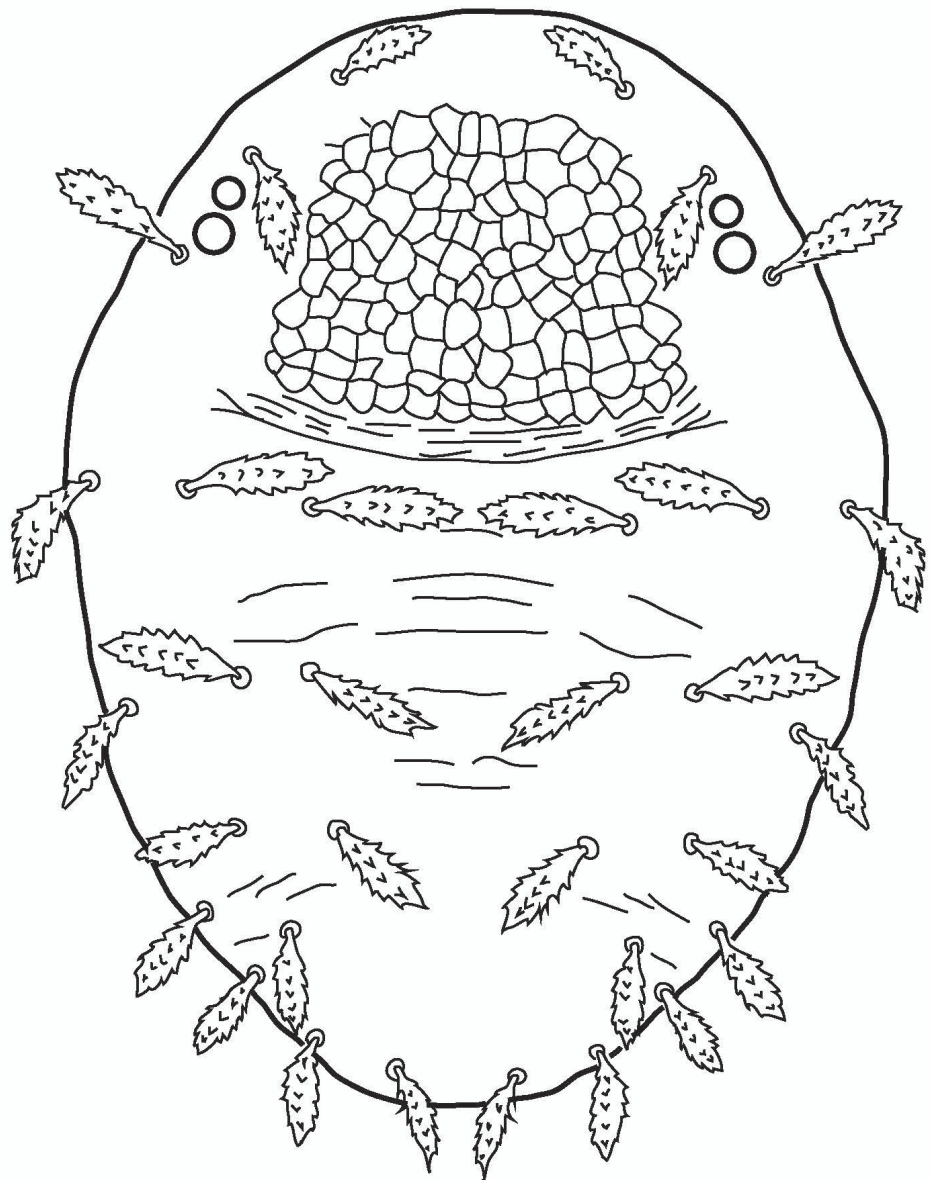


Figure 3 *Aegyptobia salixi* Zaher & Yousef – Female, dorsal view.

setae (*c3*, *d3*, *e3*, *f2*, *f3*, *h2*, *h1*, with *f2* absent or present), sublateral setae *c2* absent (Fig 4A). Setae *h2* not exceptionally long. Tarsus II with one or 2 solenidia distally (Fig 4D). Palp 4-segmented (Fig 1G). Ventral shields clearly demarcated (Fig 4B).

***Brevipalpus californicus* (Banks, 1904)
(probably *B. californicus sensu lato*, Beard et al., 2015b) (Figure 4)**

Diagnosis (Female) — Prodorsum with even reticulations and short serrate setae, opisthosoma between setae *c1* and *d1* and *d1* and *e1* wrinkled with a few V-shaped folds behind setae *e1*, reticulations mediodorsally, with 7 pairs of short, serrate marginal setae (including *f2*) and 3 pairs of dorsocentral setae apparently smooth (Fig 4A); rostrum extends to about middle of

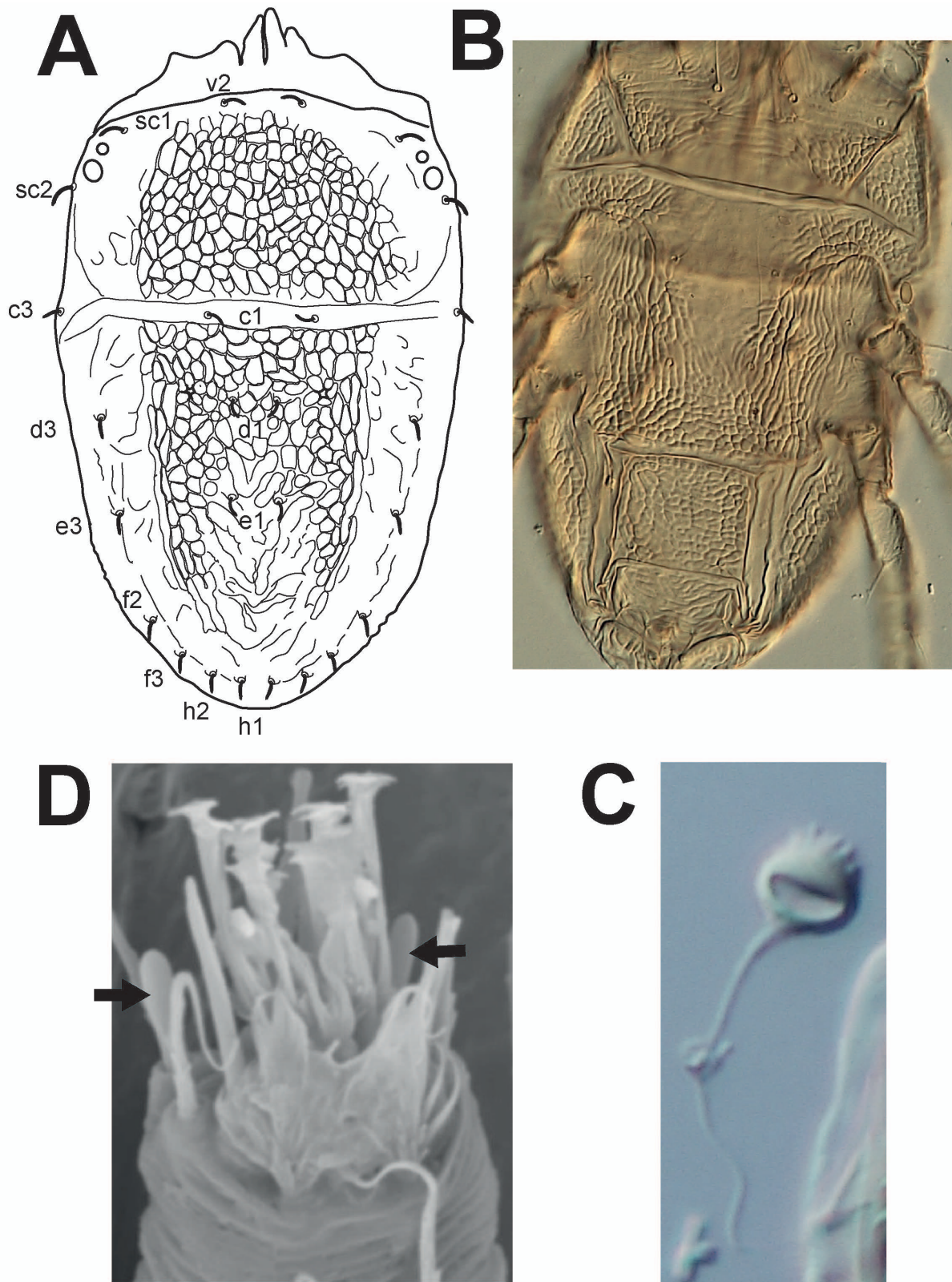


Figure 4 *Brevipalpus californicus* (Banks) – Female: A – dorsal view; B – ventral view; C – spermatheca; D – tarsus II, the arrows indicate the two distal solenidia.

femur I; tarsus II with 2 solenidia distally (Fig 4D); genital shield with large reticulations, connected to form transverse bands, and ventral shield with smaller reticulations also forming transverse bands (Fig 4B); spermatheca terminates into a round vesicle with a crown of short finger-like projections, vesicle with a semi-lunar “bubble” internally (Fig 4C).

Remarks — Beard *et al.* (2015b) identified 4 morpho type groups in this species that are still due for further examination.

Host and localities — From a wide range of hosts, but mainly citrus from: Australia, Ecuador, Israel, Italy, Kenya, Mexico, Nepal, Palestine, Peru, South Africa, Spain, Sri Lanka, Thailand, USA (Beard *et al.*, 2015b).

Symptoms — Can cause chlorosis, blistering, or necrotic areas on leaves. In the New World, it is strongly associated with the nuclear citrus leprosis viruses, citrus leprosis virus (Roy *et al.*, 2015).

***Brevipalpus lewisi* McGregor, 1949 (Figure 5)**

Diagnosis (Female) — Prodorsum weakly to strongly wrinkled or folded medially, can also appear like areolae, laterally with elongated cells forming a reticulation, opisthosoma smooth or wrinkled between setae *c1-c1* and *e1-e1* with weak to strong V-shaped folds posterior to *e1-e1*, 3 pairs of dorsocentral setae different in shape to dorsolateral setae (*f2* present) (Fig 5A); spermatheca terminating into a small rounded vesicle with a series of short projections and clear internal “bubble” (Fig 5C); genital and ventral shields with reticulations forming transverse bands (Fig 5B); palp femur seta slender, tapered and barbed; tarsus II with one solenidion (Beard *et al.*, 2015b; Hao *et al.*, 2016).

Deutonymph — Prodorsum with setae *sc1-2* broadly lanceolate. Opisthosoma with setae *c3* and the 4 pairs of caudolateral setae (*f2, f3, h2, h1*) broadly lanceolate and about as long as intervals between them, rest minute and smooth or slightly serrate (Fig 5D) (Beard *et al.*, 2015b).

Hosts and localities — In Israel it was collected from “Blue Serbian vines”, at Nachshonim (Bytinski-Salez, 1966), but could not be found again till recently in Mizpe Ramon on petit vardo leaves. Other overseas hosts are: lemon, walnut, Boston ivy, grape, pistachio, pomegranate, *Metasequoia* (Dawn Redwood) and many ornamental plants (Jeppson *et al.*, 1975). It was also reported from Algeria, Australia, Bulgaria, Canada, China, Egypt, Greece, India, Iran, Japan, Lebanon, Mexico, Taiwan, Turkey, USA and former Yugoslavia (Attiah, 1956; Baker, 1949; Baker & Tuttle, 1964, 1987; Ehara, 1956; Hatzinikolis, 1982, 1986, 1987; Khosrowshahi & Arbabi, 1997; Ma & Yuan, 1977; McGregor, 1949; Smith Meyer, 1979; Mitrofanov & Strunkova, 1979; Pritchard & Baker, 1952, 1958; Sadana, 1997; Smiley & Gerson, 1995; Tseng, 1974; Hao *et al.*, 2013).

Symptoms — This mite is an important pest of oranges, tangerines and lemons in California (USA) and Japan. Serious injury has not been recorded on grape fruit. The mites lay their red, oval eggs singly in depressions and crevices of fruit, twigs and leaves, apparently preferring any stage of fruit to twigs or leaves. They seem to prefer the stem end of citrus fruit near or under the fruit button and fruit depressions and cause a silvering of the fruit. In central California, they overwinter in the adult stage. Peak populations are reached during the warmest months. Feeding on fruit produces scab-like scars, starting from fruit depressions or from depressions produced by leafhoppers or other insects, or by any injury that ruptures the oil sacs in the citrus peels. As the mites continue to feed, the scabbed area may increase to cover most of the fruit. Damage results in reducing the grade of fruit (Reuther, 1989; Jeppson *et al.*, 1975; Elmer & Jeppson, 1957). In Greece, it is a pest of citrus, grapes, and pomegranates (Hatzinikolis, 1986). Bytinski-Salez (1966) reported it from “Blue Serbian” vines in 1952 in Israel, causing severe

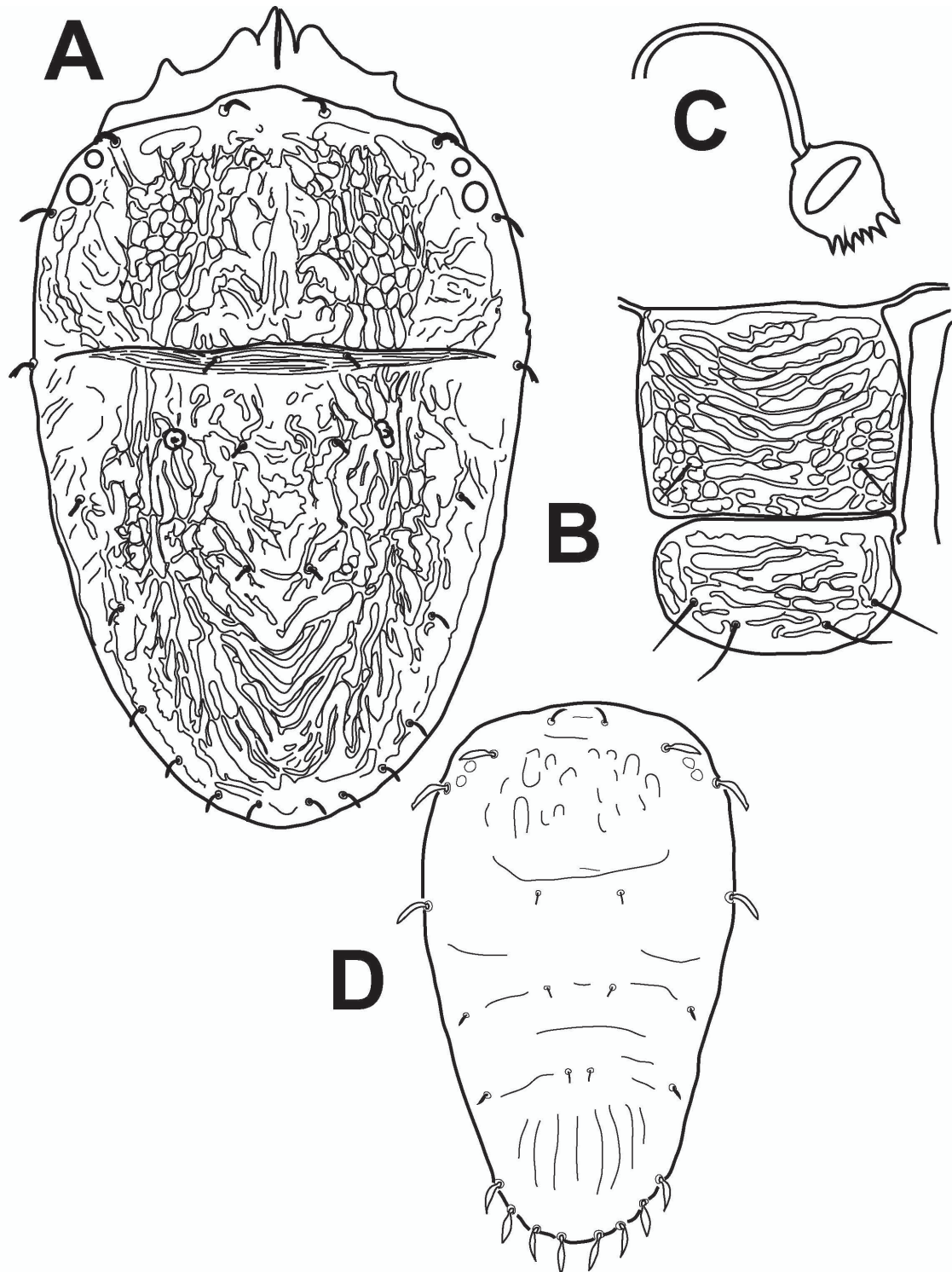


Figure 5 *Brevipalpus lewisi* McGregor – Female: A – dorsal view; B – opisthogaster; C – sermatheca; Deutonymph: D – dorsal view.

leaf chlorosis. It was recently collected again from under side of petit vardo leaves infested with *Tetranychus turkestanii* in Mizpe Ramon. It is not known as a vector of viruses (Elmer & Jeppson, 1957).

Biology and Ecology — *Overwinters* in adult stage on deciduous host plants such as grapes in California and is active throughout the year on citrus. Peak populations occur during warmest months (Rice & Weinberger, 1981). Number of annual generations is related to the type of host, for example 4 on vines in Bulgaria and California. It reproduces by thelytoky, as no males were found (Buchanan *et al.*, 1980).

***Brevipalpus obovatus* Donnadieu, 1875 (Figure 6)**

Diagnosis (Female) — Prodorsum mostly smooth centrally, strongly reticulate laterally with large cells posteriorly and smaller cells anteriorly, setae short, serrate; opisthosoma between setae *c1* and *e1* weakly reticulate to weakly wrinkled, cuticle between and posterior to setae *e1* with short transverse folds, setae *f2* absent, with marginal setae short, serrate and 3 pairs of dorsocentral setae apparently smooth (Fig 6A); genital and ventral shields colliculate (having small elevations) (Fig 6B); rostrum extends to about middle of femur I; palp tarsus II with one solenidion distally; spermatheca terminates into a round vesicle with short finger-like projections around entire perimeter (Fig 6C).

Deutonymph — Prodorsum with setae *sc1-2* short but clearly longer than *v2*, opisthosoma also with setae short but *c1*, *d1*, *d3* and *e1* shorter than *c3*, *e3*, *f3*, *h1-2* (Fig 6D).

Hosts and localities — On a wide range of hosts, but mainly citrus from: Argentina, Australia, Brazil, Canada, Chile, China, Colombia, Costa Rica, Democratic Republic of Congo, Ecuador, France, Germany, Hungary, India, Iran, Italy, Jamaica, Japan, Korea, Mauritius, Mexico, Pakistan, Papua New Guinea, Thailand, The Philippines, South Africa, Taiwan, USA, Venezuela (Beard *et al.*, 2015b). In Israel on many host plants, from Nes Ziona, Miqwe Israel, Jerusalem and Urim (Smith Meyer & Gerson, 1981).

Symptoms — This species may cause chlorosis, blistering, or necrotic areas on citrus leaves. It is strongly associated with the nuclear citrus leprosis viruses in the New World, citrus leprosis virus N (CiLV-N) and citrus necrotic spot virus (CiNSV) (Roy *et al.* 2015).

***Brevipalpus oleae* Baker, 1949 (Figure 7)**

Diagnosis (Female) — Dorsum rugose-reticulate medially and striate-granular laterally. The dorsal setae short, narrowly lanceolate and serrate. Three pairs of dorsocentral setae and *f2* present (Fig 7A). Venter smooth medially, from ventral shield to gnathosoma but laterally with reticulations and granules. Ventral, genital, and anal shields striate (Fig 7B). Dorsal setae on genua I-II and femora I-III broadly lanceolate and serrate. Spermatheca a very long, slender, coiling tube terminating into a large, prominent hairy bulb (Fig 7C); tarsus II with one solenidion distally; two setae on trochanter III and one seta on trochanter IV; rostrum reaches to distal end of genu I. This species and *B. olearius* are similar but differs only in trochanters III and IV with 2 and one setae, respectively, in *B. oleae*, as opposed to one and without setae in *B. olearius*.

Deutonymph — Dorsal setae serrate and short, except for setae *sc2*, *c3*, *f3* and *h1* which are clearly longer and lanceolate (Fig 7D). The deutonymphs of this species and that of *B. olearius* also differ as depicted (Figs 7D, 8D).

Hosts and localities — *Olea europaea* L. (Oleaceae). Described from Morocco (Baker, 1949), but also reported from Portugal, Greece, Italy and Israel (Klein & Zarabi, 2011).

Symptoms — Feeds on the bark of olive trees (Baker, 1949)

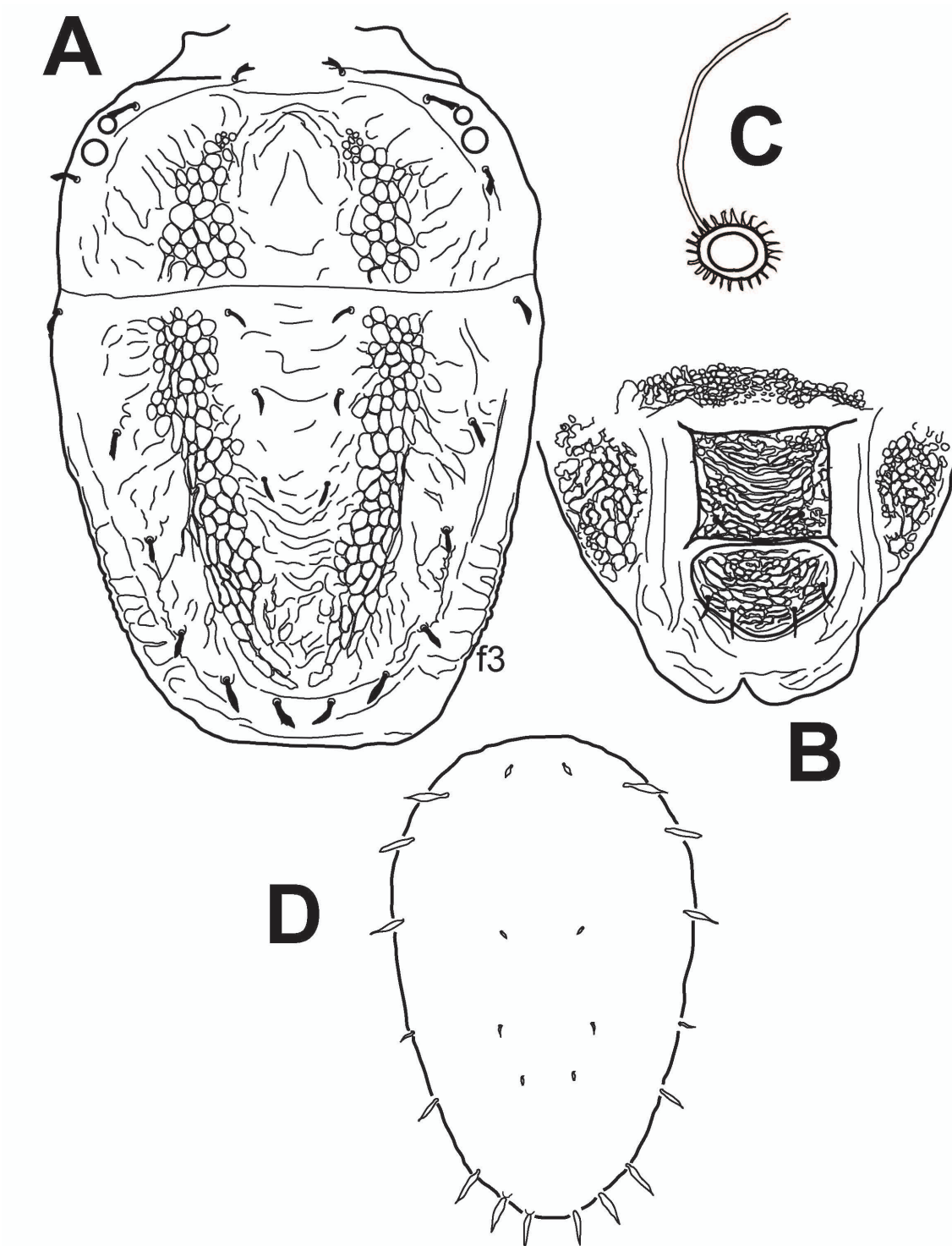


Figure 6 *Brevipalpus obovatus* Donnadieu – Female: A – dorsal view; B – opisthogaster; C – spermatheca; Deutonymph: D – dorsal view.

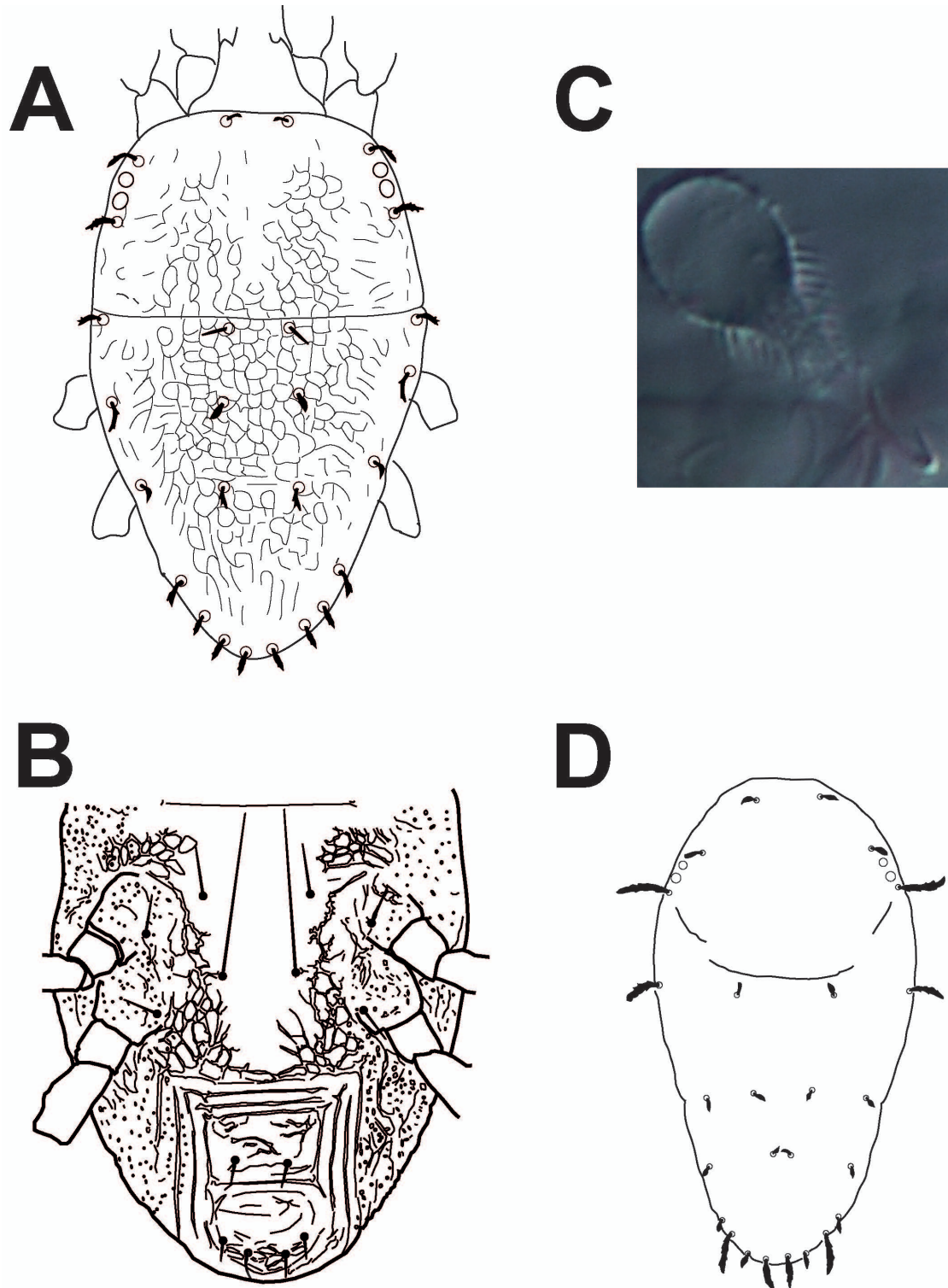


Figure 7 *Brevipalpus oleae* Baker – Female: A – dorsal view; B – opisthogaster; C – spermatheca; Deutonymph: D – dorsal view.

***Brevipalpus olearius* Sayed, 1950 (Figure 8)**

Diagnosis (Female) — Resembles *B. oleae* in all respects except for the number of setae on trochanters III and IV and the dorsal setal arrangements of the deutonymphs. Dorsum irregularly reticulate-striate medially and striate-granular laterally. Dorsal body setae short, narrowly lanceolate and serrate. Three pairs of dorsocentral setae and *f2* present (Fig 8A). Venter smooth medially from ventral shield to gnathosoma, but laterally with reticulations and granules. Ventral, genital, and anal shields striate (Fig 8B). Dorsal setae on genua I-II and femora I-III broadly lanceolate and serrate. Spermatheca a very long, slender, coiling tube terminating into a large, prominent hairy bulb (Fig 8C); tarsus II with one solenidion distally; one seta on trochanter III and trochanter IV without setae; rostrum reaches to distal end of genu I.

Deutonymph — Setae *sc2*, *c3*, *d3*, *e3*, *f3* and *h1* longest, broadly lanceolate, and serrate; setae *v2*, *sc1*, *c1*, *d1*, *e1*, *f2*, *h2* much shorter and serrate (Fig 8D).

Hosts and localities — *Olea europaea* L. (Oleaceae). Described from Egypt by Sayed, 1950, but also reported from Crimea, Ukraine, Greece, Iran, Italy, Libya, Turkey, and Israel (Castagnoli & Pegazzano, 1979; Hatzinikolis, 1986; Smith Meyer & Gerson, 1981; Khanjani *et al.*, 2013).

Symptoms — Unknown.

***Brevipalpus phoenicis* (Geijskes, 1939) (Figure 9)**

Diagnosis (Female) — Prodorsum centrally with strong areolae, mediolateral reticulations with large round cells posteriorly, small round cells anteriorly, but smooth near anterior margin, setae short serrate; opisthosoma between setae *c1* and *d1* strongly wrinkled to weakly areolate, cuticle between *d1* and *e1* strongly wrinkled with few transverse folds, between *e1* and *h1* with transverse folds, mediolateral reticulations with large round cells; transverse folds behind setae *e1*, setae *f2* absent, marginal and 3 pairs of dorsocentral setae short, serrate (Fig 9A); rostrum extends to about middle of femur I; venter verrucose laterally behind *4a* with transverse bands centrally becoming weaker to smooth towards *4a*, ventral shield with cells forming transverse bands, genital shield covered with large cells (Fig 9B); palp tarsus II with 2 solenidia distally, palp femorogenu with dorsal setae broad, flat, serrate; spermatheca terminates into a membranous bulb (Fig 9C).

Deutonymph — Prodorsal setae *v2* short and *sc1-2* broadly lanceolate; opisthosomal setae *c1*, *d1*, *d3*, *e1*, *e3* minute, setae *c3*, *f3*, *h1*, *h2* large and broadly lanceolate (Fig 9 D).

Host and localities — Material for the designation of a neotype was collected from *Phoenix canariensis* Chabaud (Arecaceae), The Netherlands. However, it is also present in Turkey, New Zealand, Brazil, and South Africa. Its presence in Israel remains to be determined (Personal communication between Dr. Jenny Beard and Prof. Uri Gerson).

Symptoms — Its main economic damage is to smaller orange fruits. In Italy, its feeding resulted in grayish scabby patches and in medial cracks on the apical epidermis of mandarins. Many lesions were located on the oil glands, which were emptied and dried; affected oranges show rounded reddish patches. In heavy infestations, the mite attacks all above-ground citrus parts, causing the leaves to turn brownish, dry and drop (Gerson, 2017).

***Brevipalpus recki* Livschitz & Mitrofanov, 1967 (Figure 10)**

Diagnosis (Female) — Dorsum reticulated, prodorsum with setae, broadly lanceolate, serrate and covered with large cells; opisthosoma with one pair of broadly lanceolate dorsocentral setae (*c1*), setae *d1*, *e1* and *f2* absent; dorsolaterals *c3* and *d3* broadly lanceolate, rest setiform,

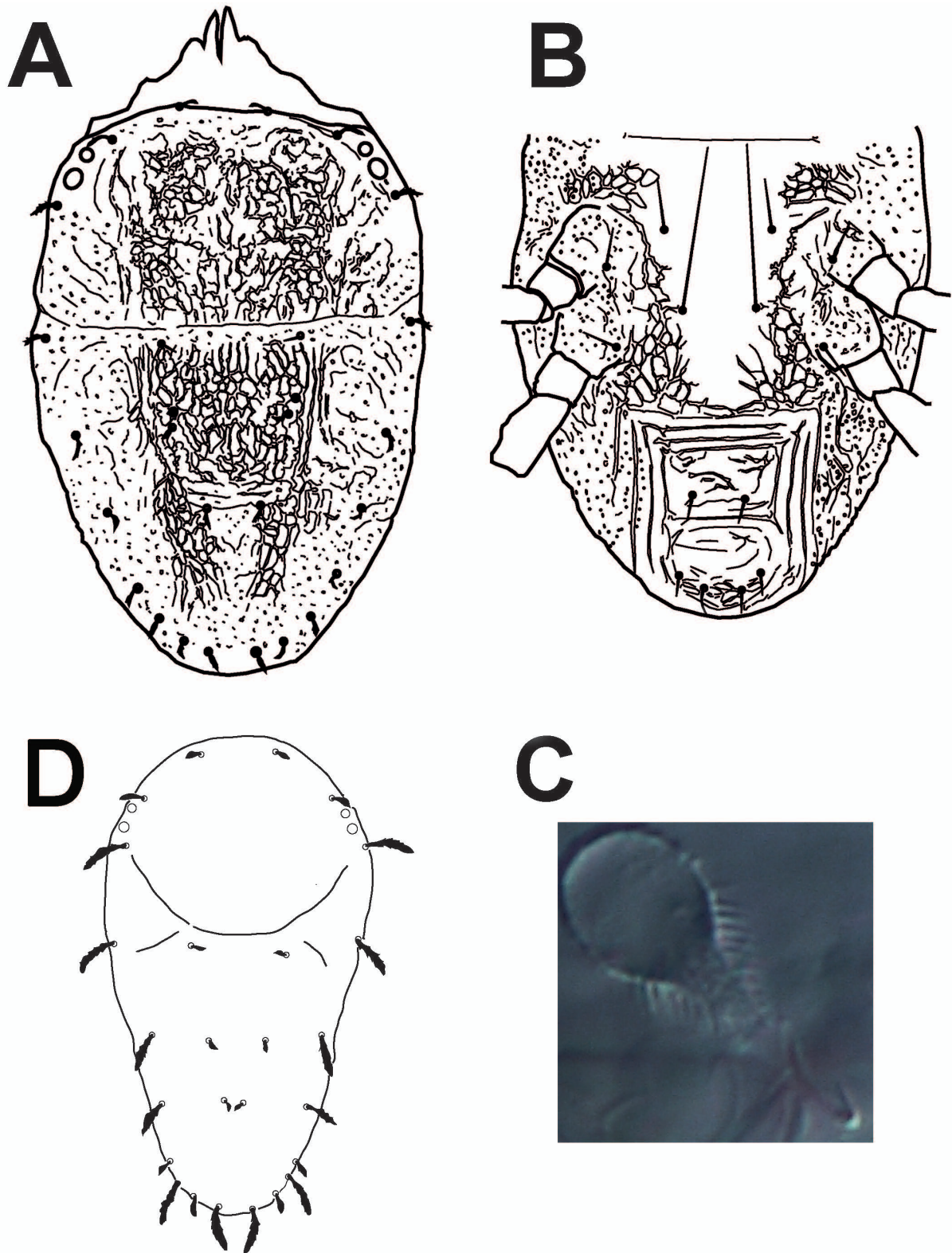


Figure 8 *Brevipalpus olearius* Sayed – Female: A – dorsal view; B – opisthogaster; C – spermatheca; Deutonymph: D – dorsal view.

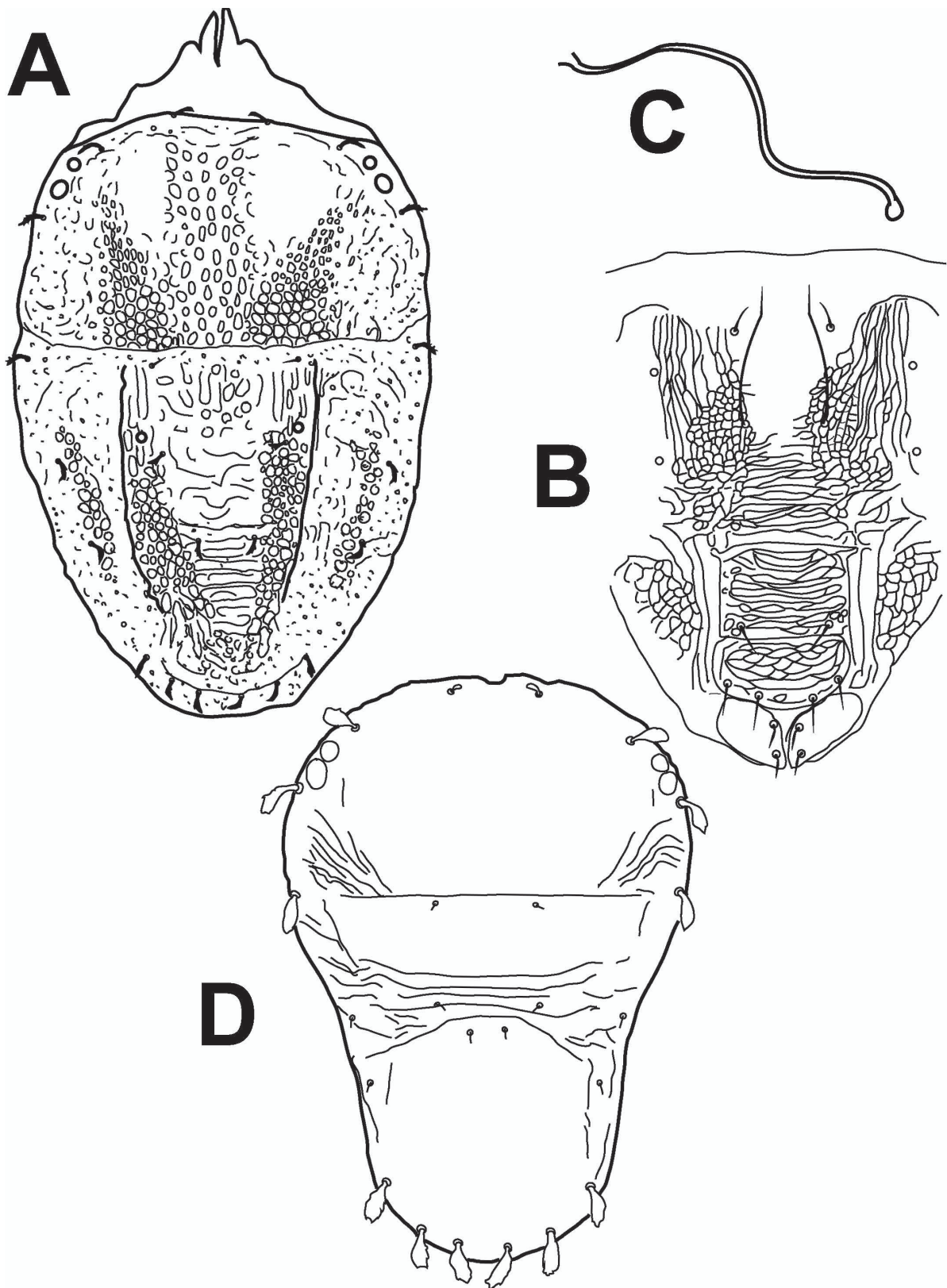


Figure 9 *Brevipalpus phoenicis* (Geijskes) – Female: A – dorsal view; B – opisthogaster; C – spermatheca; Deutonymph: D – dorsal view.

opisthosoma mostly reticulate with large cells, cuticle medially with short transverse folds (Fig 10A); solenidia on tarsi I and II longer or about as long as width of segments, each with only one solenidion (Fig 10B); rostrum reaches to middle of femur I; palp femur seta thin, tapered, weakly barbed.

Deutonymph — Prodorsum with setae *v2*, *sc1-2* broadly lanceolate; opisthosoma with all setae broadly lanceolate, except for *h1* which are very short (Fig 10C).

Hosts and localities — *Quercus ithaburensis* Decaisne (Fagaceae), Benyamina, Israel (Smith Meyer & Gerson, 1981). Described from beech and *Inula conyza* (Griess.) DC (Asteraceae) (formerly known as *Inula vulgaris*), from the Ukraine (Livschitz & Mitrofanov, 1967). Also reported from Greece (Hatzinikolis, 1987).

Symptoms — Unknown.

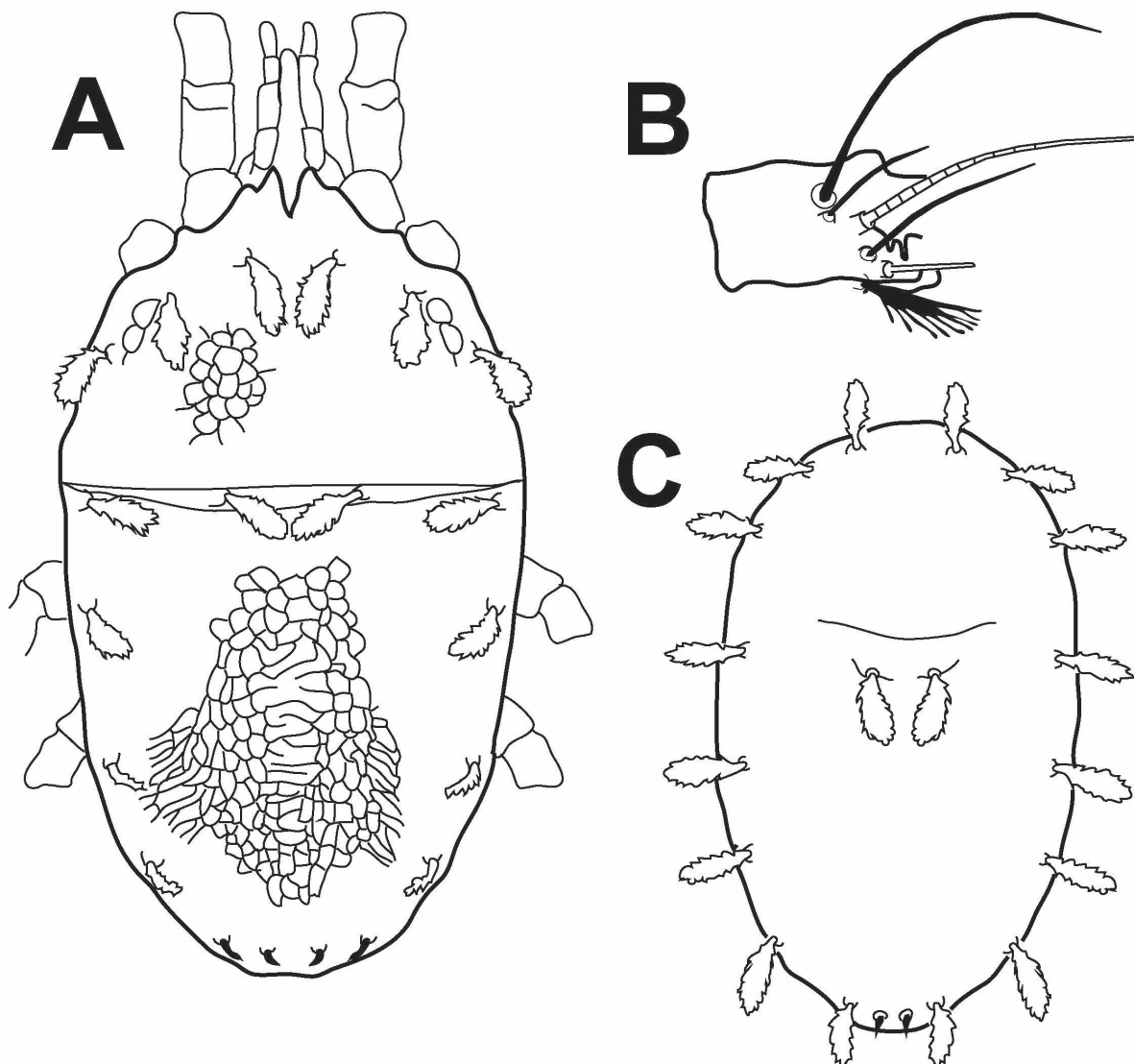


Figure 10 *Brevipalpus recki* Livshitz & Mitrofanov – Female: A – dorsal view; B – Tarsi I and II; Deutonymph: C – dorsal view.

***Brevipalpus yothersi* Baker, 1949 (Figure 11)**

Diagnosis (Female) — Prodorsum centrally with strong areolae, posteriorly reticulation with large cells, anteriorly weakly reticulate, with setae short and serrate, setae *v2* shortest; opisthosoma between setae *c1* and *d1* smooth to weakly reticulate, cuticle between *d1* and *e1* weakly reticulate or wrinkled, between *e1* and *h1* with strong V-shaped folds, mediolateral with reticulations, transverse folds behind setae *e1*; setae *f2* absent with marginal setae short, serrate, 3 pairs of short, serrate dorsocentral setae (Fig 11A); ventral and genital shields verrucose and verrucose-reticulate, respectively (Fig. 11B); rostrum extends to about middle of femur I; palp tarsus II with 2 solenidia distally; palp femorogenu with dorsal seta narrow, serrate; spermathecal terminates into a sclerotised oval vesicle with a thick distal stipe (Fig 11C).

Deutonymph — Prodorsal setae *v2* and *sc1-2* broadly lanceolate, but with *v2* short; opisthosomal setae *c1*, *d1*, *e1* minute, setae *c3*, *d3*, *e3*, *f3*, *h1*, *h2* large and broadly lanceolate, but setae *c3*, *d3* and *e3* can vary from short to large (Fig 11D).

Host and localities — From a wide range of hosts, but mainly citrus from: Argentina, Australia, Bangladesh, Brazil, Burma, China, Colombia, Costa Rica, Cuba, Democratic Republic of Congo, Dominican Republic, Ecuador, El Salvador, Ethiopia, France, Guatemala, Honduras, India, Indonesia, Israel (passion fruit), Malaysia, Mexico, Nigeria, Pakistan, Puerto Rico, Spain, Sri Lanka, Thailand, The Philippines, Trinidad, South Africa (probably, not confirm yet), Venezuela (Beard *et al.* 2015a). Beard *et al.* (2015a) examined 2 females on guava fruit from Israel that were intercepted in Washington DC, in 1985 and in Chicago (no date).

Symptoms — Large numbers found on passion fruit in Israel, causing substantial epidermal blemishing to fruits and stems.

Genus *Capedulia* Smith Meyer, 1979

This genus resembles the genera *Obdulia* Pritchard & Baker, *Larvacarus* Baker & Pritchard and *Obuloides* Baker & Tuttle in the reduction of palpi (Fig 1A). *Capedulia* and *Obdulia* are more closely related but the former differs from the latter in that setae *c2* are present (Fig 12); 3 pairs of prodorsal setae (*v2*, *sc1*, *sc2*), opisthosoma with 10 pairs of setae, comprising 3 pairs of dorsocentral (*c1*, *d1*, *e1*), 6 pairs of lateral (*c3*, *d3*, *e3*, *f3*, *h2*, *h1*) and one pair of sublateral setae (*c2*); leg tarsi with padlike claws; palp one-segmented (Fig 1A). Ventral shields indistinct.

***Capedulia maritima* Gerson & Smith Meyer, 1980 (Figure 12)**

Diagnosis (Female) — All dorsal setae are very long and serrate; dorsum coarsely striate, most striae with small tubercles (Fig 12); venter with genital shield with transverse striae and 2 pairs of setae (*gl-2*), one pair of aggenital setae (*ag*) anterior to this shield, and anal shield with 2 pairs of setae (*ps*); rostrum reaches to middle of tibia I.

Hosts and localities — Collected from the roots of *Limonium meyeri* (Boiss.) Kuntze (Plumbaginaceae), occasionally covered by sea water at Dor, Israel.

Symptoms — Unknown.

Genus *Cenopalpus* Pritchard & Baker, 1958

Members of this genus bear 3 pairs of prodorsal setae (*v2*, *sc1*, *sc2*), 10-11 pairs of opisthosomal setae, comprising 3 pairs of dorsocentral (*c1*, *d1*, *e1*), 6-7 pairs of dorsolateral (*c3*, *d3*, *e3*, *f2*, *f3*, *h2*, *h1*, *f2* absent or present) and one pair of sublateral setae (*c2*); setae *h2* not exceptionally long (Fig 13A). Palp 4-segmented (Fig 1G). Ventral shields clearly demarcated.

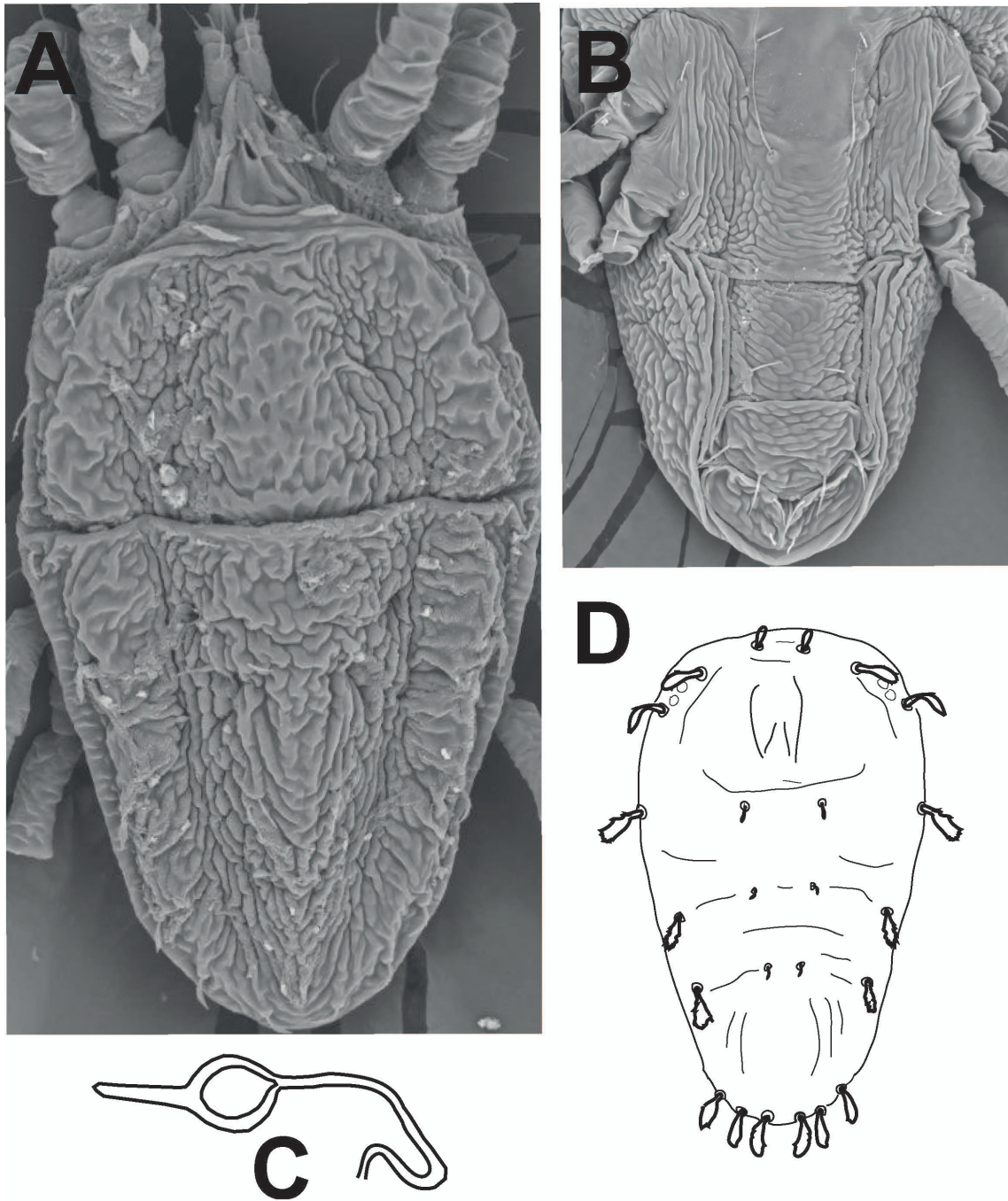


Figure 11 *Brevipalpus yothersi* Baker – Female: A – dorsal view; B – opisthogaster; C – spermatheca; Deutonymph: D – dorsal view.

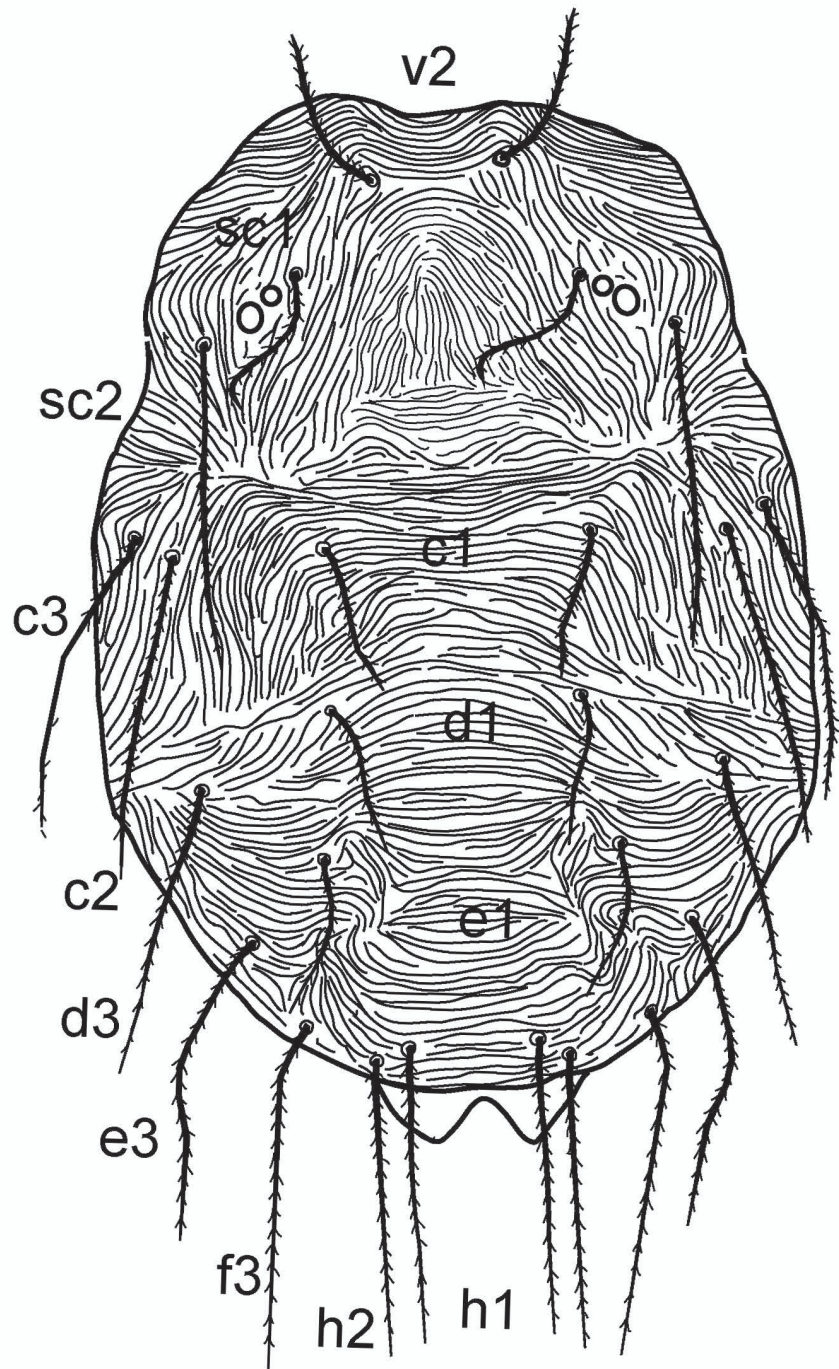


Figure 12 *Capedulia maritima* Gerson & Smith Meyer: dorsal view of female.

***Cenopalpus halperini* Castagnoli, 1987 (Figure 13)**

Diagnosis (Female) — All dorsal setae, long, lanceolate, serrate, setae *f2* present; dorsum reticulated mediolaterally, reticulations transverse medially (Fig 13A); tarsus II with one solenidion distally; rostrum reaching to distal margin of genu I, palp tibia with 2 setae; spermatheca terminating in a round bulb (Fig 13B).

Deutonymph — Dorsal setae long and serrate, except for setae *v2*, *sc1*, *c1-2*, *d1*, *e1* and *h1* which are clearly shorter (Fig 13C).

Hosts and localities — This species was described from *Pinus halepensis* Miller and *P. brutia* Ten (Pinaceae), in Israel at Mount Carmel and En Zetim, respectively. In Italy it was collected from *P. pinaster* Eiton, Mount Lu Pinu (Castagnoli, 1987).

Symptoms — Unknown.

***Cenopalpus lanceolatisetae* (Attiah, 1956) (Figure 14)**

Diagnosis (Female) — Prodorsum with setae longest and broadly lanceolate, serrate; opisthosoma with dorsolaterals broadly lanceolate, but gradually decrease in size caudally, *c2* also broadly lanceolate, serrate, *f2* present; dorsum reticulated (Fig 14A); tarsus II with one solenidion distally; rostrum reaching to middle of genu I, palp tibia with 2 setae; venter with area between *3a* and *4a* smooth, but with fine transverse striae, posterior to *4a* with large cells laterally but smooth centrally with fine transverse striae, ventral shield anterior smooth but posteriorly with medium cells, genital shield with large rounded cells (Fig 14B).

Deutonymph — All dorsal setae long, broadly lanceolate, and serrate, except for setae *d1*, *e1* and *h1* which are very short (Fig 14C).

Hosts and localities — This species was described from *Prunus domestica* L., *P. armeniaca* L., *Pyrus malus* L. and *P. communis* L. (Rosaceae), Egypt (Attiah, 1956). In Israel it was reported from: *P. domestica* L., *P. malus*, *Cotoneaster* sp. and *Crataegus azarolus* L. (Rosaceae), Tal Shahaar, Qiryat Shemona and Mt. Meron. *P. malus* and *P. communis*, Iraq; Armenia; *Cydonia oblonga* Mill. *Prunus insititia* L., apricot, pomegranate, Greece; *Prunus salicina* Lindl., *P. armeniaca*, *Malus sylvestris* (L.) Mill. and *Pyrus malus* L., Iran, Cyprus, England, Jordan, Lebanon, Libya and Portugal (Smith Meyer & Gerson, 1981; Al-Gboory, 1987; Bagdasarian, 1962; Hatzinikolis & Emmanouel, 1987; Hatzinikolis *et al.*, 1999; Khosrowshahi & Arbabi, 1997; Khanjani *et al.*, 2012).

Symptoms — In Iraq and Egypt this species is a pest of apples and pears and occurs on young shoots, buds and on both sides of leaves (Al-Gboory, 1987; Hatzinikolis & Emmanouel, 1987; Wafa *et al.*, 1968-1969).

***Cenopalpus lineola* (Canestrini & Fanzago, 1876) (Figure 15)**

Diagnosis (Female) — Dorsum coarsely striate, prodorsal setae broadly lanceolate, lateral setae lanceolate, serrate, dorsocentral setae *d1* and *e1* very short and slightly serrate, *c1* more than twice the length of *d1* and *e1*, setae *f2* present; rostral shield deeply notched (Fig 15A); tarsi I-II each with one solenidion distally; rostrum reaching to middle of femur I; setae *4a* not reaching setae *3a*; palp tibia with one seta.

Deutonymph — All dorsal setae long and lanceolate, except setae *d1* and *e1* which are very short (Fig 15B).

Hosts and localities — This species was described from *Pinus* spp., Italy (Canestrini & Fanzago, 1876) and from: *Pinus* spp., Algeria, Armenia, France, Georgia (SSR), Iran, Israel,

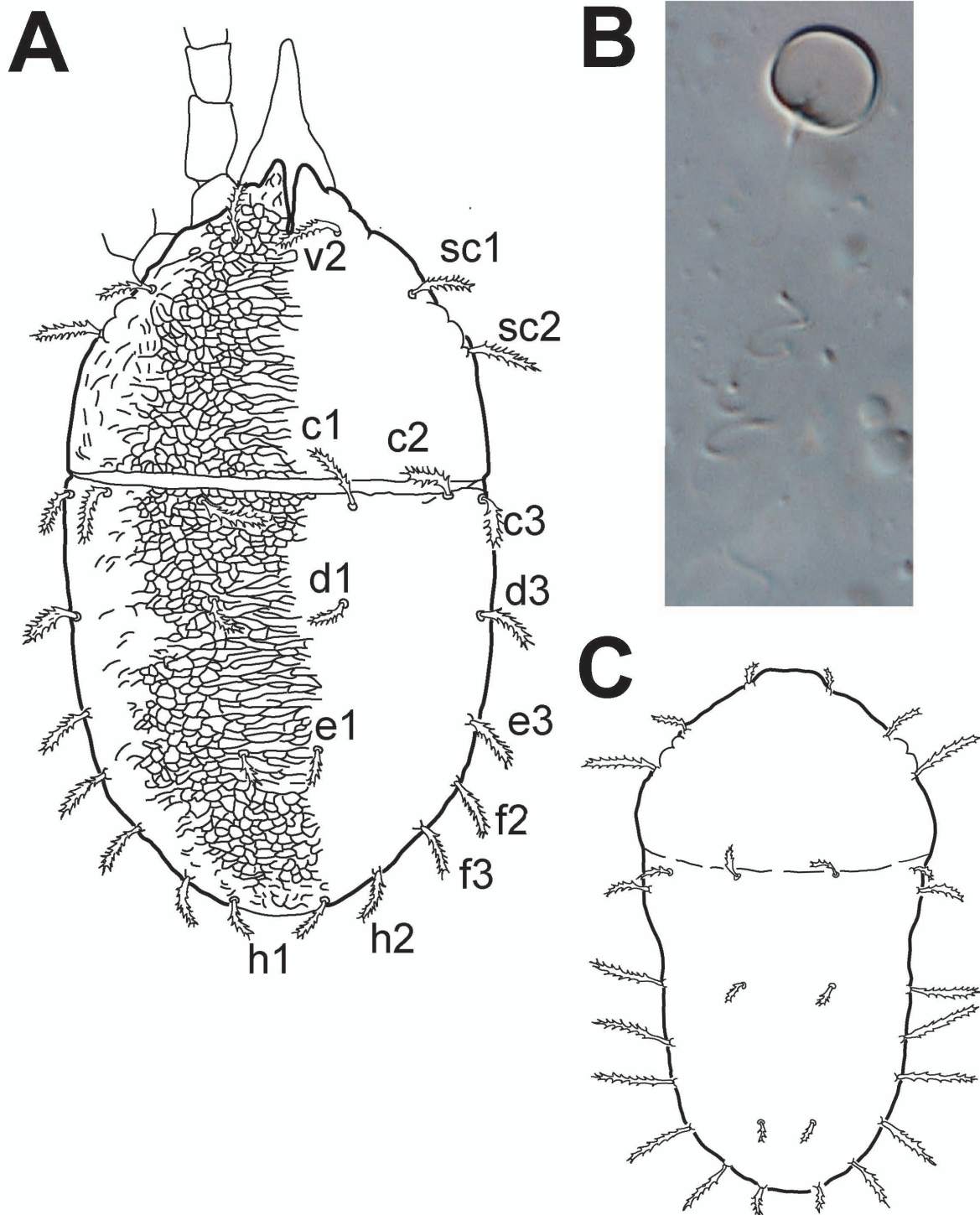


Figure 13 *Cenopalpus halperini* Castagnoli – Female: A – dorsal view; B – spermatheca; Deutonymph: C – dorsal view.

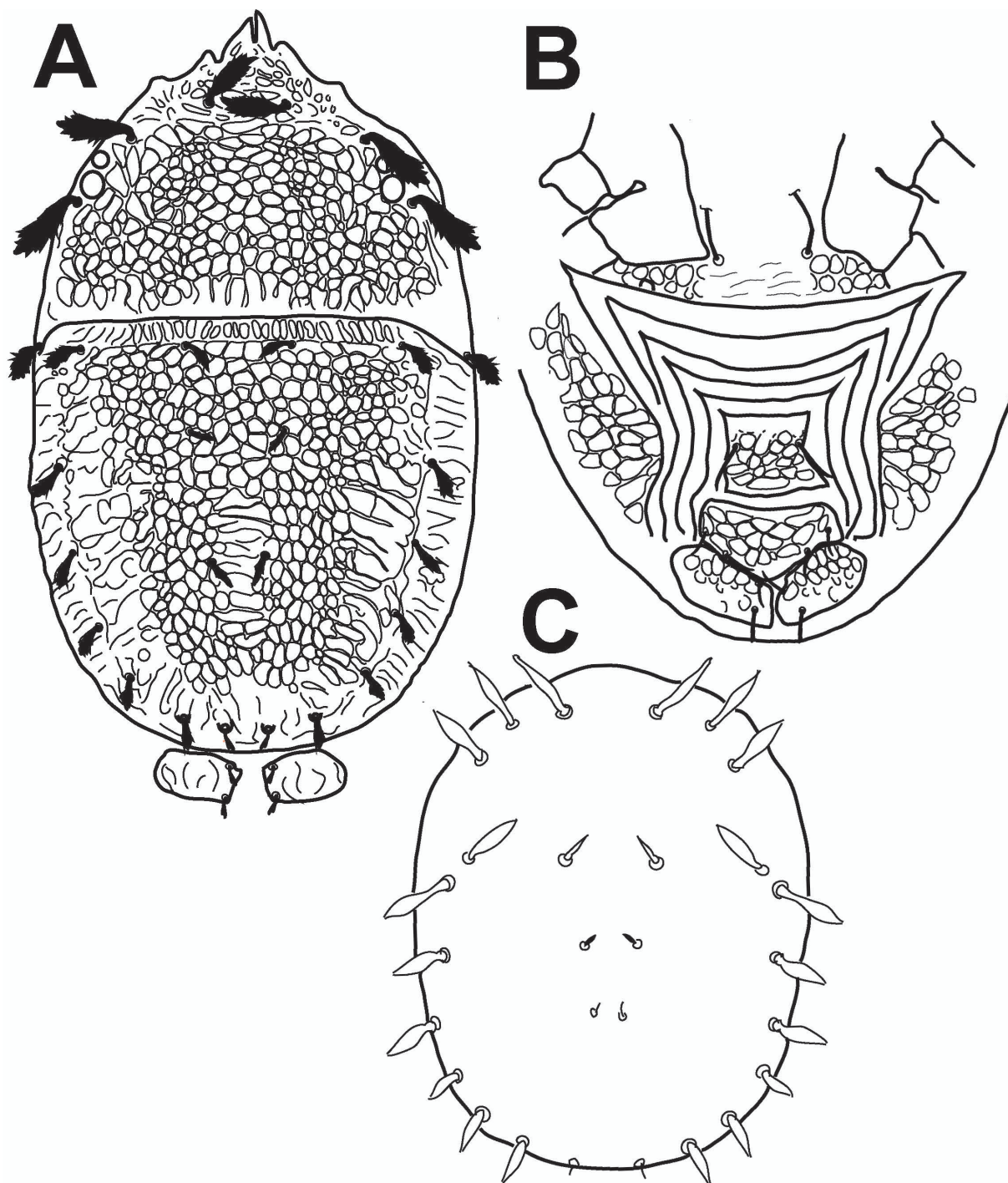


Figure 14 *Cenopalpus lanceolatisetae* Attiah – Female: A – dorsal view; B – spermatheca; Deutonymph: C – dorsal view.

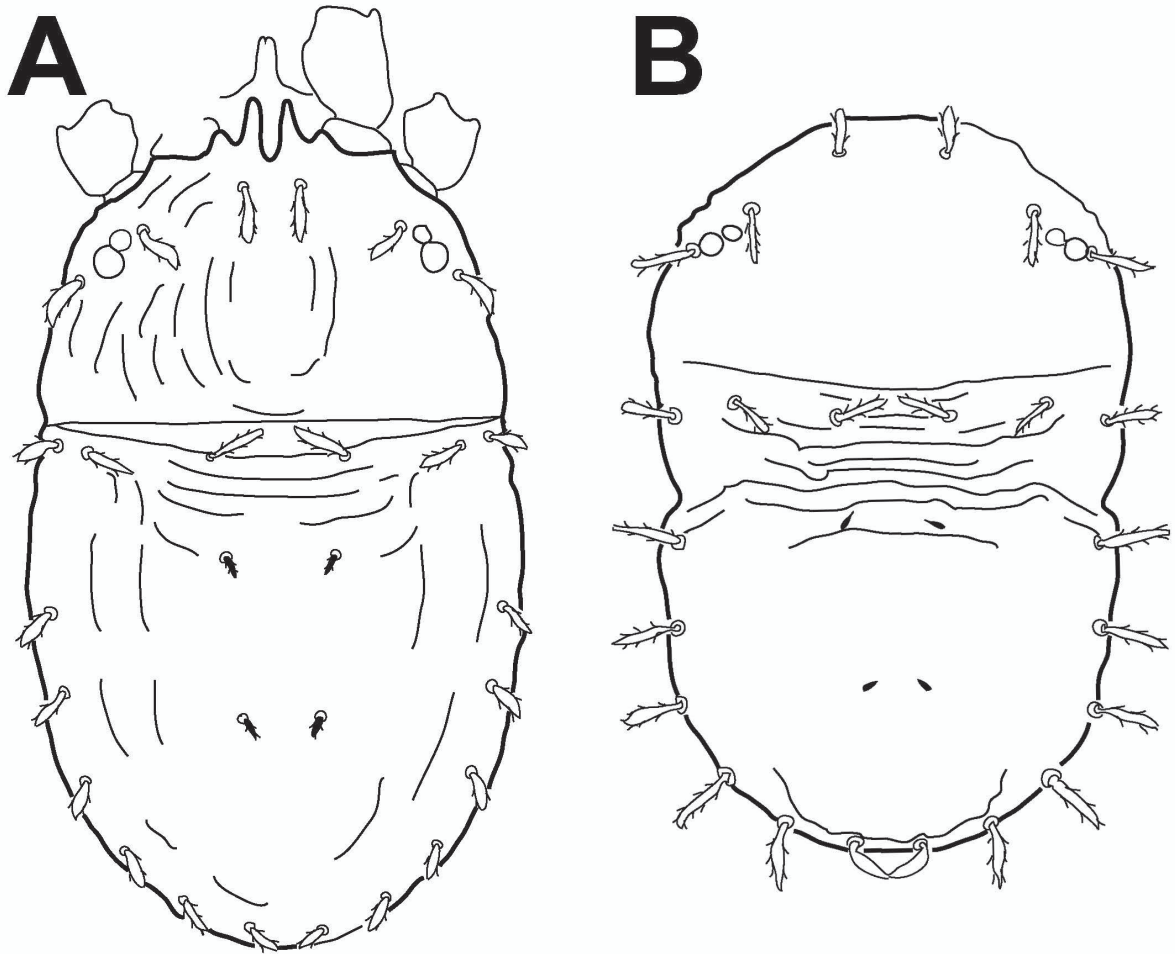


Figure 15 *Cenopalpus lineola* (Canestrini & Fanzago) – Female: A – dorsal view; Deutonymph: B – dorsal view.

Japan, Lebanon, Libya, Morocco, Netherlands, The Philippines, Poland, and Portugal (Mitrofanov & Strunkova, 1979; Baker & Pritchard, 1952; Reck, 1951; Gutierrez *et al.*, 1989; Ehara, 1966; Hatzinikolis, 1970; Dosse, 1974).

Symptoms — A pest of pine trees in The Netherlands, Italy, and Georgia, SSR (Jeppson *et al.*, 1975).

***Cenopalpus pulcher* (Canestrini & Fanzago, 1876) (Figure 16)**

Diagnosis (Female) — Prodorsum with 3 pairs of long, narrowly lanceolate, serrate setae, longer than opisthosomal setae, evenly reticulate with large cells; opisthosoma with *f2* present and covered with large regular cells between *c1-d1*, between *d1-h1* reticulation becoming series of short transverse folds, mediolaterally with even reticulation of large cells (Fig 16A); tarsus II with one solenidion distally; rostrum reaching to middle of genu I, palp tibia with 2 setae. Opisthogaster with cuticle between *3a* and *4a* smooth, but with fine striae, posterior to *4a* with even large round cells laterally forming weak transverse bands or become smooth centrally, ventral shield with large round cells often transversely elongate, genital shield with large transverse cells (Fig 16B).

Deutonymph — Opisthosomal setae *c1*, *c2*, *d1*, *e1*, *f2*, *h1* and *h2* minute, rest of setae long (Fig 16C).

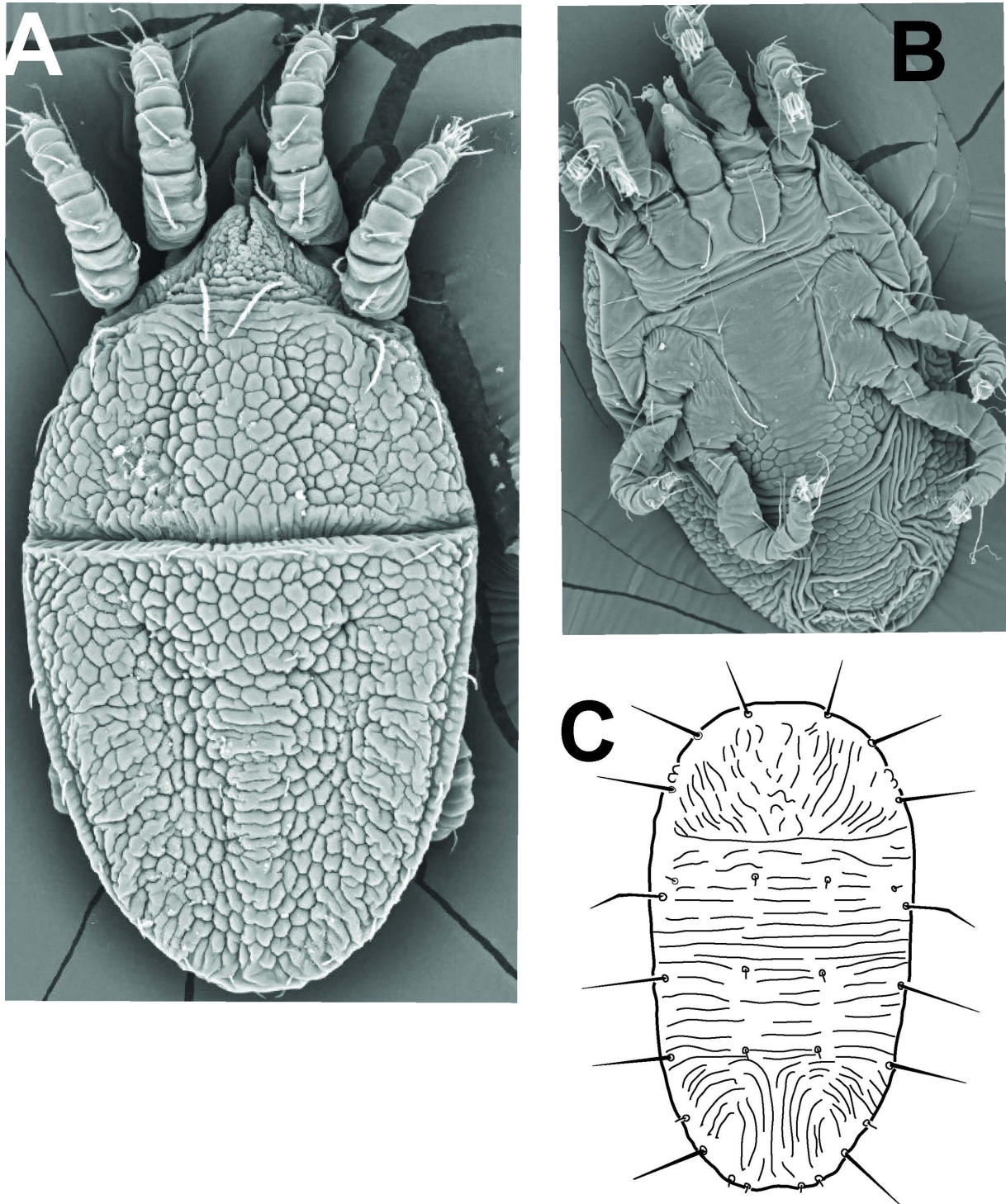


Figure 16 *Cenopalpus pulcher* (Canestrini & Fanzago, 1876) – Female: A – dorsal view; B – opisthogaster; Deutonymph: C – dorsal view.

Hosts and localities — Hosts mainly of the Rosaceae family from: Algeria, Afghanistan, Argentina, Austria, Bulgaria, China, Croatia, Greece, Cyprus, Denmark, Egypt, England, France, Germany, Greece, India, Iran, Israel, Italy, Lebanon, Morocco, The Netherlands, Pakistan, Portugal, Romania, former Soviet Union USSR, Syria, Turkey, USA, Wales, Yugoslavia (Beard *et al.*, 2013; Hatzinikolis *et al.*, 1999; Hatzinikolis & Emmanouel, 1987; Khanjani *et al.*, 2012; Pritchard & Baker, 1958)

Symptoms — Unknown.

***Cenopalpus spinosus* (Donnadieu, 1875) (Figure 17)**

Diagnosis (Female) — Prodorsum with 3 pairs of long, strongly barbed setae, longer than opisthosomal setae, most also strongly barbed, evenly reticulate with small to medium cells, opisthosoma with *f2* present and cuticle with large irregular cells between *c1-d1*, between *d1-h1* reticulation becoming series of short transverse folds, mediolaterally with even reticulation of small cells (Fig 17A); tarsus II with one solenidion distally; rostrum reaching to middle of genu I, palp tibia with 2 setae. Opisthogaster with cuticle between *3a-3a* smooth but with fine striae, between *4a-4a* with weak transverse bands, ventral and genital shields with medium to large rounded cells and genital shield (Fig 17B).

Deutonymph — Opisthosomal setae *c1*, *d1*, *e1*, *h1* and *h2* minute, rest of setae long (Fig 17C).

Hosts and localities — Hosts mainly of the Rosaceae family from: Algeria, France, Germany, Greece, India, Iran, Israel, Morocco (Beard *et al.* 2013; Hatzinikolis *et al.*, 1999; Hatzinikolis & Emmanouel, 1987; Khanjani *et al.*, 2012; Pritchard & Baker, 1958).

Symptoms — This species prefers the underside of host leaves and causes yellow to dark spots when feeding on roses (Hatzinikolis & Emmanouel, 1987).

***Cenopalpus wainsteini* (Livschitz & Mitrofanov, 1967) (Figure 18)**

Diagnosis (Female) — All dorsal setae, lanceolate, serrate, opisthosoma with 3 pairs of dorsocentrals gradually becoming shorter posteriorly, *c1* subequal or slightly longer than *d1*, setae *f2* present; dorsum coarsely striate and rostral shield slightly indented (Fig 18); setae *4a* reaching pass setae *3a*; palp tibia with one seta; tarsus II with one solenidion distally; rostrum reaching just past distal margin of femur I.

Deutonymph — Hatzinikolis & Emmanouel (1987) described the deutonymph but excluded setae *f2*, while present in the female. Therefore we decided to omit it till it can be proofed otherwise.

Hosts and localities — This species was described from *Pinus* sp. in the Ukraine (Livschitz & Mitrofanov, 1967). In Israel, it was reported from ornamentals by Halperin *et al.*, (1989). Arabuli & Kvavadze (2013) redescribed *C. wainsteini* from *Ficus carica* L. (Moraceae), *Philadelphus caucasicus* Koehne (Hydrangeaceae) and *Styphnolobium japonicum* Schott (Fabaceae) Caucasia and Georgia. Other records are from: Giza, Egypt and Gaza Strip (Hatzinikolis 1983, 1987; Hatzinikolis & Emmanouel, 1987).

Symptoms — Distorted needles that eventually dry out (Hatzinikolis & Emmanouel, 1987).

Genus *Dolichotetranychus* Sayed, 1938

Idiosoma elongate, evenly rounded, without dorsal plates, striated. Anterior margin of prodorsum without rostral shield, projections, or notch; opisthosomal setae mainly short,

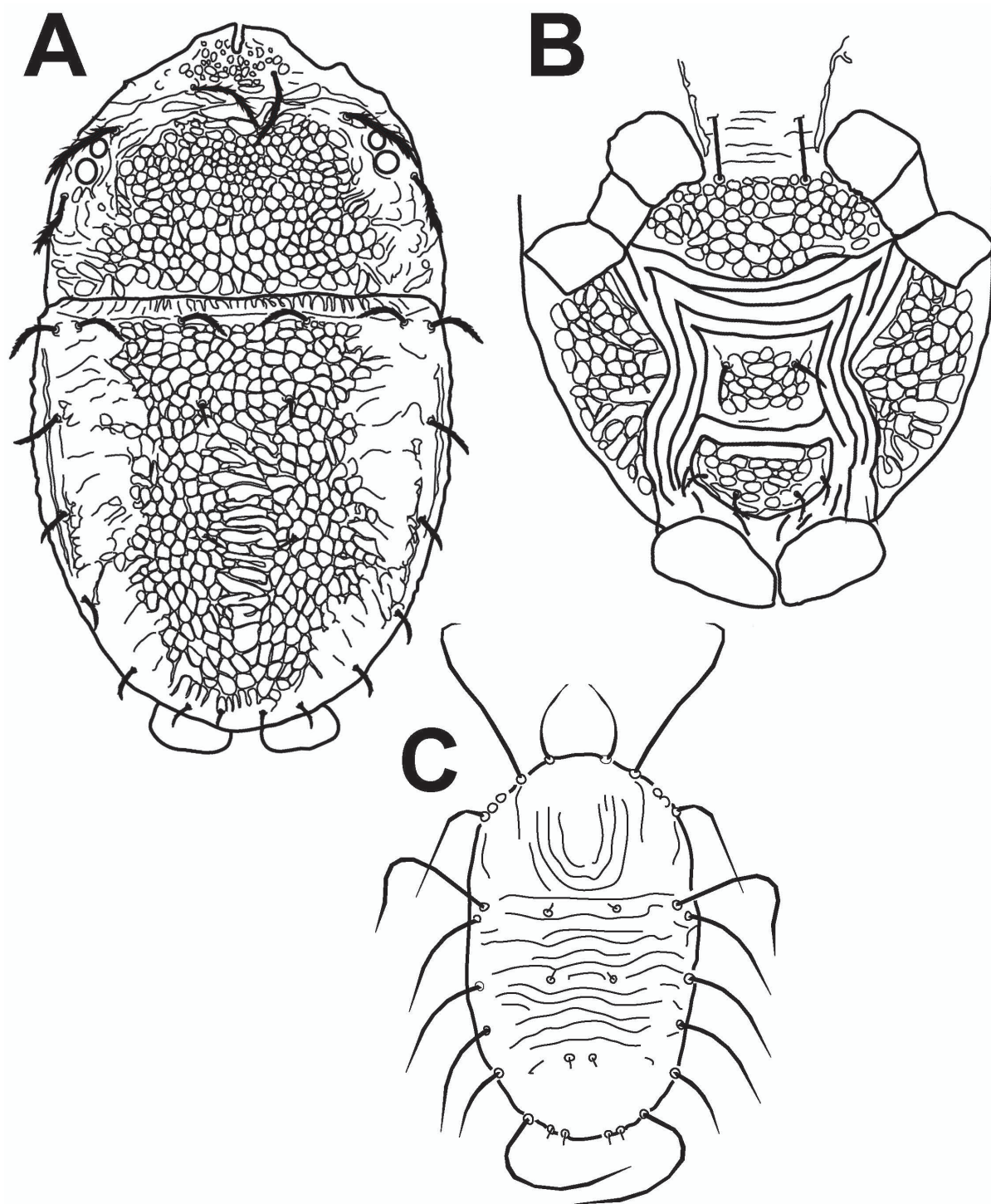


Figure 17 *Cenopalpus spinosus* (Donnadieu) – Female: A – dorsal view; B – opisthogaster; Deutonymph: C – dorsal view.

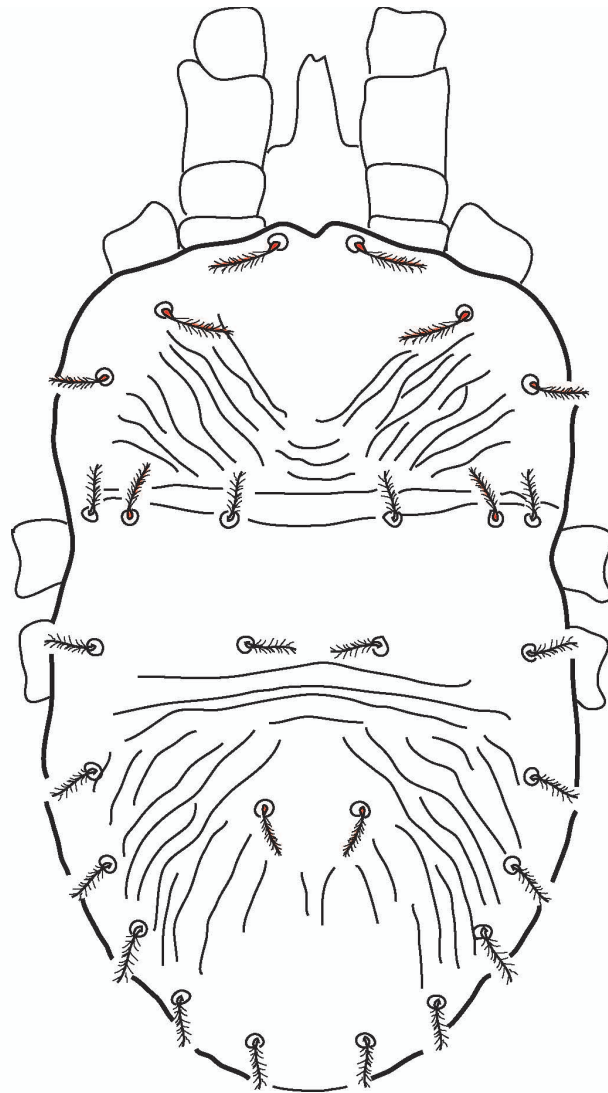


Figure 18 *Cenopalpus wainsteini* (Livshitz & Mitrofanov): dorsal view of female.

setiform, smooth or with few barbs, with 9 pairs of setae: 2 pairs of dorsocentral (*c1*, *d1*), 6 pairs of dorsolateral (*c3*, *d3*, *e3*, *f3*, *h2*, *h1*) and one pair of sublateral setae (*c2*); setae *d3* and *e3* usually inserted in submedial position; setae *e1*–*2*, *f2* absent (Fig 19A). Ventral shields not distinct with one or 2 pairs of anal setae (*ps1*–*2*). One or two pairs of genital setae (Fig 19B). Palp 3-segmented (Fig 1F). Tibia I–II with four setae. Genua III–IV bare. Tarsal claws uncinuate or highly reduced. Male with posterior opisthosoma elongated, narrowing to a blunt point, modified pseudanal setae *ps1* in membranous tubercle (Seeman *et al.*, 2016).

***Dolichotetranychus australianus* (Womersley, 1943) (Figure 19)**

Diagnosis (Female) — Body elongate-oval, opisthosoma with dorsolaterals *h1*, *h2* and *f3* clearly longest, all dorsal setae serrate; dorsum covered with longitudinal striae (Fig 19A); spermatheca a long tube terminating in a small vesicle; ventrally genital shield with longitudinal, smooth striae and 2 pairs of setae, one pair of aggenital (*ag*) setae anterior to this shield, anal shield with 2 pairs of setae (*ps*) (Fig 19B); setae *3a* four times longer than *4a* (Fig 19C). Tarsal claws with small hooks (Fig 19D).

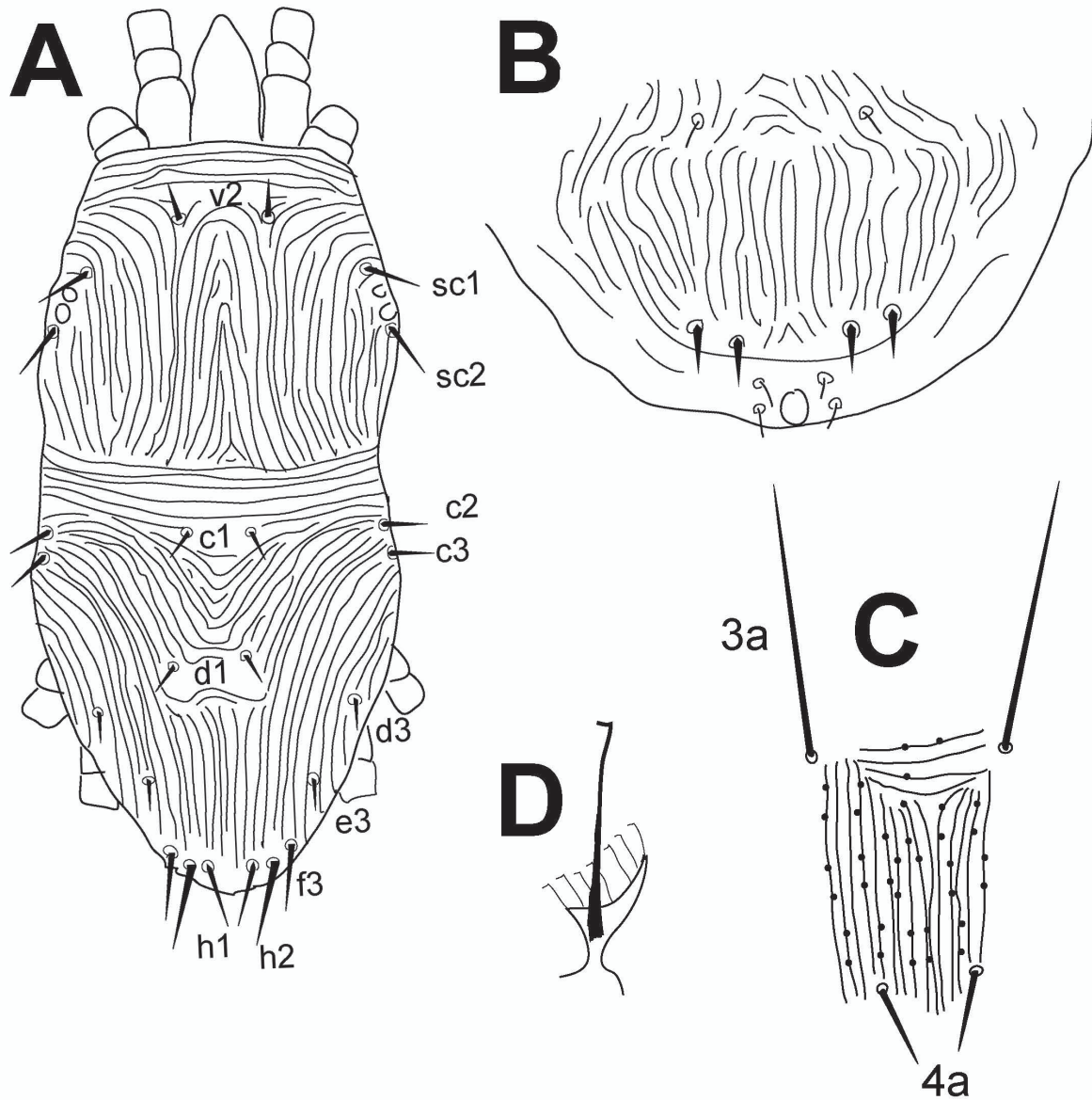


Figure 19 *Dolichotetranychus australianus* (Womersley) – Female: A – dorsal view; B – opisthogaster; C – metapodosoma, lengths of setae 3a and 4a spermatheca; D – tarsal claw.

Hosts and localities — Collected from *Cynodon dactylon* (L.) Pers. (Graminaceae) at Elot, Israel (Smith Meyer & Gerson, 1981). Womersley (1943) described this species from *C. dactylon*, Australia. It was also recorded from *C. magennisii* Hurcombe in South Africa, from *C. dactylon*, Egypt and Zimbabwe (Baker & Pritchard, 1956; Wafa & Yousef, 1968-1969; Goldsmid, 1962). Recently it was also reported from Bangladesh and the Seychelles (Woods, 2010).

Symptoms — *Dolichotetranychus australianus* is a serious pest of turf grasses in Australia and is often found together with the eriophyid *Aceria cynodontiensis* Sayed. The symptoms of these two species differ in that *A. cynodontiensis* causes a “witches-broom” response at the nodes, whereas the feeding of *D. australianus* results in thinning and weakening of stands;

severe infestations can virtually turn the whole sward brown and die; the symptoms can be described as pinetree-like growths (Seeman *et al.*, 2016).

Genus *Obdulia* Pritchard & Baker, 1958

Idiosoma roundish; prodorsum with 3 pairs of setae (*v2*, *sc1*, *sc2*); opisthosoma with 11 pairs of setae consisting of 3 pairs of dorsocentral (*c1*, *d1*, *e1*), 6 pairs of dorsolaterals (*c3*, *d3*, *e3*, *f3*, *h2*, *h1*) and 2 pairs sublateral setae (*c2*, *d2*), setae *f2* absent (Fig 20); palp one-segmented (Fig 1A); tarsi with true claws uncinated.

Obdulia tamaricis Pritchard & Baker, 1958 (Figure 20)

Diagnosis (Female) — Body broadly oval, prodorsum smoothly rounded anteriorly, all dorsal setae short, setiform and serrate; dorsum striate (Fig 20); ventral and genital shields not outlined, 2 pairs of genital, one pair of aggenital (*ag*) and 2 pairs anal setae (*ps*) present; palp with one segment with 2 setae and one solenidion.

Hosts and localities — From *Tamarix maris-mortui* Guttm. (Tamaricaceae), Wadi Fukra, Israel (Pritchard & Baker, 1958). Smith Meyer & Gerson (1981) reported that it occurred all along the Arava, from the Dead Sea to the Red Sea. It was also reported from Greece (Hatzinikolis, 1987) and Iran (Khanjani *et al.*, 2013).

Symptoms — Cause twig galls.

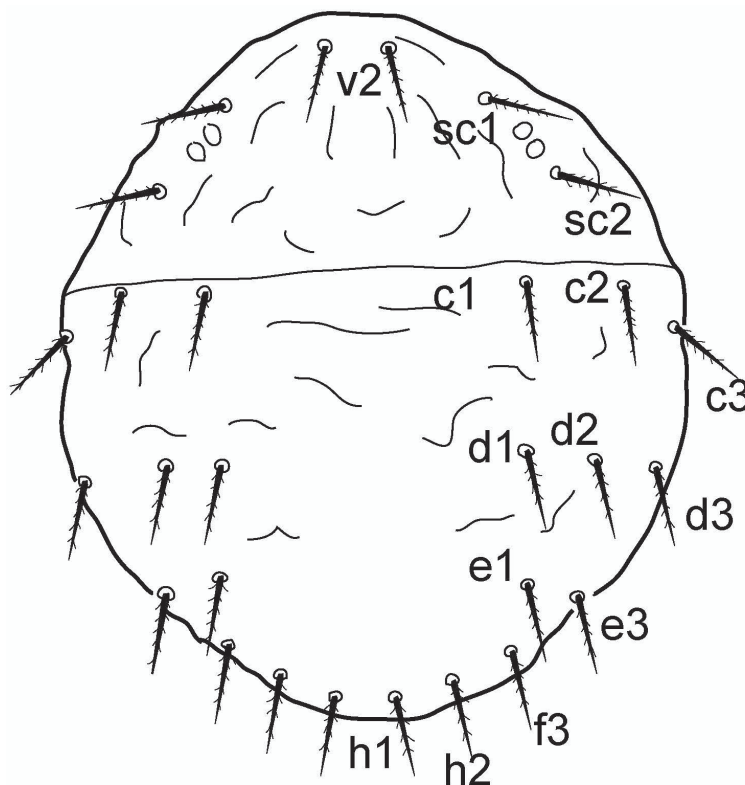


Figure 20 *Obdulia tamaricis* Pritchard & Baker: dorsal view of female.

Genus *Phyllotetranychus* Sayed, 1938

Idiosoma oval, bearing large fan-shaped, veined dorsal setae: 3 pairs of prodorsal (*v2*, *sc1*, *sc2*), opisthosoma with 7 pairs of dorsolateral (*c3*, *d3*, *e3*, *f2*, *f3*, *h2*, *h1*), 3 pairs of sublateral (*c2*, *d2*, *e2*) and 3 pairs of dorsocentral setae (*c1*, *d1*, *e1*); palp two-segmented (Fig 1E).

Phyllotetranychus aegyptiacus Sayed, 1938 (Figure 21)

Diagnosis (Female) — Body oval and dorsally covered with fan-shaped, veined setae, prodorsum with setae *v2* very broad near middle and distally pointed (Fig 21). Differs from second species in this genus, *P. romaine* Pritchard & Baker, only in having setae *v2* elongate-elliptical. Palp two-segmented.

Male — Dorsal setae also fan-shaped but clearly smaller than those of female, not covering dorsum. Dorsocentral setae all similar but very dissimilar in *P. romaine*.

Hosts and localities — In Israel this species was collected from *Phoenix dactylifera* L. (Arecaceae), Arava Valley (Smith Meyer & Gerson, 1981). It was originally described from *P. dactylifera* from Egypt (Sayed, 1938) and also reported from Iran (Khanjani *et al.*, 2013).

Symptoms — Sucks plant sap with chlorophyll from leaves resulting in infested areas turning yellowish. In heavy infestations the affected areas change to dirty whitish blotches which result from the aggregation of the mites with their whitish fan-like setae, and the leaves eventually turn dark brown and die (Zaher *et al.*, 1969). In Israel, no damage has ever been reported in association with this species (Palevsky, unpublished, Blumberg, 2008).

Genus *Raoiella* Hirst, 1924

Idiosoma round; prodorsum with 3 pairs of setae (*v2*, *sc1*, *sc2*); opisthosoma with 13 pairs of setae consisting of 3 pairs of dorsocentral, (*c1*, *d1*, *e1*), 6 pairs of dorsolateral (*c3*, *d3*, *e3*, *f3*, *h2*, *h1*) and 4 pairs sublateral setae (*c2*, *d2*, *e2*, *f2*) (Fig 22A); palp 2-segmented (Fig 1E); tarsi with true claws uncinated.

Raoiella indica Hirst, 1924 (Figure 22)

Diagnosis (Female) — Body round, prodorsum with 3 pairs setae and smoothly rounded anteriorly, dorsal setae long and with clavate tips, setae *c1*, *d1*, *e1* weakly spatulate (*e1* often tapered), seta *h1* subequal in length to *h2*, seta *h2* setiform, with finely tapered tip, seta *f2* shorter than *f3* (Fig 22A); coxae III-IV nude, femur II with 4 setae, genua I-II with 3 setae, tarsi I-II with companion seta obviously longer than solenidion (Fig 22B); palp with distal segment with one setiform eupathidium, one seta and one solenidion.

Male — With distinctively shaped posterior opisthosoma, with *ps1* very short (Fig 22C).

Hosts and localities — In Israel this species was collected from *Phoenix dactylifera* L. (Arecaceae), Arava Valley (Smith Meyer & Gerson, 1981). Originally described from *Cocos nucifera* L. (Arecaceae), in India (Hirst, 1924), it has since then been collected from many palm species world-wide (Dowling *et al.*, 2012). After its introduction into the Americas this pest has expanded its host plant range to 96 plant species, including bananas (Amaro & De Morais, 2013).

Symptoms — The symptoms in coconut plants start as small yellow spots on the abaxial leaf surface. Feeding damage causes the two sides of leaflets to fold onto each other. Continued feeding probably is responsible for the curling and drying of the leaflet tips. As feeding progresses the green leaves turn pale green, then yellow and finally copper-brown (Rodrigues *et al.*, 2007). This species is not a pest in Israel but a severe pest in Central America and southern USA.

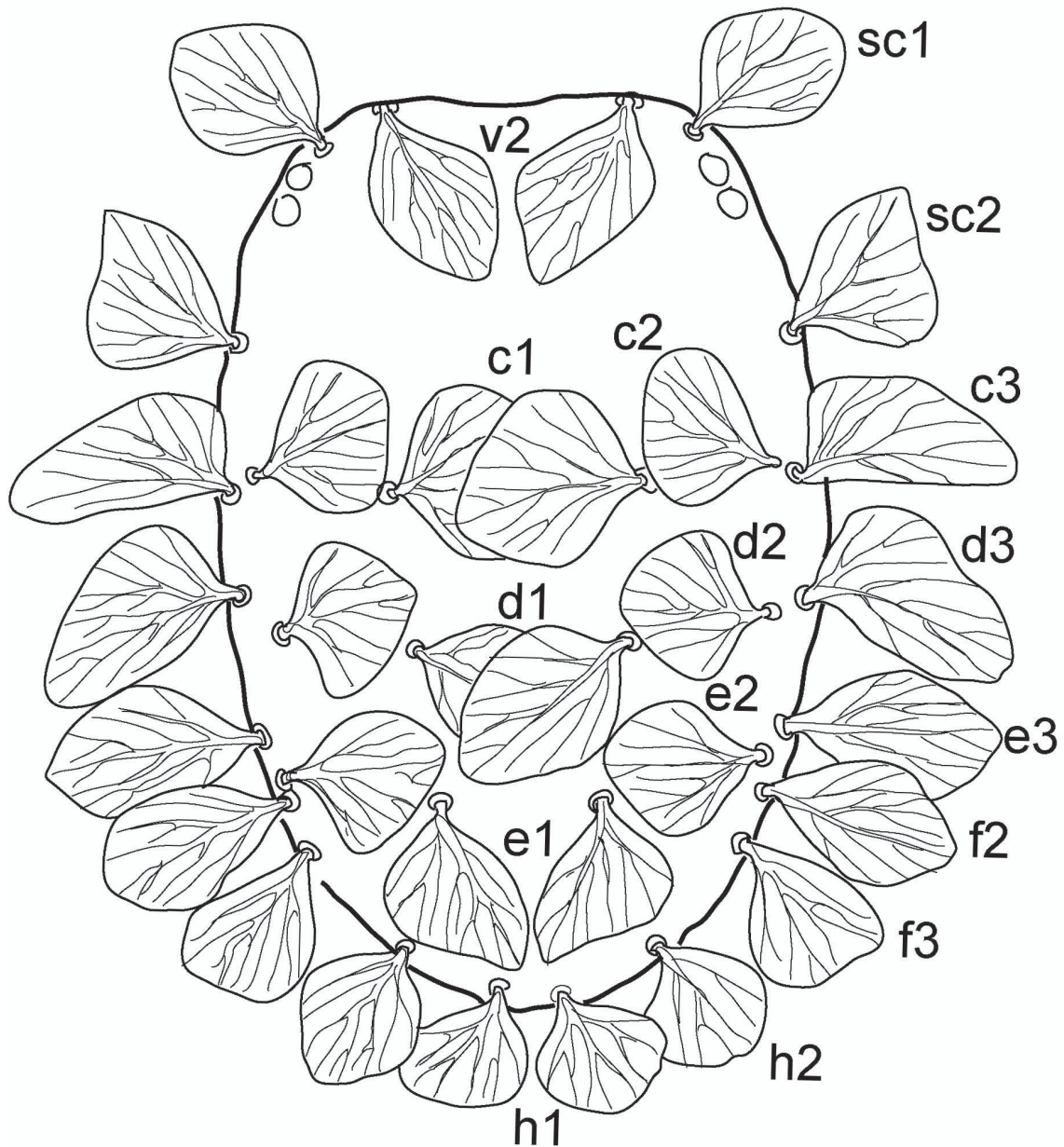


Figure 21 *Phyllotranychus aegyptiacus* Sayed: dorsal view of female.

Genus *Tenuipalpus* Donnadieu, 1875

This genus can be defined as follows: prodorsum with 3 pairs of setae (*v2*, *sc1*, *sc2*) (rarely 2 pairs); 8-10 pairs of opisthosomal setae: 1-3 pairs of dorsocentral (*c1*, *d1*, *e1*) and 6-7 pairs of dorsolateral *c3*, *d3*, *e3*, *f2* absent or present, *f3*, *h2*, *h1*; setae *c2* absent; setae *h2* flagellate and elongate; opisthosoma tapers behind legs IV; metapodosoma with 1-3 pairs of *3a* (*3a* always present; *3a2*, *3a3* present or absent) and 1-5 pairs of *4a* setae (*4a* always present; *4a2*, *4a3*, *4a4*, *4a5* present or absent); palp one to 3 segmented (Figs. 1B,1C,1D); ventral and genital shields usually fused and not developed.

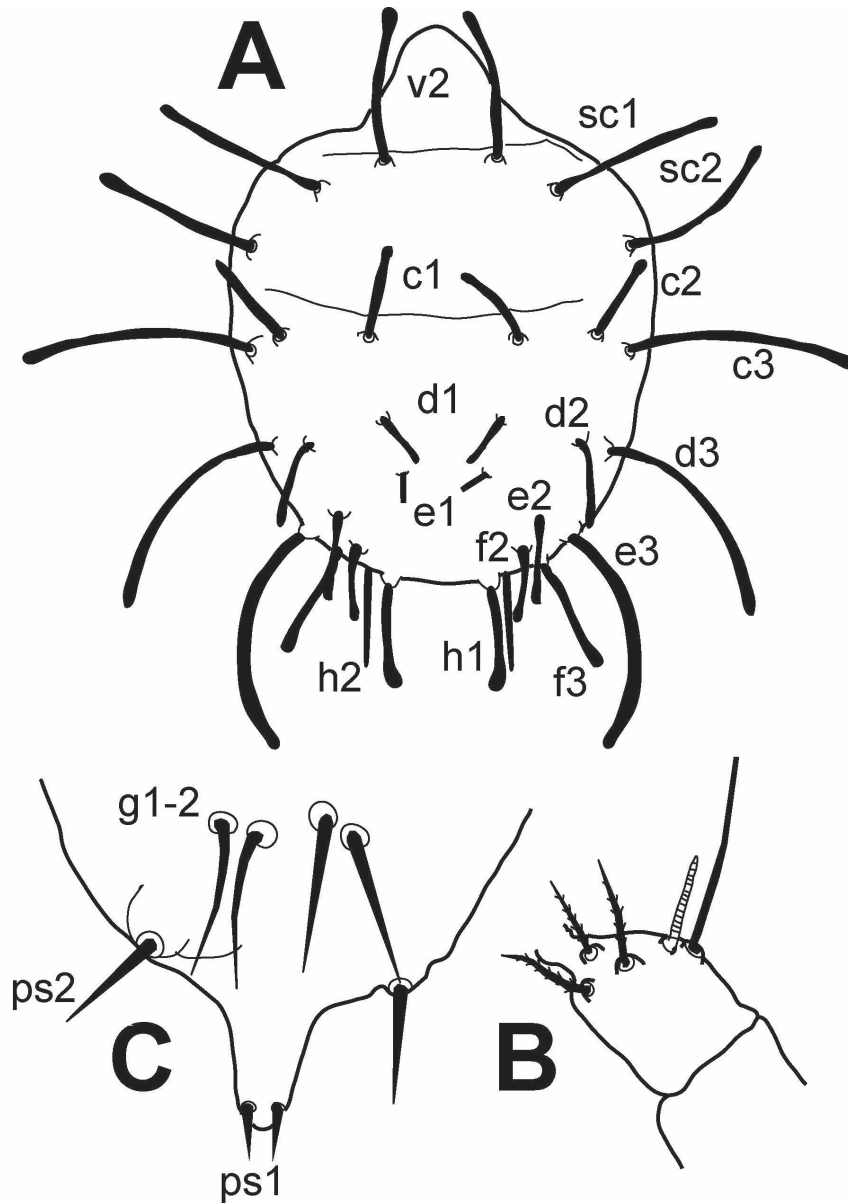


Figure 22 *Raoiella indica* Hirst – Female: A – dorsal view; B – tarsi I-II; ; Deutonymph: C – opisthogaster.

***Tenuipalpus cupressoides* Smith Meyer & Gerson, 1981 (Figure 23)**

Diagnosis (Female) — Prodorsum with 2 Y-shaped ridges stretching from eyes posteriorly, first 2 pairs of setae (*v2* and *sc1*) minute and spatulate, setae *sc2* much longer and broadly lanceolate, rostral shield deeply bifurcate; opisthosoma with 10 pairs of setae and constricted and covered with folds and irregular coarse striae: 3 pairs of spatulate dorsocentrals, with *c1* and *d1* much bigger than minute *e1*, 7 pairs of dorsolaterals varying from spatulate to broadly lanceolate, setae *d3* are minute and *h2* long, flagellate; one pair of lateral projections associated with setae *c3* (Fig 23A); venter with one pair of setae *3a* and *4a*, ventral and genital shields indistinct with one pair of aggenital and 2 pairs of genital setae, respectively; anal shield with 2 pairs of setae (Fig 23B); tarsal claws and empodia padlike; palp with 3 segments; spermatheca a short tube terminating in a knob (Fig 23C).

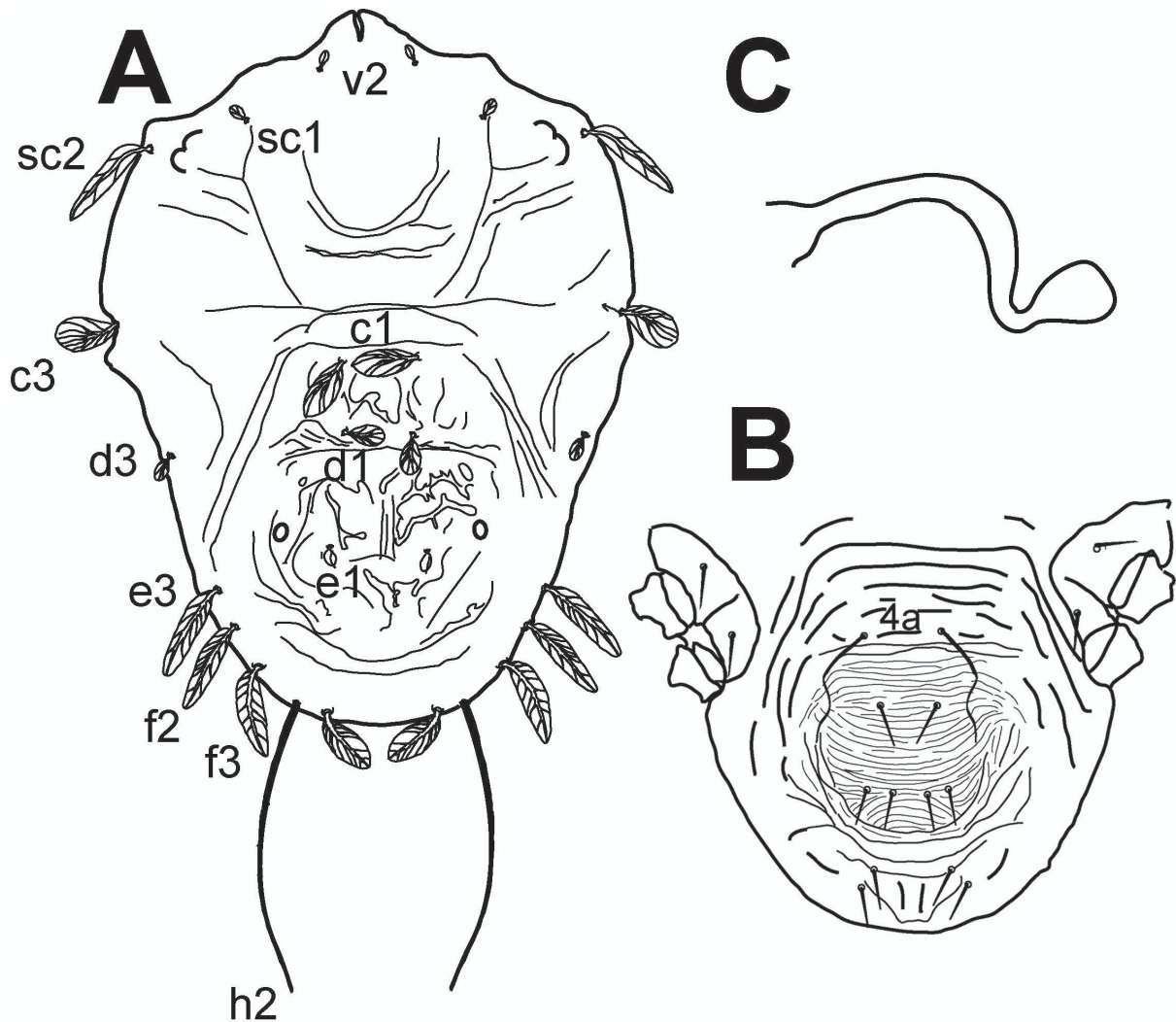


Figure 23 *Tenuipalpus cupressoides* Smith Meyer & Gerson – Female: A – dorsal view; B – opisthogaster; C – spermatheca.

Hosts and localities — Described from *Cupressus sempervirens* L. (Cupressaceae), at Kabri and Maabarot, Israel (Smith Meyer & Gerson (1981).

Symptoms — Unknown.

***Tenuipalpus dubinini* Reck, 1951 (Figure 24)**

Diagnosis (Male) — Dorsum striate, most setae very short and serrate, except for very long setae *h2*, setae *sc2*, *e3*, *f3* and *h1* also longer than rest of setae, rostral shield deeply bifurcate, opisthosoma with 9 pairs of setae, 2 large pores: 3 pairs of dorsocentrals, 6 pairs of dorsolaterals (Fig 24A); venter with 2 pairs of *3a* and 5 pairs of *4a* setae, ventral and genital shields indistinct with a pair of aggenital and 2 pairs of genital setae, respectively; anal shield with 2 pairs of setae (Fig 24B). Palp 3-segmented.

Hosts and localities — Reported from *Ephedra campylopoda* C.A.Mey (Ephedraceae), Hiram, Israel (Smith Meyer & Gerson, 1981). Reck (1951) described it from *E. procera* Fisch.

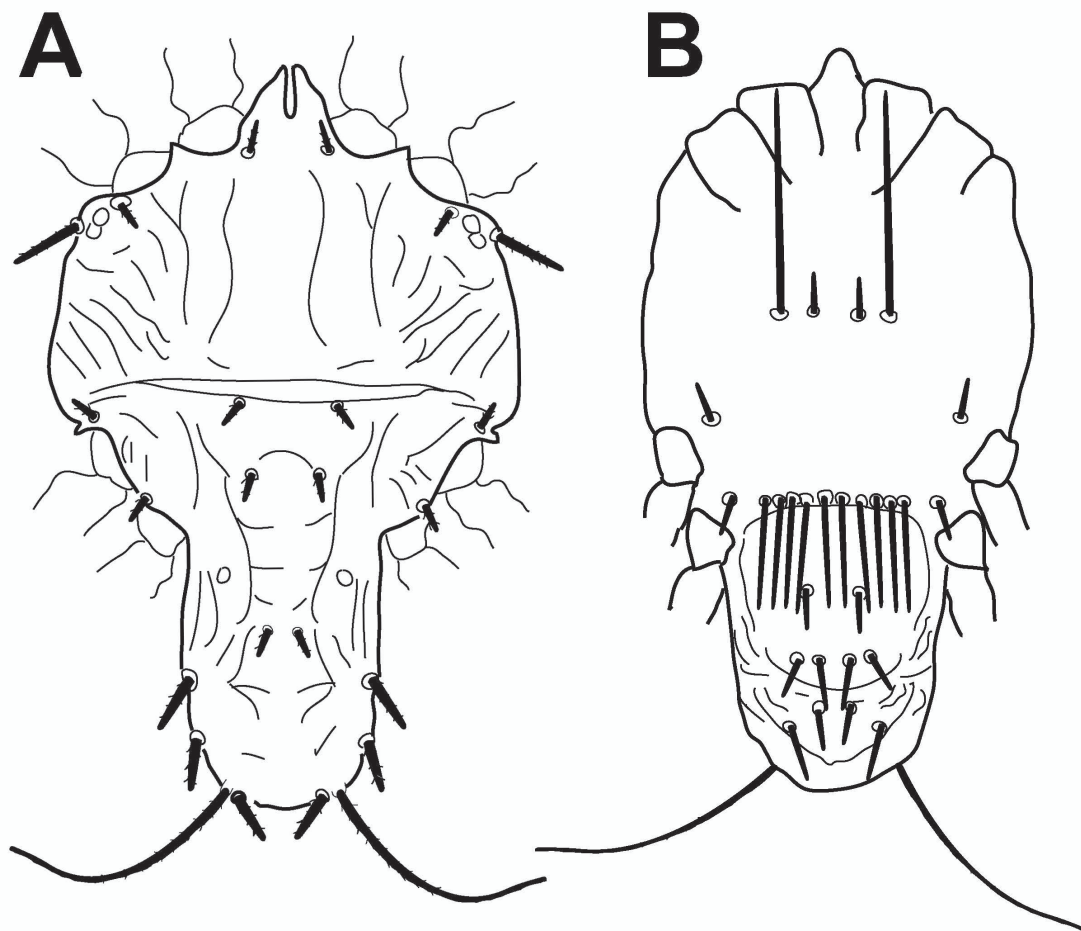


Figure 24 *Tenuipalpus dubinini* Reck – Female: A – dorsal view; B – ventral view.

& Mey, Georgia, SSR.

Symptoms — Unknown.

***Tenuipalpus granati* Sayed, 1946 (Figure 25)**

Diagnosis (Female) — Dorsum with irregular striae, longitudinal laterally on opisthosoma, most setae very short and serrate, except for setae *sc2*, *f2*, *f3*, *e3*, *h1*, which are much longer; *h2* long and flagellate; rostral shield deeply bifurcate, opisthosoma with 8 pairs of setae, 2 large pores and constricted behind coxae IV: one pair of dorsocentrals (*c1* present, *d1* and *e1* absent), 7 pairs of dorsolaterals (Fig 25A); venter with mainly transverse striae, with one pair of *3a* and 2 pairs of *4a* setae, ventral and genital shields indistinct with one pair of aggenital and 2 pairs of genital setae, respectively; anal shield with 2 pairs of setae (Fig 25B). Spermatheca with basal half bulged but anterior half a slender tube, terminating blunt (Fig 25C). Palp 3-segmented.

Hosts and localities — This species was described from pomegranate *Punica granatum* L. (Lythraceae) in Egypt (Sayed, 1946) and reported from Israel, the former USSR, Greece, Cyprus, India and Iran (Sternlicht & Golan, 1967; Channabasavanna & Lakkundi, 1977; Hatzinikolis, 1986; Khosrowshahi & Arbabi, 1997).

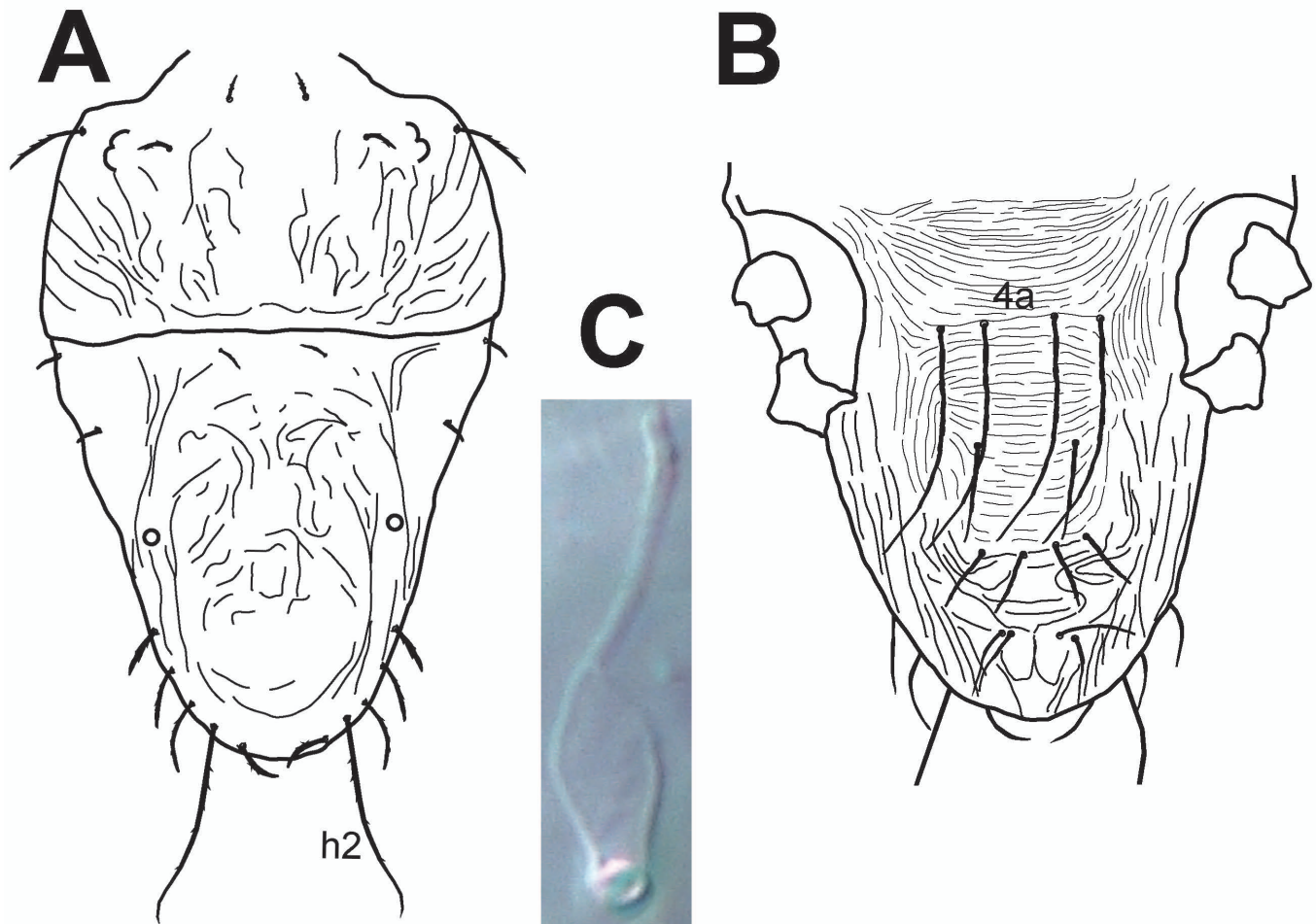


Figure 25 *Tenuipalpus granati* Sayed – Female: A – dorsal view; B – opisthogaster; C – spermatheca.

Symptoms — A pest of pomegranates and grapes in the Middle East (Gerson 2017) and Greece (Hatzinikolis, 1986), but has not recently been reported on pomegranates in Israel (Tselila Ben-David unpublished).

***Tenuipalpus pareriophyoides* Smith Meyer & Gerson, 1981 (Figure 26)**

Diagnosis (Female) — Dorsum striate, most setae very short and serrate, except for very long setae *h2*, rostral shield deeply bifurcate, opisthosoma with 10 pairs of setae, 2 large pores: 3 pairs of dorsocentrals, 7 pairs of dorsolaterals (Fig 26A); venter with one pair of *3a* and 4 pairs of *4a* setae overreaching genital setae, ventral striae anastomosing and broken, ventral and genital shields indistinct with one pair of aggenital and 2 pairs of genital; anal shield with 2 pairs of setae, all barbed (Fig 26B). Palp 3-segmented.

Hosts and localities — Described from *Phoenix dactylifera* L. (Arecaceae) at En Yahav, Israel (Smith Meyer & Gerson, 1981).

Symptoms — Unknown.

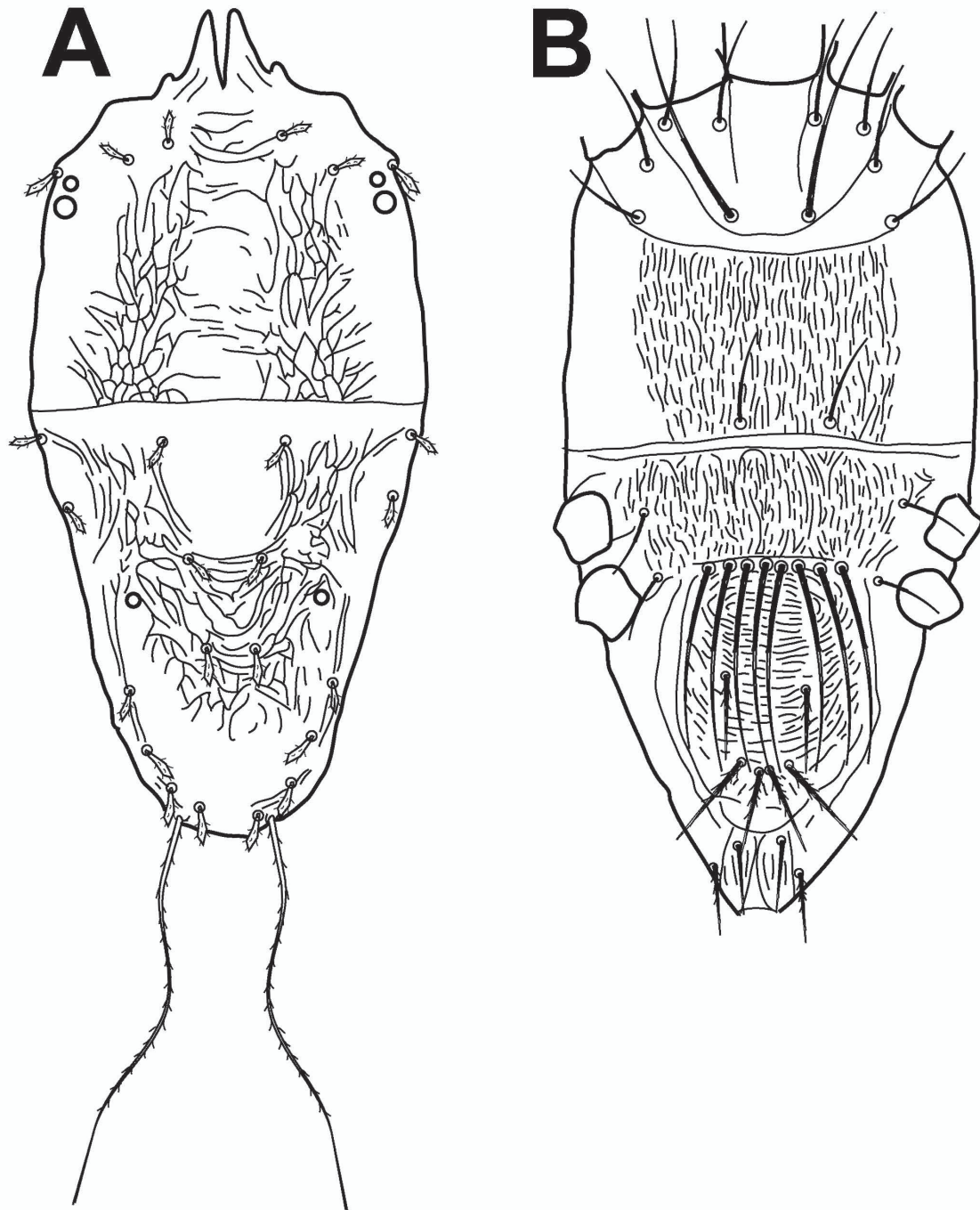


Figure 26 *Tenuipalpus pareriophyoides* Smith Meyer & Gerson – Female: A – dorsal view; B – ventral view.

***Tenuipalpus punicae* Pritchard & Baker, 1958 (Figure 27)**

Diagnosis (Female) — Dorsum medially and laterally reticulate; prodorsum with oblique striae and folds laterally; opisthosoma with longitudinal striae laterally. Prodorsal setae *v2*, *sc1* minute and *sc2* longer, lanceolate and serrate; dorsal opisthosomal setae *c1*, *d1*, *e1*, *f2* present; opisthosoma with dorsocentral setae *c1*, *d1*, *e1* short and slightly serrate; lateral setae longer, weakly lanceolate and serrate; setae *h2* flagelliform (Fig 27A). Venter mostly smooth with weak striae laterally and posteriorly (Fig 27B). Palp 3-segmented. Spermathecal duct narrows to form proximal constriction, prior to forming a membranous bulge and narrows again into a slender tube terminating into a small bulb distally (Fig 27C).

Hosts and localities — Reported from *Punica granatum* L. (Lythraceae) in Greece, India, Iraq, Iran, Israel, Jordan, Spain, Turkey and Russia (Pritchard & Baker, 1958; Wainstein, 1960; Livschits & Mitrofanov, 1967; Hatzinikolis, 1986; Khanjani *et al.*, 2013).

Symptoms — Serious pest of pomegranates (Zaher & Yousef, 1972; Al-Gboory & El-Haidari, 1989) and is the prevalent species on pomegranates in Israel (Tselila Ben-David

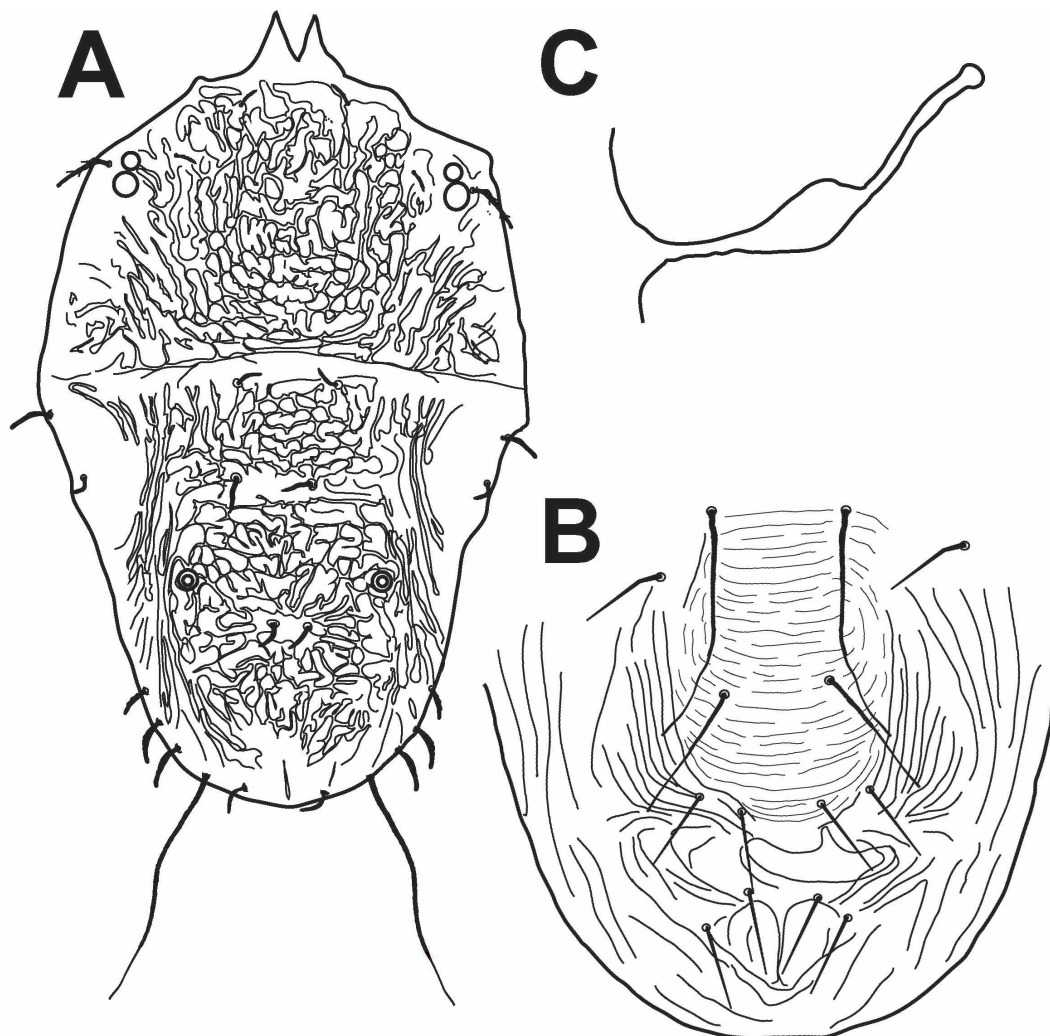


Figure 27 *Tenuipalpus punicae* Pritchard & Baker – Female: A – dorsal view; B – opisthogastric; C – spermatheca.

unpublished).

Key to Tenuipalpidae species of Israel (adult females and deutonymphs)

1. Dorsal opisthosoma with any of sublateral setae *c2*, *d2*, *e2* and *f2* present 2
 — Dorsal opisthosoma setae *c2*, *d2*, *e2* absent, *f2* absent or present 14

2. Dorsal opisthosoma with two or all pairs of setae *c2*, *d2*, *e2*, *f2* present; ventral and genital shields not developed to weakly developed; ventral shield not framed by distinct striae; palp 4–5-segmented (Figs 1G-H) 10
 — Dorsal opisthosoma with setae *c2* present and setae *d2*, *e2* absent 3

3. Palp 1 or 3-segmented (Fig 1 A, F) 4
 — Palp 4-segmented (Fig 1G); setae *f2* present or absent; ventral and genital shields distinct and separate; ventral shield framed by distinct striae (= genus *Cenopalpus* Pritchard & Baker) 5

4. Palp 3-segmented (Fig 1F); Idiosoma elongate, more than 1.5 times as long as wide, slender, parallel-sided, tapering posteriorly; *d3* and *e3* usually inserted in submedial region; rostral shield absent; opisthosomal setae usually setiform or serrate, not ramose or lanceolate nor longer than half width of idiosoma; posterior end of idiosoma with 4 pairs of dorsal setae, *f2* absent; genu IV without setae (= genus *Dolichotetranychus* Sayed), setae *v2* less than half as long as distance between them, setae *h1*, *h2* and *f3* 3–4 times longer than other dorsal setae; setae *3a* 4 times longer than *4a* (Figs 19 A-D) *D. australianus* (Womersley)
 — Palp one-segmented (Fig 1A); Idiosoma oval; opisthosoma with 10 pairs of dorsal setae; paired claws and empodium short and padlike, each claw with 2 short inner tenant hairs and a long outer hair; empodium with 2 rows of short tenant hairs (= genus *Capedulia* Smith Meyer), all dorsal setae very long (Fig 12) *C. maritima* Gerson & Smith Meyer

5. Dorsum striate; palp tibia with one seta 6
 — Dorsum mainly covered with reticulations; palp tibia with 2 setae 7

6. Rostral shield deeply incised, rostrum reaches to middle of femur I; setae *c1* longer than half the length of *d1* (Figs 15 A-B) *C. lineola* (Canestrini & Fanzago)
 — Rostral shield shallowly incised, rostrum reaches past anterior margin of femur I; setae *c1* subequal or slightly longer than *d1* (Fig 18) *C. wainsteini* (Livschitz & Mitrofanov)

7. Prodorsal setae narrowly lanceolate to setiform, serrate 8
 — Prodorsal setae broadly lanceolate to spatulate, strongly pilose 9

8. Dorsal opisthosomal cuticle with distinct series of short transverse bands between setae *d1-e1*; prodorsum with small irregular elements in reticulation; ventral cuticle between setae *4a* and ventral shield covered in small irregular reticulations; deutonymph with dorsal opisthosomal setae very long except for setae *c1*, *d1*, *e1*, *h1* and *h2*, very short (Figs 17 A-C)
 *C. spinosus* (Donnadieu)
 — Dorsal opisthosoma cuticle without distinct series of short transverse bands between setae *d1-e1*; prodorsum with large regular elements in reticulation; ventral cuticle between setae *4a* and ventral plate with large regular reticulation, strongest laterally becoming weak to absent centrally (i.e. smooth centrally); deutonymph with dorsal opisthosomal setae *c3*, *d3*, *e3* and *f3* very long and *c1*, *c2*, *d1*, *f2*, *h1* and *h2* minute (Figs 16 A-C)

.....	<i>C. pulcher</i> (Canestrini & Fanzago)	
9. Prodorsum reticulate laterally, with transverse reticulations medially; rostrum extending to anterior margin of genu I; deutonymph with setae <i>sc2</i> , <i>d3</i> , <i>e3</i> , <i>f2</i> , <i>f3</i> and <i>h2</i> clearly longest, rest of dorsal setae clearly shorter (Figs 13 A-C)	<i>C. halperini</i> Castagnoli	
— Prodorsum entirely reticulated with medial elements larger; rostrum reaching past distal end of femur I; deutonymph with most dorsal setae long except for <i>d1</i> , <i>e1</i> , and <i>h1</i> which are minute (Figs 14 A-C).....	<i>C. lanceolatisetae</i> (Attiah)	
10. Four pairs of sublateral setae present (<i>c2</i> , <i>d2</i> , <i>e2</i> , <i>f2</i>)		11
— Two pairs of sublateral setae (<i>c2</i> , <i>d2</i>) present; idiosoma roundish; opisthosoma with 11 pairs of setae; <i>e2</i> absent and <i>d2</i> present (= genus <i>Obdulia</i> Baker & Pritchard), dorsal body setae setiform, minutely serrate (Fig 20).....	<i>O. tamaricis</i> Baker & Pritchard	
11. Palp 5-segmented (Fig 1H) (= genus <i>Aegyptobia</i> Sayed).....		12
— Palp 2-segmented		13
12. Prodorsum with reticulations medially only; dorsal setae broadly lanceolate and coarsely serrate (Fig 3)	<i>A. salixi</i> Zaher & Yousef	
— Dorsum completely covered with reticulations; dorsal setae broadly club-shaped and smooth (Figs 2 A-C)	<i>A. eremia</i> Smith Meyer & Gerson	
13. Dorsal setae long and rodlike, with clavate tips; idiosoma round (= genus <i>Raoiella</i> Hirst), dorsal body setae long with small knobs distally, seta <i>h1</i> subequal in length to <i>h2</i> , seta <i>h2</i> setiform, with finely tapered tip, seta <i>f2</i> shorter than <i>f3</i> (Figs 22 A-C)	<i>R. indica</i> Hirst	
— Dorsal setae broadly palmate with extensive venation (= <i>Phyllotetranychus</i> Sayed), dorsal setae large, fan-shaped and veined, with setae <i>v2</i> very broad near middle (Fig 21).....	<i>P. aegyptiacus</i> Sayed	
14. Setae <i>h2</i> not long and attenuate, almost similar in length to other opisthosomal setae; genital and ventral shields separated, former elliptical, wider than long, latter rectangular, usually with striate cuticle forming a frame around plate; palp 4-segmented (Fig 1G); lateral margin of opisthosoma with 6 or 7 pairs of setae (= genus <i>Brevipalpus</i> Donnadieu)		15
— Setae <i>h2</i> long and whip-like, at least 4 times longer than other dorsal opisthosomal setae, opisthosoma tapered with 6–10 pairs of setae; ventral shields indistinctly outlined; palp usually 1-3-segmented (Figs 1A-D) (= genus <i>Tenuipalpus</i> Donnadieu).....		22
15. Opisthosoma with 6 pairs of dorsolateral setae (<i>c3</i> , <i>d3</i> , <i>e3</i> , <i>f3</i> , <i>h2</i> and <i>h1</i> ; setae <i>f2</i> absent) .		16
— Opisthosoma with 7 pairs of dorsolateral setae (<i>f2</i> present)		18
16. Tarsus II with a single solenidion distally; prodorsum with even reticulations laterally but devoid of median reticulations; spermatheca terminates into a round vesicle with short finger-like projections around entire perimeter; deutonymph with setae <i>c3</i> , <i>d3</i> , <i>e3</i> shorter than <i>f3</i> , <i>h1-2</i> (Figs 6 A-D).....	<i>B. obovatus</i> Donnadieu	
— Tarsus II with 2 solenidia distally		17
17. Prodorsum centrally with strong areolae, posterior reticulation with large round cells, small round cells medially, anteriorly mostly smooth; palp femorogenu with dorsal seta broad, flat, serrate; spermatheca terminates into a membranous bulb; deutonymph with prodorsal setae <i>v2</i> short, opisthosomal setae <i>c1</i> , <i>d1</i> , <i>d3</i> , <i>e1</i> , <i>e3</i> minute, setae <i>c3</i> , <i>f3</i> , <i>h1</i> , <i>h2</i> large and broadly lanceolate (Figs 9 A-D).....	<i>B. phoenicis</i> (Geijskes)	
— Prodorsum centrally with strong areolae, posterior reticulation with large cells, anteriorly		

- weakly reticulate; palp femorogenu with dorsal seta narrow, serrate; spermathecal terminates into a sclerotised oval vesicle with a thick distal stipe; deutonymph with prodorsal setae *v2* lanceolate, opisthosomal setae *c1*, *d1*, *e1* minute, setae *f3*, *h1*, *h2* large and broadly lanceolate, setae *c3*, *d3* and *e3* vary from short to large (like *f3*, *h1*, *h2*) (Figs 11 A-D) *B. yothersi* Baker
18. Tarsus II with one single solenidion distally 19
 — Tarsus II with two solenidia distally; Prodorsum evenly reticulated; 3 pairs of dorsocentral setae very short, setiform, equally long; all dorsal setae very short, setae *d1*, *e1* and *f2* present (Figs 4 A-D) *B. californicus* (Banks)
19. Solenidia on tarsi I and II shorter than width of segments 20
 — Solenidia on tarsi I and II longer or as long as width of segments; most dorsal setae broadly lanceolate, marginal setae slightly longer and serrate; nymph with setae *sc1*, *sc2*, *f2*, *f3*, *h2* and *h1* broadly lanceolate, serrate, except for *h1*, which are clearly shortest (Figs 10 A-C) *B. recki* Livschits & Mitrofanov
20. Rostrum extending beyond distal end of femur 21
 — Rostrum not extending beyond distal end of femur; spermatheca terminating into a small rounded vesicle with a series of short projections and clear internal “bubble”; deutonymph with setae *sc1*, *sc2*, *c3*, *f2*, *f3*, *h2* and *h1* longest, rest short (Figs 5 A-D) *B. lewisi* McGregor
21. Trochanter III with one seta, trochanter IV without setae; spermatheca a very long, slender, coiling tube terminating into a large, prominent hairy bulb; deutonymph with setae *sc2*, *c3*, *d3*, *e3*, *f3* and *h1* longest, broadly lanceolate and serrate; setae *v2*, *sc1*, *c1*, *d1*, *e1*, *f2*, *h2* much shorter and serrate (Figs 8 A-D) *B. olearius* Sayed
 — Trochanter III with 2 setae and trochanter IV with one seta; spermatheca a very long, slender, coiling tube terminating into a large, prominent hairy bulb; deutonymph with setae *sc2*, *c3*, *f3* and *h1* longest, broadly lanceolate, and serrate; setae *v2*, *sc1*, *c1*, *d1*, *d3*, *e1*, *e3*, *f2*, *h2* much shorter and serrate (Figs 7 A-D) *B. oleae* Baker
22. Venter with two to five pairs of setae *4a* 23
 — Venter with one pair of setae *4a* 25
23. Venter with two or four pairs of setae *4a* 24
 — Venter with five pairs of setae *4a* (Fig 24 B) *T. dubinini* Reck
24. Venter with four pairs of setae *4a* (Fig 26 B), overreaching aggenital setae (*ag*); 3 pairs of dorsocentral setae present, dorsum with complete or incomplete reticulations (Figs 26 A-B) ..
 *T. pareriophyoides* Smith Meyer & Gerson
 — Venter with two pairs of setae *4a* (Fig 24 B); one (rarely 2) pairs of dorsocentral setae present, dorsum nearly smooth (Figs 25 A-C) *T. granati* Sayed
25. Most dorsal setae minute except for *sc2*, *c3*, *e3*, *f2*, *f3* and *h1* which are slightly longer and serrate; dorsum covered with strong, irregular reticulations (Figs 27 A-C)
 *T. punicae* Pritchard & Baker
 — Setae *v2*, *sc2*, *d3* and *e1* minute and spatulate, rest larger and spatulate or broadly lanceolate; dorsum striate (Figs 23 A-C) *T. cupressoides* Smith Meyer & Gerson

Discussion

Seven of the 26 tenuipalpid species known from Israel can be regarded as pests, the rest have either no, or little, economic impact, or else are controlled by their natural enemies. *Brevipalpus californicus*, *B. lewisi*, *B. phoenicis* and *B. yothersi* infest citrus. *B. lewisi* was reported from “Blue Serbian” vines, causing severe leaf sclerosis, at Nachshonim in 1952 (Bytinski-Salez, 1966), but never found again till during this study when it was found on under side of petit vardo leaves in Mizpe Ramon. *Tenuipalpus granati* is a pest of pomegranates and grapes, and *T. punicae* can be a very significant pest of pomegranates. However the palm-infesting *Phyllotetranychus aegypticus*, and *Tenuipalpus pareriphyoides* do not seem to affect their hosts. Nor does *Raoiella indica*, another palm-infesting species, despite being a major pest of palms (and banana) in Central America (Amaro & De Morais, 2013; Dowling *et al.*, 2012).

A review of the Tenuipalpidae fauna of Turkey (Çobanoğlu *et al.*, 2016) revealed almost the same number of species (28) as in Israel (26). Both faunas shared 11 species (*Cenopalpus lineola*, *C. spinosus*, *C. pulcher*, *C. lanceolatisetae*, *T. granati*, *T. punicae*, *B. phoenicis*, *B. obovatus*, *B. californicus*, *B. lewisi* and *B. olearius*). Turkey has four endemic species (*Cenopalpus bakeri* Duzgunes, *C. pritchardi* Duzgunes, *Pseudoleptus zelihae* Pritchard & Baker and *Aegyptobia juniper* Çobanoğlu *et al.*), oppose to five in Israel (*A. eremia*, *C. halperni*, *C. maritima*, *T. cupressoides* and *T. pareriphyoides*). The Israel fauna consists of six *Cenopalpus*, eight *Brevipalpus*, five *Tenuipalpus*, two *Aegyptobia* spp., one *Capedulia*, one *Dolichotetranychus*, one *Phyllotetranychus*, one *Obdulia* and one *Raoiella* sp. The Turkish fauna comprises seven *Cenopalpus*, seven *Brevipalpus*, two *Tenuipalpus*, six *Aegyptobia*, three *Pentamerismus* spp., one *Raoiellana*, one *Pseudoleptus* and one *Phytoptipalpus* sp.

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