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First record of *Cenopalpus officinalis* Papaioannou-Souliotis (Tenuipalpidae) for Israel, Italy and Mexico and a redescription

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Original research

ABSTRACT

Cenopalpus officinalis Papaioannou-Souliotis, 1986 (Trombidiformes: Tetranychoidae: Tenuipalpidae) is reported for the first time from Israel, Italy and Mexico. Previously, this flat mite species was only known to occur in Greece and is the first species belonging to the genus *Cenopalpus* recorded from Mexico. Adult females and males, deutonymphs and eggs, collected in Italy and Israel as well as the material intercepted from Italy and Mexico at United States ports of entry were studied, illustrated and analyzed.

Keywords new records; Tenuipalpidae; interceptions; invasive species; cryo-scanning electron microscopy; *Cenopalpus pterinus* species-group

Introduction

Obligatory phytophagous mites belonging to the family Tenuipalpidae Berlese, 1913 (Castro *et al.* 2015; Beard *et al.* 2018), are cosmopolitan in distribution, containing several economically important pest species. Within the family, *Cenopalpus* is an important genus with 71 described species (Castro *et al.* 2020). In the last two decades, researchers reported new records and species of this genus in several countries, including Bulgaria (Trencheva and Trenchev 2018), Georgia (Arabuli and Kvavadze 2013), Greece (Hatzinikolis *et al.* 2001), Hungary (Ueckermann and Ripka 2016; Kotschán *et al.* 2020), India (Mitra *et al.* 2018), Iran (Rahmani *et al.* 2008; Khanjani *et al.* 2012; Ardali *et al.* 2014), Japan (Negm *et al.* 2020), Pakistan (Hasan *et al.* 2004; Iqbal *et al.* 2007), Syria (Barbar 2016; Barbar 2018; Zeity and Srinivasa 2019), Turkey (Sağlam and Cobanoğlu 2010; Cobanoğlu *et al.* 2016; Cobanoğlu *et al.* 2019) and the United States (Bajwa *et al.* 2001). The increasing discoveries of *Cenopalpus* spp. indicates an ever-growing risk of invasion in a global economy. Despite multiple surveys for flat mites made by Baker and colleagues in Mexico, no records of the genus *Cenopalpus* were cited until now (Baker *et al.* 1975; Tuttle *et al.* 1976; Baker and Tuttle 1987). The study of the geographical distribution of these mites along with their host association, damage and potential pathogen transmission requires careful examination for the formation of future control plans (Gerson 2008; Farzan *et al.* 2013; Rodrigues and Childers 2013; Alberti and Kitajima 2014).

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This paper aims to report new findings of *Cenopalpus officinalis* Papaioannou-Soulitiotis, 1986 from Israel, Italy and Mexico and revise the species description based on new morphological characters observed by cryo-scanning electron microscopy.

Materials and methods

In 2019, flat mites were collected from twigs and leaves of *Rosmarinus officinalis* L. (Lamiaceae) in Apulia-District (Southern-Italy). The samples were placed inside a polyethylene bag with a paper towel and stored at reduced temperatures (about +4°C). The coordinates were taken using Map Coordinates (version 4.8.28) and expressed in degrees, minutes, seconds.

Plant samples from Apulia were examined under an Olympus SZH10 stereomicroscope at the Department of Soil, Plant and Food Sciences (DiSSPA), University of Bari Aldo Moro. The stereomicroscope's photos were taken by a Canon Mark III camera using EOS utility 0.1.18.0. The specimens were mounted on microscope slides in Hoyer's medium (Walter and Krantz, 2009) and placed in an oven (40-50 °C) for one week. The specimens were examined and compared with material deposited at the United States National Mite Collection (USNM) using Differential Interference Contrast (DIC) and Phase Contrast microscopy. The light microscopy photographs were taken with a Zeiss Imager D1 microscope with an AxioCam ICc5 using AxionVision SE64 and optimized by Adobe Photoshop 10 version 21.0.3. Drawings were made through a camera lucida mounted on a Leica DMR microscope and were optimized by Adobe Photoshop 10 version 21.0.3. Specimens stored in 70% ethanol were used for cryo-scanning electron microscopy studies; specimen preparation followed the technique outlined by Bolton *et al.* (2014). The specimens were analyzed by cryo-scanning electron microscopy following, without any modifications, the methodology completely described in Beard *et al.* 2015.

All measurements are presented in micrometers (µm), followed by the measurements for the paratype in square brackets reported in the re-description (Hatzinikolis *et al.* 1999). Setae were measured from the centre of the setal base to the tip of the setal shaft; distances between setae were measured as the distance between the centre of the bases of the setae. Body size was measured as: *v2-h1* (= length excluding gnathosoma), palp tarsus-*h1* (= length including gnathosoma), propodosoma width between *v2-sc1* and between *sc1-sc2*, opisthosoma width just posterior to leg IV.

Body chaetotaxy follows Grandjean (1939) and Lindquist (1985). Leg chaetotaxy is adapted from Lindquist (1985), Quiros-Gonzalez (1985) and Kane (2003). Leg setal formulas are written as the total number of tactile setae followed by the number of solenidia in parentheses. Legs were measured from the posterior margin of the coxa to the distal end of the claws. Identification was carried out using the original species description (Papaioannou-Soulitiotis 1986). The terminology follows Baker and Tuttle (1987), Mesa *et al.* (2009) and Beard *et al.* (2012, 2015, 2018).

The slide mounted specimens are deposited at the Entomological and Zoological Section, Department of Soil, Plant and Food Sciences (DiSSPA), University of Bari Aldo Moro, Italy (UNIBA) and at the United States National Insect & Mite Collection Smithsonian Institution, located in the Systematic Entomology Laboratory (SEL), USDA, Beltsville, Maryland, USA (USNM).

Family Tenuipalpidae Berlese, 1913

Genus *Cenopalpus* Pritchard and Baker, 1958

Cenopalpus pterinus species group, Hatzinikolis *et al.* (1999)

Adult female

Six dorsolateral setae on opisthosoma (*c3*, *d3*, *e3*, *f3*, *h2*, *h1*). Palps four segmented. Setal formula: 0-1-2-2: palp trochanter without setae, palp femur with 1 dorsal seta, palp genu-tibia

Figure 1 *Cenopalpus officinalis* Papaioannou-Souliotis, 1986 on *Rosmarinus officinalis* L.: **a** – eggs (indicated with arrows) and adults on lower leaf surface; **b** – adult on trichomes. Samples collected from Italy.

with 2 setae and palp tarsus with 2 sensory setae. Leg setal formula (coxae to tarsi): I 2-1-4-3-5-8(1 ω), II 2-1-4-3-5-8(1 ω), III 1-2-2-1-3-5, IV 1-1-1-0-3-5. Leg chaetotaxy as follows: coxae I-II each with two setae (*1b*, *1c* and *2b*, *2c* respectively); coxae III-IV each with one seta (*3b* and *4b*). Trochanters I-II-IV each with one seta (*v'*); trochanter III with two setae (*l'*, *v'*). Femora I-II with four setae (*d*, *l'*, *v'*, *bv''*); femur III with two setae (*d*, *ev'*); femur IV with one seta (*ev'*). Genua I-II with three setae (*d*, *l'*, *l''*); genu III with one seta (*l'*); genu IV without setae. Tibia I-II with five setae (*d*, *v'*, *v''*, *l'*, *l''*); tibia III-IV with three setae (*d*, *v'*, *v''*). Tarsi I-II with eight setae and each with one long and tapering solenidion; tarsi III-IV with five setae (*ft'*, *tc'*, *tc''*, *u'*, *u''*). Ventral plate with two setae (*ag-ag*); genital plate with 2 pairs of setae (*gl* and *g2*); anal plate with 2 pairs of setae (*ps1* and *ps2*).

***Cenopalpus officinalis* Papaioannou-Souliotis, 1986**

(Figures 1-16)

Diagnosis

(Figs. 1a-1b)

As per *C. pterinus* species group, in addition to the following. Color in life red with a presence of dark circular spots in the middle of opisthosoma. Body ovate to elliptical (sensu Beentje 2010), wider posteriorly and narrower anteriorly. Anterior margin of propodosoma always smooth, partly reticulate with elongate cells. Cuticle of propodosoma with strong, broad polygonal and weak areolae medially placed. Sublateral cuticle of propodosoma with reticulation forming large cells posteriorly. Dorsal opisthosoma completely reticulate: dorsocentral, from *c1-c1* to the end of *e1-e1* with reticulation forming large polygonal to elongated cells. Sublateral cuticle of opisthosoma with polygonal, vertical and elongate cells. Metapodosoma almost smooth, with weak transverse striae medially between coxae III. Ventral reticulation between coxae IV can vary from polygonal to elongate (almost smooth) cells. Ventral plate with small, polygonal to elongate cells; genital plate with elongate to polygonal cells. Both plates developed and sclerotized, surrounded by four transverse and large bands. Propodosoma and opisthosoma with well-developed lanceolate and plumose setae.

Material examined

ISRAEL: Newe Ya'ar, ex. *R. officinalis* L. (Lamiaceae), collector E. Recht, 30 Nov. 2016, 2 males, 2 females, deposited in USNM 2 slides.

ITALY: Ecotekne-Lecce (Southern-Italy) 40°20'14" N 18°06'17" E, 30 m, ex. twigs and leaves of *R. officinalis* L. (Lamiaceae), collector de Lillo Enrico, 5 Feb. 2019, 3 deutonymphs, 1 male, 7 females, deposited in DiSSPA (3 deutonymphs, 1 male and 2 females slides) and USNM (2 females slides and 3 females stored from Cryo-SEM); Bitetto (Southern-Italy) 41°02'24" N 16°44'29" E, 140 m, ex. stem and lower leaf surface of *R. officinalis*, collector De Giosa Marcello, 13 Sep. 2019, 2 deutonymphs, 17 females, deposited in DiSSPA (1 deutonymph and 11 females slides) and USNM (1 deutonymph and 3 females slides and 3 females stored from Cryo-SEM); Bari (Southern-Italy), intercepted at New York, leaves of *R. officinalis*, collected in 1962, 2 females, deposited in USNM 1 slide.

MEXICO: Mexico City, leaves of *R. officinalis*, intercepted at Chicago Airport (CHI036746), collector M. Krosniak, 26 Mar. 2009, 1 male, 1 female, deposited in USNM 2 slides.

Re-description

Female (n=29)

Figure 2 *Cenopalpus officinalis*, adult female: **a** – dorsal habitus (scale 100 µm); **b** – ventral, genital ad anal plates (scale 50 µm).

Figure 3 Light micrographs (DIC) *Cenopalpus officinalis*, adult female: **a** – dorsal habitus; **b** – ventral habitus. Samples collected from Mexico. Scales 50 µm.

Dorsum. (Figures 2a, 3a, 4) Body length 275-286 [313] including the gnathosoma and distance between setae *v2-h1* 242-258 [270] excluding gnathosoma; propodosoma width 130-143 and opisthosoma width 109-169. Dorsal setae: *v2* 29-44 [40], *sc1* 25-31 [44], *sc2* 38-48 [49], *c1* 34-47 [42], *c2* 36-39 [41], *c3* 37-39 [40], *d1* 42 [36], *d3* 37-45 [44], *e1* 27-28 [28], *e3* 35-37 [43], *f3* 31-33 [36], *h2* 21-26 [31], *h1* 14-18 [23]. Distance between dorsal tubercles *v2-v2* 38-73, *sc1-sc1* 36, *sc2-sc2* 133, *c1-c1* 61, *c2-c2* 133, *c3-c3* 150, *d1-d1* 45, *d3-d3* 140, *e1-e1* 31, *e3-e3* 126, *f3-f3* 105, *h2-h2* 77, *h1-h1* 32.

Microplates. (Figures 5a-5b) Mostly separated individually, some fused, rounded to oblong shape.

Venter. (Figures 2b, 3b) Ventral setae: *1a* 64-75, *1b* 31-32, *1c* 16-19, *2b* 19, *2c* 22-28, *3a* 18-26, *3b* 14-15, *4a* 59, *4b* 13-14, *ag* 16-21, *g1* 11-12, *g2* 12-15, *ps2* 5-6, *ps3* 13-15. Distance between *ag-ag* 24, *g1-g1* 11-12, *g2-g2* 42, *ps2-ps2* 19, *ps3-ps3* 26. Ventral setae *1a* and *4a* longer than others and lanceolate, smooth and fine. Ventral setae (*ag-ag*) more barbed than genital and anal setae (*g1*, *g2*, *ps2*, *ps3*).

Gnathosoma. (Figure 6a) Subcapitulum long, extending almost to level of distal end of femur I. Subcapitulum with two subcapitular setae *m*: length 11-13 [10], distance between tubercles *m-m* 27.

Palps. Setal formula for palps as in diagnosis of *Cenopalpus pterinus* species group. Palp tarsus with 1 solenidion (8) [8] and 1 eupathidia (4-5) [3]. Femur seta mostly plumose and

Figure 4 *Cenopalpus officinalis*, dorsal habitus of adult female. Samples collected from Italy. Scale 100 μ m.

Figure 5 *Cenopalpus officinalis* adult female, detail of microplates on dorsal cuticle: **a** – scale 10 μm; **b** – scale 3 μm.

lanceolate; genu-tibia setae long, smooth and lanceolate.

Spermathecal apparatus. (Figures 6b, 7a-7b) The shape varies from long narrow convoluted duct, often not visible, with duct ending with a membranous, bulbous lobe or small rounded vesicle.

Legs. (Figures 8a-8d) Setal formula for legs I–IV as in species group. Length (coxae to tarsi): leg I 162–166, leg II 132–139, leg III 133–135, leg IV 148–154. Shape of setae on legs: leg I, femur barbed-lanceolate ($bv'' - v'$) and plumose-lanceolate ($d - l'$) setae; genu plumose setae ($d - l' - l''$); all tibia setae barbed and lanceolate ($l' - l'' - v' - v''$) and plumose (d). Shape

Figure 6 *Cenopalpus officinalis*, adult female: **a** – detail of gnathosoma and subcapitular setae; **b** – spermathecal apparatus. Scale 50 μm.

Figure 7 Light micrographs (phase contrast) *Cenopalpus officinalis*, adult female: long narrow, duct often visible, ending in membranous bulb.

of setae on leg II, as following leg I, except v' on femur and l'' on genu, smooth. Leg III with plumose-lanceolate femur seta (d) and smooth-lanceolate seta (ev'); seta l' on genu barbed; tibia with lanceolate and moderately serrate setae ($v' - v''$), plumose seta (d). Shape of setae on leg IV as following leg III.

Male (n=4)

Dorsum. (Figures 9a, 10a) Dorsal reticulations with strong and polygonal cells medially, elongated to fused cells laterally. Body length 248 [241] including the gnathosoma and 196 [222] excluding gnathosoma; propodosoma width 108-116; opisthosoma width 56-101. Body: distance between setae $v2-h1$ 196. Dorsal setae: $v2$ 32-35, $sc1$ 25-31, $sc2$ 40-43, $c1$ 28-29, $c2$ 28-34, $c3$ 36-48, $d1$ 27-28, $d3$ 36, $e1$ 13-15, $e3$ 39-45, $f3$ 24-25, $h2$ 25-29, $h1$ 16-17. Distance between tubercles $v2-v2$ 36, $sc1-sc1$ 73, $sc2-sc2$ 105, $c1-c1$ 47, $c2-c2$ 97, $c3-c3$ 103, $d1-d1$ 49, $d3-d3$ 98, $e1-e1$ 25, $e3-e3$ 85, $f3-f3$ 70, $h2-h2$ 49, $h1-h1$ 14.

Venter. (Figures 9b, 10b) Ventral cuticle almost smooth, covered mostly with transverse to longitudinal striae; coxal fields with weak striae. Cuticle posterior to $4a$ with transverse striae, widely spaced; irregular reticulation with large cells posterior to $ag-ag$. Ventral setae: $1a$ 50-61, $1b$ 9-20, $1c$ 16-19, $2b$ 10-22, $2c$ 18-20, $3a$ 19-25, $3b$ 14-19, $4a$ 65-75, $4b$ 13-16, ag 13-17, gl 9, $ps1$ 10, $ps2$ 32-34. Distance between $ag-ag$ 16. Ventral setae short except $1a$ and $4a$ lanceolate and fine; $1b$, $1c$, $2b$, $2c$, $3a$, $3b$, $4b$ smooth and moderately barbed; ag , agl , $ag2$, $ps2$ barbed; anal setae $ps3$ very long, lanceolate and fine.

Aedeagus. (Figures 9b, 11a-1b) Aedeagus narrow, elongate and sclerotized, ending in a rounded membranous bulb. Length: 97.

Gnathosoma. Subcapitulum not reaching distal end of femur I. Subcapitulum with two subcapitular setae m : length 5-7, distance between tubercles $m-m$ 15.

Palps. As in female: femur with 1 dorsal seta, palp genu-tibia with 2 setae, palp tarsus with 1 solenidion (length 7) and one eupathidia. Femur seta finely serrate-barbed; genu-tibia setae smooth and lanceolate.

Legs. Similar to adult female. Length: leg I 151-152; leg II 121-134; leg III 122-124; leg IV 135-140.

Deutonymph (n=5)

Dorsum. (Figures 12a, 13a, 14a-14b) Length of the body including the gnathosoma 237-285 [282]; length body excluding gnathosoma 217-253 [263]; width propodosoma 72-103; width opisthosoma 42-102. Dorsal propodosoma reticulation absent, mostly smooth with weak

Figure 8 *Cenopalpus officinalis*, legs: **a** – leg I; **b** – leg II; **c** – leg III; **d** – leg IV. Scales 50 μ m.

striations. Dorsal opisthosoma with transverse striate medially between *c3-c3* to *f3-f3*. Dorsal propodosoma and opisthosoma setae thin with short setules (lanceolate and finely serrate): *v2*, *sc1*, *sc2*, *c1*, *c2*, *c3*, *d1*, *d3*, *e3*, *f3*, *h2*; except *e1* and *h1* that are absent. Body: distance between setae *v2-h1* 199-240. Dorsal setae: *v2* 44-66, *sc1* 37-46, *sc2* 41-51, *c1* 42-71, *c2* 38-70, *c3* 42-51, *d1* 63-63, *d3* 47-73, *e3* 52-69, *f3* 42-60, *h2* 55-63. Distance between tubercles: *v2-v2* 16-40, *sc1-sc1* 25-64, *sc2-sc2* 39-103, *c1-c1* 35-36, *c2-c2* 79-89, *c3-c3* 95-101, *d1-d1* 16-20, *d3-d3* 88-102, *e3-e3* 84-95, *f3-f3* 74-76, *h2-h2* 55-55, *h1-h1* 21.

Figure 9 *Cenopalpus officinalis*, adult male: **a** – dorsal habitus (scale 100 μm); **b** – genital and anal view with detail of aedeagus (scale 50 μm).

Venter. (Figure 13b) Cuticle mostly plicate, covered with transverse and narrow striae up to *ag-ag*, except coxal fields with weak striae. Ventral, genital and anal shields indistinct, with short and weak transverse-vertically striae. Ventral setae: *1a* 36-67, *1b* 5-14, *1c* 7-12, *2b* 11-16, *2c* 14-20, *3a* 13-14, *3b* 12-15, *4a* 39-40, *4b* 10-13, *ag* 4-5, *gl* 3-4, *ps2* 5, *ps3* 6. Distance between *ag-ag* 25, *gl-gl* 17. Ventral setae short except for *1a* and *4a* which are much longer and lanceolate; *ag-ag* and *gl-gl* more barbed than pseudoanal setae (*ps2-ps3*).

Gnathostoma. Subcapitulum with two subcapitular setae *m*: length 4-6.

Palps. (Figure 12b) Setal formula: 0-1-2-2: palp genu-tibia with 2 setae, palp tarsus with 1 solenidion and 1 short eupathidium. Femur seta finely barbed; genu-tibia setae smooth and lanceolate.

Legs. (Figures 15a-15c) Setal formula (femur to tarsi): I 4-3-5-8(1 ω), II 4-3-5-8(1 ω), III 2-1-3-5, IV 1-0-3-5. Length (coxae to tarsi): leg I 98-114, leg II 80-93, leg III 93-71, leg IV 91-111. Shape of setae on legs: leg II with four setae on femur, *bv''* - *d* and *l'* plumose and

Figure 10 Light micrographs (DIC) *Cenopalpus officinalis*, adult male: **a** – dorsal habitus; **b** – ventral habitus. Scales 50 μ m.

lanceolate, v' smooth and lanceolate; genu with barbed and short seta (d) and shorth-smooth setae ($l' - l''$); tibia setae moderately barbed and lanceolate ($l' - v' - v''$), mostly barbed and lanceolate (d), barbed and short (l''). Leg III with barbed femur seta (d) and smooth seta (ev'); seta l' on genu short and barbed; tibia with lanceolate and moderately serrate setae ($v' - v''$), short and barbed seta (d). Shape of setae on leg IV as following leg III.

Eggs (Figures 16a-16b)

Most of the eggs were grouped on lower leaf surface (near the abaxial veins) and in general on the trichome tips. This behavior may be a strategy to protect the eggs from predation. Eggs are oblong with longitudinal fine ridges (almost smooth).

Differential diagnosis remarks

The specimens of *C. officinalis* recovered from Israel, Italy and Mexico are in concordance with the redescription of the paratypes collected by Hatzinikolis *et al.* (1999), except for some minor morphological differences. The anterior margin of the female's propodosoma is smooth distally and shows polygonal cells in a more proximal area (vs. completely and strongly reticulated with polygonal cells), the palp's eupathidia is shorter than the solenidion (vs. solenidion longer than the eupathidia), the seta on palp femur is plumose and lanceolate (vs. pilose and short), the ornamentation of the genital and anal plates has cells that are polygonal to elongate (vs. only polygonal). In addition, the distal end of the spermathecal apparatus can vary: the

Figure 11 Light micrographs (DIC): **a** – aedeagus of *Cenopalpus officinalis* (a rounded membranous bulb is indicated with an arrow); **b** – genital and anal plates. Scales 20 μ m.

specimens from Israel, Mexico, and some from Italy, agree with the type since the convoluted duct terminates in a bulbous lobe; however, some of the specimens from Italy differ as the distal end of the spermathecal apparatus ends in a small membranous vesicle. Considering the deutonymph, only the length of dorsocentral (*e1*) and dorsolateral (*h1*) setae appeared to be different between our specimens and the types. Indeed, in the original description given by Papaioannou-Souliotis (1986), and according with the first re-description (Hatzinikolis *et al.* 1999), the third pair of the dorsocentrals and the fifth pair of dorsolaterals were indicated as “minute.” These setae could not be discerned on their tubercles in some of our specimens, possibly because *e1* and *h1* are micro-setae.

Discussion

Cenopalpus officinalis resembles *C. pterinus* (Pritchard and Baker 1958) and *C. adventicius* (Ueckermann and Ripka 2016); all belong to the *pterinus* species group (Baker *et al.* 1975; Hatzinikolis *et al.* 1999) in which setae *f2* is absent. The adult females of this group share some morphological characters: six dorsolateral setae, palp genu-tibia and tarsus each with two setae and tarsus II with one very long and tapering solenidion. The similarities between these three species needs further examination. The immatures of these three species differ by the length of dorsocentral and dorsolateral setae. In the deutonymph of *C. officinalis*, *e1* and *h1* are minute/absent; *C. pterinus* *d1*, *e1*, *e3*, *h1* are minute and all dorsal setae of *C. adventicius* are longer than those of the other two species, except *d1*, *e1*, and *h1* that are minute. In addition, after studying the literature (Bytinski-Salez 1966; Hatzinikolis 1982; Papaioannou-Souliotis 1986; Hatzinikolis and Emmanouel 1987; Papaioannou-Souliotis *et al.* 1994; Ueckermann and Ripka 2016; Kontschán and Ripka 2017; Mesa *et al.* 2009; Kontschán *et al.* 2018), we consider that *R. officinalis* is a preferred host for these three closely species. Future molecular analyses are needed for understanding of the possible variation of these three species. The deutonymph setae length of these three species are probably related to biotic factors and geographical distribution. Additionally, the holotype of *C. officinalis* was collected in Greece on *R. officinalis* in 1983 and the paratypes on *Cupressus sempervirens* Linnaeus and some ornamental plants (Papaioannou-Souliotis 1986; Papaioannou-Souliotis *et al.* 1994). Hatzinikolis *et al.* (1999), in the first re-description of *C. officinalis*, reported *Parthenocissus* sp. as a new host plant. In Apulia territories, *C. officinalis* was recovered only from *R. officinalis*, no mites were collected from *C. sempervirens*. Finally, the host plant may play a significant

Figure 12 *Cenopalpus officinalis*, deutonymph: **a** – dorsal habitus (scale 100 μ m); **b** – palp (scale 50 μ m).

role in the spread of *C. officinalis*, being a popular cuisine plant, it is moved to many parts of the world. For this reason, we encourage a greater awareness of plant movement and education to recognize the symptoms of the mite damage in this host plant. High populations of these mites can cause discoloration of the leaves (silvering to brown) and affecting the market appearance.

Figure 13 Light micrographs (DIC) of *Cenopalpus officinalis*, deutonymph: **a** – dorsal habitus; **b** – ventral habitus. Scales 50 μ m.

Figure 14 Light micrographs (DIC) of *Cenopalpus officinalis*, deutonymph dorsal setae: **a** – dorsocentral hysterosomal on anterior opisthosoma; **b** – hysterosomal dorsolateral tubercles on posterior dorsal opisthosoma. Scales 20 μ m.

Figure 15 *Cenopalpus officinalis*, deutonymph: **a** – leg II; **b** – leg III; **c** – leg IV. Scales 50 μ m.

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Figure 16 Eggs of *Cenopalpus officinalis*: **a** – under lower leaf surface, near the abaxial veins (scale 400 µm); **b** – details of egg (scale 50 µm).

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