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## **Eriophyoid mites (Acari: Prostigmata: Eriophyoidea) from the Maltese Islands (Central Mediterranean): new reports and a preliminary check-list**

### ABSTRACT

In the 20<sup>th</sup> Century, about 20 species of eriophyoids were listed for the Maltese Islands but these reports were entirely based on plant gall surveys. In these last four years, plant collections were made in order to investigate the species of eriophyoids present in Malta and Gozo. Most of the earlier reports have been confirmed and eight species were found to be new for the Maltese islands: *Aceria caulobia* (Nalepa) gall-making on *Suaeda vera* Gmelin; *Aceria onychia* (Nalepa) on *Phlomis fruticosa* L.; *Aceria sheldoni* (Ewing) on lemon; *Aculus tetanothrix* (Nalepa) gall-making on *Salix* sp.; *Cecidophyopsis hendersoni* (Keifer) on yucca; and three species associated with olive, *Ditrymacus athiasella* Keifer, *Oxycenus maxwelli* (Keifer) and *Tegolophus hassani* (Keifer). Additional remarks were included for *Acalitus phloeocoptes* (Nalepa), collected on cherry plum, whose earlier Maltese record was doubtful. A complete morphometric description of *Aceria carlinae* (Nalepa) is here provided.

Key words: faunistic survey, eriophyoids, new records, Malta.

### INTRODUCTION

The Maltese Islands are a group of low lying islands situated in the Central Mediterranean Basin. Although the total surface area is small (c. 316 km<sup>2</sup>) when compared to other islands/territories in the Mediterranean, and despite the high population density (over 1,200 persons/km<sup>2</sup>) and negative impacts of the tourist industry, the islands still harbour an array of natural habitats with more than 900 species of flowering plants. Due to the strategic position of the Maltese Islands, several groups of organisms have been studied and compared to those found in nearby territories. This is not the case with the eriophyoid fauna of Malta which was never studied as such.

The Eriophyoid fauna of the Maltese Islands has never been studied in detail, and earlier data came from the so-called cecidological papers where eriophyoids were

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primarily identified from visual symptoms on host plant species. The well-known cecidologist HOUARD (1913) listed only *Aceria carlinae* (Nalepa), previously reported by MASSALONGO (1911) who also found an unidentified species on *Galium murale* (L.) All. and *Sherardia arvensis* L.

BORG (1922) in his book entitled “*Cultivation and diseases of fruit trees in the Maltese Islands*” mentioned some eriophyoid mites of economic importance but it is often not clear whether these records are authentically Maltese. CARUANA GATTO (1926) made a first attempt to compile an inventory of the gall-making organisms for the Maltese Islands and a number of eriophyoid mites were included. SALIBA (1963) in his compilation entitled “*Insect pests of crop plants in the Maltese Islands*” included five species of eriophyoid mites, probably basing himself on symptoms and on earlier records. HABER and MIFSUD (2007) recorded three eriophyoids new for Malta in a contribution regarding the arthropods associated with olive trees.

In this last decade, the interest in Eriophyoidea has been always relevant (DE LILLO & SKORACKA, 2008) and a number of check-lists have been published for some Palaearctic countries (ÖZKAN *et al.*, 1994; BERNINI *et al.*, 1995; DE LILLO, 2004; PETANOVIC & STANKOVIC, 1999; SKORACKA *et al.*, 2005; ERMAN *et al.*, 2007; RIPKA, 2007). The eriophyoid check-list produced for the Fauna Europaea by one of the authors includes few species for Malta owing to the restricted diffusion of old published literature.

Therefore, a first attempt to look specifically at Eriophyoidea occurring in the Maltese Islands was carried out and an updated list for the European check-list was produced.

## MATERIALS AND METHODS

Sites in Malta and Gozo were surveyed and sampled for potential Eriophyoid symptoms and species presence. Specimens were recovered from plant materials by means of direct observations under a dissecting microscope and by using the extraction methods in MONFREDA *et al.* (2008). Mites were prepared and slide mounted according to Keifer’s method (KEIFER, 1975). LINDQUIST’s (1996) terminology and setal notation of the morphological details have been adopted for species description. All measurements of mites were made according to AMRINE and MANSON (1996), and are given in micrometers, and measurements are rounded off to the nearest integer; range values are given in brackets. The generic classification follows that of AMRINE *et al.* (2003) and HONG and ZHANG (1996).

Material has deposited at the Dipartimento di Biologia e Chimica Agro-forestale e Ambientale (Di.B.C.A.), Entomological and Zoological Section, University of Bari, Italy and at the Department of Biology, University of Malta, Malta. Figures of

eriphyoid damages or galls included in this work were all taken in Malta using a FinePix S-5000 digital camera. Host plant names and their synonymies are in accordance with the Flora Europaea of the Royal Botanic Garden of Edinburgh, UK (<http://rbg-web2.rbge.org.uk/FE/fe.html>), and the Germoplasm Resources Information Network (GRIN) - Taxonomy for Plants, USDA-ARS, Beltsville, Maryland, USA (<http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl>). Data on eriophyoid mites have been collected from de Lillo and Amrine personal database, and from the catalogue by AMRINE and STASNY (1994).

Information on symptoms, host plant and localities of the species previously recorded are reported according to the scheme previously used for other catalogues (SKORACKA *et al.*, 2005).

## LIST OF SPECIES

### Family ERIOPHYIDAE Nalepa, 1898

#### SUBFAMILY CECIDOPHYINAE KEIFER, 1966

#### TRIBE CECIDOPHYINI KEIFER, 1966

### 1. *Cecidophyopsis hendersoni* (Keifer, 1954)

“*Cecidophyes*” *hendersoni* KEIFER, 1954; *Bull. Calif. Dept. Agric.*, [E. S. 22], 43: 123-124, pl. 236.

TYPE DATA. *Yucca glauca* Nutt. (Agavaceae); Syracuse, Kansas (USA).

GENERAL DISTRIBUTION. Australian, Nearctic, Palaearctic.

MATERIAL EXAMINED. Malta: Zejtun, private house, 18.ii.2006, on *Yucca* sp. (cultivated indoor), leg. D. Mifsud; Hal Lija, Plant Biotechnology Centre, 9.iii.2006 on *Yucca* sp. (cultivated indoor), leg. D. Mifsud; Msida, University of Malta (Junior College), 27.iii.2008 on *Yucca* sp. (cultivated indoor), leg. D. Mifsud.

RELATION TO THE HOST. Vagrant. The mites inhabit lamina of outer leaves and cause browning, when highly infested, along with the presence of a whitish powder including live, dead mites, and their exuviae (Fig. 1a).

REMARKS. New record for the Maltese Islands. This species has been reported for New Zealand, Poland, USA (California, Georgia and Kansas) and Yugoslavia and displays a patch distribution which could depend on the nursery trade of the ornamental plants and it is expected to be wider than that known at present. The mite was previously collected also on *Y. guatemalensis* Baker (originally listed as *Y. elephantipes* Regel) (LABANOWSKI, 1999) and *Y. gloriosa* L. (PETANOVIC & STANKOVIC,

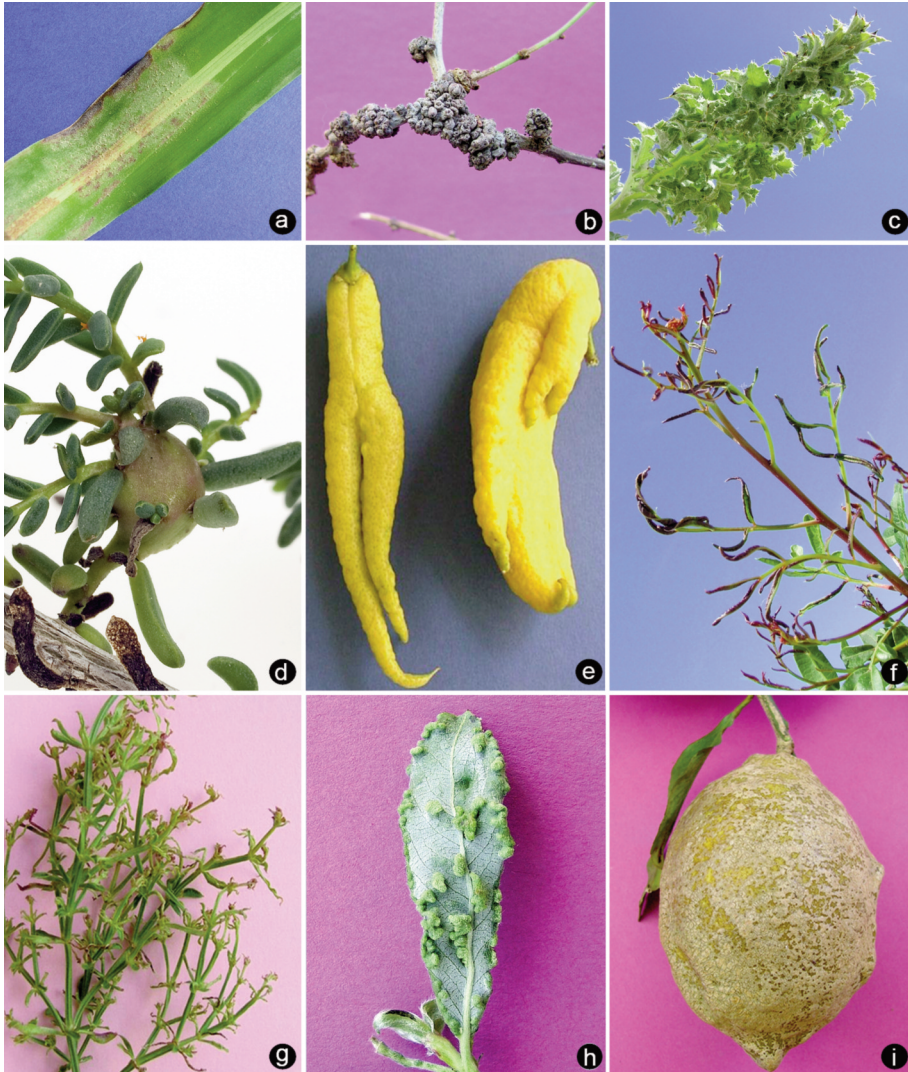


Fig. 1 - Plant damage and plant-galls caused by eriophyoid mites: a) *Cecidophyopsis hendersoni* on *Yucca* sp.; b) *Acalitus phloeocoptes* on cherry plum; c) *Aceria carlinae* on *Atractylis gummifera*; d) *Aceria caulobia* on *Sueda vera*; e) *Aceria sheldoni* on lemon fruit; f) *Aceria stefanii* on *Pistacia lentiscus*; g) *Aculus anthobius* on *Galium* sp.; h) *Aculus tetanothrix* on *Salix alba*; i) *Phyllocoptura oleivora* on lemon fruit.

1999).

TRIBE COLOMERINI NEWKIRK ET KEIFER, 1975

2. *Colomerus vitis* (Pagenstecher, 1857)

*Phytoptus vitis* PAGENSTECHEER, 1857; *Verh. Naturh.-med. Ver.*, Heidelberg 1(2): 51; NALEPA, 1890 - *Sitzb.*, 99(2): 57-58, pl. 7, figs 1-2.

TYPE DATA. *Vitis vinifera* L. (Vitaceae); Germany (presumed).

GENERAL DISTRIBUTION. Australian, Ethiopian, Nearctic, Neotropical, Oriental, Palearctic.

MATERIAL EXAMINED. Malta: Ghammieri, 24.vi.2006, on *V. vinifera* (cultivated), leg. D. Mifsud; Rabat, 16.viii.2008, on *V. vinifera* (cultivated), leg. D. Mifsud.

RELATION TO THE HOST. Gall-making. It causes the formation of hemispherical bulges on grapevine upper surface of leaves; corresponding areas on the under surface of the leaves are concave and host a felty mass of hairs (erineum). These hair masses are initially white but they turn to a reddish brown colour during the growing season.

REMARKS. BORG (1922) and CARUANA GATTO (1926) listed Landois as authorship of the species. This combination was synonymized to Pagenstecher by KEIFER (1944). Recent genetic investigation resolved the taxonomical status of the bud and blister strains, identifying two closely related but distinct species which cause these different symptoms (CAREW *et al.*, 2004) and which need to be morphologically separated, yet. *Colomerus vitis* is a very common species distributed all over the Maltese Islands (BORG, 1922; CARUANA GATTO, 1926; SALIBA, 1963).

SUBFAMILY ERIOPHYINAE NALEPA, 1898

TRIBE ACERIINI AMRINE ET STASNY, 1994

3. *Acalitus phloeocoptes* (Nalepa, 1890)

*Phytoptus phloeocoptes* NALEPA, 1890; *Sitzb.*, 99(2): 54-55, pl. 6, figs 4-5, pl. 7, fig. 6.

TYPE DATA. *Prunus domestica* L. (Rosaceae); not stated by the author; Austria (presumed).

GENERAL DISTRIBUTION. Nearctic, Neotropical, Oriental, Palearctic.

MATERIAL EXAMINED. Malta: St. Julians, 4.i.2006, on *Prunus cerasifera* Ehrh. (cherry plum), leg. D. Mifsud.

RELATION TO THE HOST. Gall-making. On plum the mites cause irregular galls, about 2 mm high, around the buds. The galls become woody (Fig. 1b). Fruit spurs are

deformed, but the trees recover showing no lasting injuries. On almond, mite feeding causes systematic effects resulting in permanent irregular woody tissue. Fruit buds fail to form; tree loses vigour and dies in 3-6 years.

REMARKS. BORG (1922) stated that “the erinosis of the plum, a rare disease in our orchards is due to *Phytoptus phlaeocoptes* Nal.”. This symptom does not seem to be related to *A. phloeocoptes* and a doubt remains on the correctness of this record. Later, CARUANA GATTO (1926) cited the species on the basis of Borg’s contribution. We have found typical galls of this species on only one severely affected tree in Malta. This species is also associated with other *Prunus* species, including *P. cerasifera*.

#### 4. *Aceria brevipes* (Nalepa, 1899)

*Eriophyes brevipes* NALEPA, 1889; *Anz.*, 36(19): 250 (no fig.).

TYPE DATA. *Halimione portulacoides* (L.) Aellen, originally listed as *Atriplex portulacoides* L. (Chenopodiaceae); Palermo, Sicily, Italy.

GENERAL DISTRIBUTION. Palaearctic.

MATERIAL EXAMINED. None.

RELATION TO THE HOST. Gall-making. Blister-like galls on the undersurface of the leaves with a correspondent small depression on the uppersurface. The leaf could be somewhat deformed when galls are numerous on the lamina.

REMARKS. *Aceria brevipes* was reported for Malta (Floriana, Gzira, Mdina and Valletta) as common throughout the year especially in Autumn, on *Atriplex halimus* L. (CARUANA GATTO, 1926). The presence of this mite in Malta is consistent with its reports for Algeria, Sicily, Sardinia and Egypt (NALEPA, 1899; CECCONI, 1901; DÇBSKI, 1918; HOUARD, 1922). The available description of this species is in Nalepa’s style without drawings. Its re-description is recommended and is currently in progress from samples collected in Sicily.

#### 5. *Aceria carlinae* (Nalepa, 1905)

*Eriophyes carlinae* NALEPA, 1905; *Anz.*, 42(7): 79-80 (no fig.).

TYPE DATA. *Atractylis gummifera* L., originally listed as *Carlina (Atractylis) gummifera* (L.) Less. (Asteraceae). AMRINE and STASNY (1994) reported Palermo, Sicily, Italy, as type locality following NALEPA (1905). DE STEFANI-PEREZ (1905), who collected and sent the sample to Nalepa, indicated “territorio di Sciacca, contrada Mahauda” (currently Makuada) in the province of Agrigento, Sicily, Italy.

GENERAL DISTRIBUTION. Palaearctic.

MATERIAL EXAMINED. Malta: Hagar Qim, 14.iv.2006 and 12.v.2008, Wardija,

12.v.2008, leg. D. Mifsud. All samples collected from *A. gummifera*.

RELATION TO THE HOST. Gall-making. The mite induces the growth of a whitish, long and soft hair on the leaf lamina; DE STEFANI-PEREZ (1905) observed wrinkled leaves, denticulate edge of laciniae and leaves, appearance of numerous and basally hypertrophied spines (Fig. 1c).

REMARKS. *Aceria carlinae* was previously reported from the Maltese Islands by MASSALONGO (1911) and CARUANA GATTO (1926). The presence of this mite in Malta is consistent with its reports for Algeria, Sicily and Tunisia (MASSALONGO, 1911; HOUARD, 1922). In Malta (Wied il-Qlejgha), an *Eriophyes* sp. was reported on *Carlina involuocrata* Poir. (synonym of *C. corymbosa* L.) causing leaf erineia similar to those caused by *A. carlinae* (CARUANA GATTO, 1926). No other host plants have ever been reported for this mite and, thus, samples of the deformations caused by this *Eriophyes* sp. should be collected and studied.

Due to the fact that the original description of this species is available in Nalepa's style, lacking drawings, and type material, a complete morphometric description is here included on the basis of the material collected from Malta.

*Female* (Fig. 2) - Body wormlike, 175 (neotype measurements) (160-195, range of 10 specimens) long, 38 (38-50) wide, 42 (35-50) thick. Gnathosoma 20 (19-25) long projecting obliquely downwards, chelicerae 20 (18-22) long, seta *d* 3 (3-5) long. Prodorsal shield 24 (23-28) long, 20 (20-25) wide, semielliptical in anterior shape with anteromedian lobe over gnathosoma base 3 (3-4) long; shield pattern composed of complete median and admedian lines, short submedian lines, numerous coarse granules on the lateral sides and a few granules and lines on the median field. Tubercles *sc* are on the rear shield margin 18 (16-22) apart, *sc* setae 38 (35-42) long.

Foreleg 33 (32-37) long, tibia 8 (7-9) long, tarsus 7 (7-8) long,  $\omega$  8 (7-8) long distally truncated, empodium simple, 7 (6-7) long, 5-rayed. Hindleg 31 (27-33) long, tibia 6 (5-7) long, tarsus 7 (6-7) long,  $\omega$  8 (8-9) long distally truncated, empodium simple, 7 (6-7) long, 5-rayed.

Coxae ornamented; *Ib* setae 9 (8-10) long, *Ib* tubercles 12 (10-14) apart, *Ia* setae 15 (14-19) long, *Ia* tubercles 9 (8-11) apart, *2a* setae 49 (31-52) long, *2a* tubercles 24 (20-29) apart. Prosternal apodeme 8 (8-10) long.

Opisthosoma with 71 (68-75) annuli. Microtubercles rounded and thinner in the posterior part. Setae *c*<sub>2</sub> 20 (17-20) long on annuli 8 (7-8), *d* 45 (42-55) long on annuli 25 (21-27); *e* 14 (12-15) long on annuli 42 (39-48); *f* 22 (20-23) long on annuli 66 (57-72). Last 5 annuli with elongated and linear tubercles ventrally. Setae *h*<sub>2</sub> 60 (58-65) long very thin at the apex, *h*<sub>1</sub> 4 (3-5) long.

Genitalia 12 (10-14) long, 23 (18-24) wide. Female genital coverflap with 14 (12-15) striae; *3a* 17 (15-21) apart, 17 (16-24)  $\mu\text{m}$  long.

*Male* - Similar to the female, 167 (160-170; 5 specimens) long, prodorsal shield 26 (25-27) long; *sc* setae 27 (24-28) long; opisthosoma with 54-57 annuli.

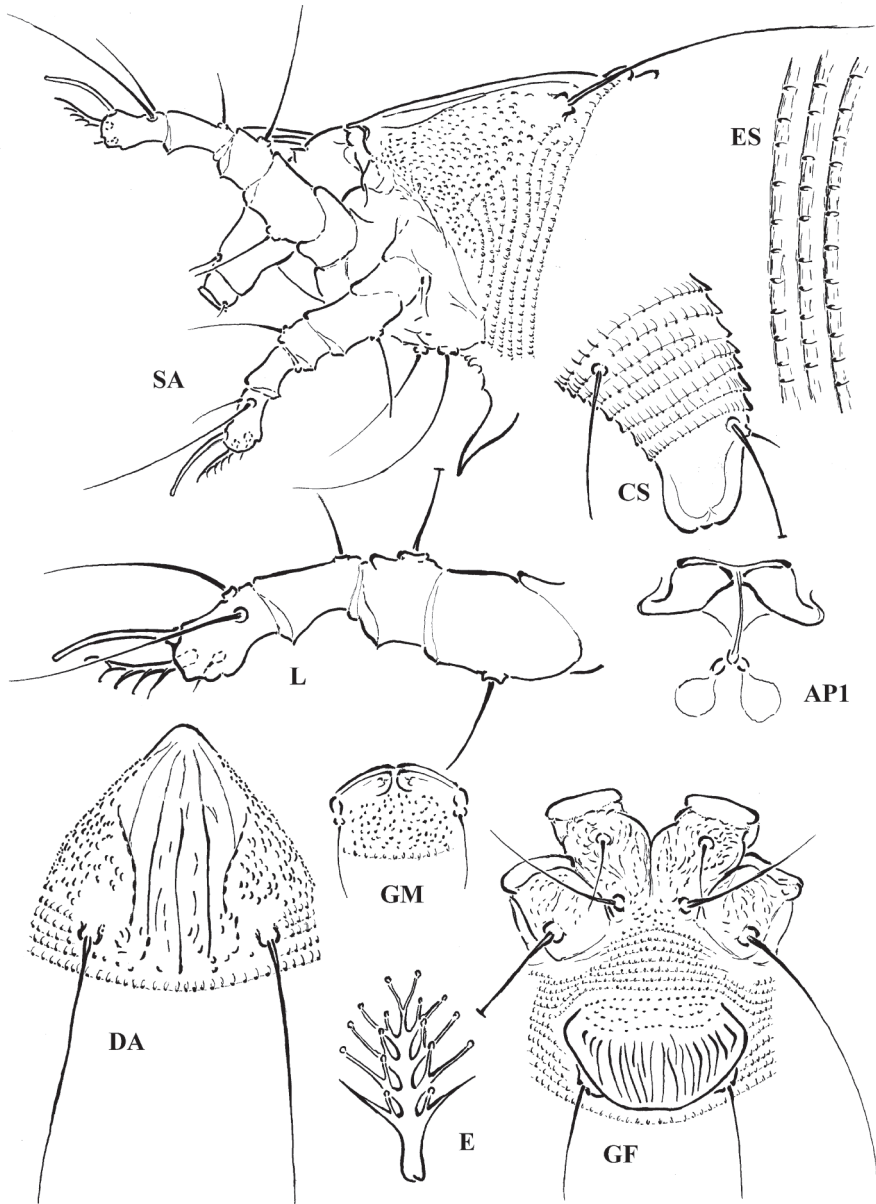


Fig. 2 - *Aceria carlinae* (Nalepa): semischematic drawings. Abbr.: AP1, internal female genitalia; CS, lateral view of caudal region; DA, dorsal view of the prodorsal shield; E, empodium; ES, lateral view of annuli; GF, coxal and genital region of a female; GM, genital region of a male; L, foreleg; SA, lateral view of anterior region.



*Nymph* - Similar to the adult, 156 (150-165; 5 specimens) long, prodorsal shield 23 (20-25) long; *sc* setae 25 (21-29) long; opisthosoma with 59-65 annuli. Setae *3a* 9 (8-10) apart, 8 (6-9)  $\mu\text{m}$  long.

6. *Aceria caulobia* (Nalepa, 1900)

*Eriophyes caulobius* NALEPA, 1900; *Anz.*, 37(15): 155 (no fig.); DE LILLO, 1988; *Entomologica*, Bari, 22: 6-9, figs 1-4.

TYPE DATA. *Suaeda vera* Gmelin, originally listed as the synonym *S. fruticosa* Forsk (Chenopodiaceae); Cagliari, Sardinia, Italy.

GENERAL DISTRIBUTION. Palearctic.

MATERIAL EXAMINED. Malta: St. Thomas Bay (towards Tal-Munxar), 20.x.2004, on *S. vera*, leg. D. Mifsud.

RELATION TO THE HOST. Gall-making. Ellipsoidal-spherical galls of 2–10 mm diameter on the stems (Fig. 1d), being green-purple in early herbaceous growth and turning brownish as the plant tissue senesces and acquires more woody characteristics. Some new shoots begin to grow from the gall hardened surfaces. Galls reach maximum size generally in late Summer–early Winter and contain mites up to June. The mites migrate and colonize new buds in April–May, producing new galls.

REMARKS. New record for the Maltese Islands. The host is related to sandy and saline soils along the coast and this mite is common in Italy (Apulia and Sardinia), Cyprus and France (NALEPA, 1900; HOUARD, 1917; MONACO, 1971; GEORGHIOU, 1977).

7. *Aceria granati* (Canestrini & Massalongo, 1884)

*Phytoptus granati* CANESTRINI & MASSALONGO, 1894; *Atti Soc. Veneto-Trentina*, Ser. 2, 1: 465; KEIFER 1952, *Bull. Calif. Insect Survey*, 2(1): 29, pl. 9-20.

TYPE DATA. *Punica granatum* L. (Punicaceae); Passignano sul Trasimeno, province of Perugia, Umbria, Italy.

GENERAL DISTRIBUTION. Nearctic, Neotropical, Pacific, Palearctic.

MATERIAL EXAMINED. Malta: Mdina, 13.iv.2006, leg. D. Mifsud; Zejtun, 9.vii.2008, leg. D. Mifsud. All samples collected from *P. granatum*.

RELATION TO THE HOST. Gall-making. Leaf edge finely rolled up giving an appearance of a thick border of the lamina.

REMARKS. *Aceria granati* was previously reported from Malta (Zurrieq and Imtahleb) by CARUANA GATTO (1926). The species is widely distributed in the Mediterranean basin.

8. *Aceria ilicis* (Canestrini, 1890)

*Phytoptus ilicis* CANESTRINI, 1890; *Atti Soc. Veneto-Trentina Sci. Natur.*, 12(1): 11-2, pl. 6, figs 8-11.

TYPE DATA. *Quercus ilex* L. (Fagaceae); Botanical garden, Padua, Veneto, Italy.

GENERAL DISTRIBUTION. Palaearctic.

MATERIAL EXAMINED. Malta: Buskett, 20.ii.2005, leg. D. Mifsud. Sample collected from *Q. ilex*.

RELATION TO THE HOST. Gall-making. Rusty brown erineum on the underside of leaf blades associated with a bulge of the lamina on the correspondent upper side.

REMARKS. This species was previously reported from Malta (San Anton Gardens, Addolorata cemetery, Ta' Braxia and Buskett) by CARUANA GATTO (1926). The species is widely distributed in the Mediterranean Region, and it has been collected also on some other *Quercus* species.

9. *Aceria massalongoi* (Canestrini, 1890)

*Phytoptus massalongoi* CANESTRINI, 1890; *Atti Soc. Veneto-Trentina Sci. Natur.*, 12(1): 12-13, pl. 6, figs 1-2, 6; pl. 7, figs 1-3.

TYPE DATA. *Vitex agnus-castus* L. (Verbenaceae); Simeto, Sicily, Italy.

GENERAL DISTRIBUTION. Palaearctic.

MATERIAL EXAMINED. None.

RELATION TO THE HOST. Gall-making. Small pocket galls on both sides of the leaf lamina; sometimes, galls tend to aggregate and leaves appear to be deformed.

REMARKS. This species was previously reported from Malta (Marsaskala and Wied Sant'Antnin) in May (CARUANA GATTO, 1926). The Lilac chaste tree, which is the only known host of this mite, is not common in the Maltese Islands. In these last two years, repeated search for this eriophyid in Malta and Gozo was not successful and it seems that the host plant no longer exists from the two previously recorded localities. The mite is widely known within the Mediterranean Region.

10. *Aceria ononidis* (Canestrini, 1890)

*Phytoptus ononidis* CANESTRINI, 1890; *Atti Soc. Veneto-Trentina Sci. Natur.*, 12(1): 21-22, pl. 7, fig. 13.

TYPE DATA. *Ononis spinosa* L. (Fabaceae); Canestrini stated that he received material from Massalongo who probably collected it in the province of Verona, Italy.

GENERAL DISTRIBUTION. Palaearctic.

MATERIAL EXAMINED. None.

RELATION TO THE HOST. Gall-making. Shoots distally unusual; leaves abnormally hairy and small, simplified in shape, often stipule-like; flowers greened. The shoots assume the appearance of a witches' broom.

REMARKS. CARUANA GATTO (1926) recorded this species from Malta (Ghadira-Mellieha) on the basis of a single affected plant of *Ononis natrix* L. The species has been recorded in Central Europe (DE LILLO, 2004) and the Maltese report is the southernmost one among them. No other reports are available on *O. natrix* while symptoms and/or mites have been found on few other *Ononis* and *Medicago* species (COTTE, 1924; FARKAS, 1966; SKORACKA *et al.*, 2005).

### 11. *Aceria onychia* (Nalepa, 1915)

*Eriophyes onychius* NALEPA, 1915; *Marcellia* 13(6): 182-183 (no fig.); FARKAS, 1965; Die Tierwelt Mitteleuropas, 3: 38, fig. 28c-e; FLECHTMANN *et al.*, 2002; *Acarologia*, 42(3): 239, 241-242, figs 1-2.

TYPE DATA. *Phlomis fruticosa* L. (Lamiaceae); Gruz (old name Gravosa) and Dubrovnik (old name Ragusa), Croatia.

GENERAL DISTRIBUTION. Palaearctic.

MATERIAL EXAMINED. Malta: Wied Incita, 23.ii.2006 on *P. fruticosa*, leg. D. Mifsud.

RELATION TO THE HOST. Gall-making. Leaf vagrants, associated to sparse erineum patches.

REMARKS. This species can be considered as the first report for Malta. However, CARUANA GATTO (1926) found an unidentified *Eriophyes* on samples of *P. fruticosa* at Wied Incita, Mistra, Gozo and other unspecified locations. The plant abnormalities described by Caruana Gatto could well fit with the characteristic symptoms observed during the present study. In addition, this mite has been reported only for Croatia, France and Hungary (DE LILLO, 2004) also on *Marrubium peregrinum* L., *Phlomis herba-venti* L. and *P. tuberosa* L. (FARKAS, 1966; FLECHTMANN *et al.*, 2002).

### 12. *Aceria oxalidis* (Trotter, 1902)

*Eriophyes oxalidis* TROTTER, 1902; *Marcellia*, 1: 126-127; FARKAS, 1965; Die Tierwelt Mitteleuropas, 3: 34, fig. 25d.

TYPE DATA. *Oxalis corniculata* L. (Oxalidaceae); Avellino, Campania, Italy.

GENERAL DISTRIBUTION. Palaearctic.

MATERIAL EXAMINED. None.

RELATION TO THE HOST. Gall-making. The leaves appear to be wrinkled, twisted and shrunken.

REMARKS. CARUANA GATTO (1926) recorded this species from *O. corniculata* L., commenting that the symptoms (we presume) are frequent on flower pots and gardens. No information on localities and data were provided. *Oxalis stricta* L. is reported as another host plant for this mite in the Mediterranean area.

*13. Aceria rubiae* (Canestrini, 1897)

*Phytoptus rubiae* CANESTRINI, 1897; *Atti Soc. Veneto-Trentina*, ser. 2, vol. 3: 1 (no fig.).

TYPE DATA. *Rubia peregrina* L. var. *lucida* (Rubiaceae); Palermo (presumed), Sicily, Italy.

GENERAL DISTRIBUTION. Palaearctic.

MATERIAL EXAMINED. None.

RELATION TO THE HOST. Gall-making. Tips of the shoots and last whorls of leaves and flowers modified into globular galls, varying considerably in size and shape, at first green and then turning black.

REMARKS. This species was reported for Malta (Buskett, Girgenti, Imtahleb) from May till July (CARUANA GATTO, 1926) and is widely distributed within the Mediterranean countries. The available description of this species is in Canestrini's style and without drawings. The re-description of this eriophyoid is strongly recommended.

*14. Aceria salicina* (Nalepa, 1911)

*Aceria salicis* (NALEPA, 1892); *Anz.*, 28(16): 162 - nomen nudum; NALEPA, 1911; Eriophyiden. Zoologica, Stuttgart, 24(61), Lief. 1: 220 (No. 27), pl. 2, fig. 6a-b.

TYPE DATA. *Salix alba* L. (Salicaceae); not stated by the author; Austria (presumed).

GENERAL DISTRIBUTION. Nearctic, Palaearctic.

MATERIAL EXAMINED. None.

RELATION TO THE HOST. Gall-making. Large bud deformations (VANECKOVÁ-SKUHRAVÁ, 1996).

REMARKS. CARUANA GATTO (1926) reported this species from Malta (Girgenti) in Summer and described the deformations as small sub-spherical galls on both sides of the leaf lamina whose colour turned from green to reddish. The symptoms reported by CARUANA GATTO (1926) are in accordance to those caused by *Aculus tetanothrix* (Nalepa) and hence this report needs re-evaluation.

15. *Aceria salviae* (Nalepa, 1891)

*Phytoptus salviae* NALEPA, 1891; *Nova Acta*, 55(6): 370 - nomen nudum; NALEPA, 1891; *Anz.*, 28(16): 162; NALEPA, 1891; *Denks.*, 58: 871-872, 883, pl. 1, figs 11-12.

TYPE DATA. *Salvia pratensis* L. (Lamiaceae); Linz, Gmunden and Kriglach in Steiermark, Austria.

GENERAL DISTRIBUTION. Palaearctic.

MATERIAL EXAMINED. None.

RELATION TO THE HOST. Gall-making. Erinea usually on the underside of the leaves, with irregular bulges on the correspondent upper side; hairs whitish or yellowish at first, later brownish; often several in a leaf. The mite may also affect petioles, stems and flowers.

REMARKS. CARUANA GATTO (1926) reported this species from Malta and Gozo in Summer and Autumn on *S. clandestina* L. (= *Salvia verbenaca* L.). The species has been widely recorded in Europe (DE LILLO, 2004) on several *Salvia* species. In particular, Massalongo collected infested samples of *S. verbenaca* at Lentini, in Sicily (CANESTRINI, 1892).

16. *Aceria sanguisorbae* (Canestrini, 1892)

*Phytoptus sanguisorbae* CANESTRINI, 1892; *Atti Soc. Veneto-Trentina Sci. Natur.*, 12(2): 379 (no fig.); CANESTRINI, 1892; *Prosp. Acarof. Ital.*, ser. II: 634-635, pl. 45 figs 3-4.

TYPE DATA. *Sanguisorba minor* Scop. *minor* (Rosaceae), originally listed as *Poterium sanguisorba* L.; Tregnago, Verona, Italy.

GENERAL DISTRIBUTION. Palaearctic.

MATERIAL EXAMINED. None.

RELATION TO THE HOST. Gall-making. Leaves covered with thick, white or yellowish-white felt-like erinea; leaves often small and deformed; erinea sometimes on stems and flower buds.

REMARKS. This species was reported for Malta (Wied Incita, Wied il-Ghasel and Imtahleb) by CARUANA GATTO (1926) on *Poterium muricatum* Spach. (= *Sanguisorba minor* Scop. subsp. *muricata* Briq). The species is also known to occur on some other *Sanguisorba* species in other Mediterranean countries.

17. *Aceria sheldoni* (Ewing, 1937)

*Eriophyes sheldoni* EWING, 1937; *Proc. Entomol. Soc. Wash.*, 39: 193-194, figs 1-4.

TYPE DATA. *Citrus limon* (L.) Burm. (Rutaceae); Santa Paula, California (USA).

GENERAL DISTRIBUTION. Australian, Ethiopian, Nearctic, Neotropical, Oriental, Pacific, Palaearctic.

MATERIAL EXAMINED. Malta: Wied Hazrun, limits of Dingli, 29.xii.2004, symptoms on lemon fruit, leg. D. Attard; same locality, 14.iii.2006, leg. D. Mifsud; Siggiewi, 16.xi.2006, symptoms on lemon fruit, leg. D. Mifsud.

RELATION TO THE HOST. Gall-making. Bud blasting, distortion of shoot growth, excessive and bizarre deformations mainly of fruits (Fig. 1e), often of foliage and blossoms; discoloration of fruit may occur.

REMARKS. Widely distributed and well-known mite species, officially recorded for the first time from the Maltese Islands. Fruit symptoms arising from damage of this mite are rarely encountered in the Maltese Islands.

### 18. *Aceria stefanii* (Nalepa, 1898)

*Eriophyes stefanii* NALEPA, 1898; *Anz.*, 35(17): 164 (no fig.); NALEPA, 1899; *Denk.*, 68: 212, pl. 4, figs 9-10.

TYPE DATA. *Pistacia lentiscus* L. (Anacardiaceae); Palermo, Sicily, Italy.

GENERAL DISTRIBUTION. Palaearctic.

MATERIAL EXAMINED. Malta: St. Paul's Bay, 15.iv.2006, on *P. lentiscus*, leg. D. Mifsud.

RELATION TO THE HOST. Gall-making. Leaf margin folded upwards on the lamina giving the appearance of a thickened lamina which often turns reddish (Fig. 1f).

REMARKS. This species was previously reported from Malta (Buskett and Girgenti) in Spring (CARUANA GATTO, 1926). In the Mediterranean area, this species is also known on other *Pistacia* species.

## TRIBE ERIOPHYINI NALEPA, 1898

### 19. *Eriophyes pyri* (Pagenstecher, 1857)

*Phytoptus pyri* PAGENSTECHEER, 1857; *Verh. Naturh.-med. Ver.*, Heidelberg 1(2): 51 (no fig.). NALEPA, 1890; *Sitzb.*, 99(2): 50-51, pl. 4, figs 1-2.

TYPE DATA. *Pyrus communis* L. (Rosaceae); Germany (presumed).

GENERAL DISTRIBUTION. Australian, Ethiopian, Nearctic, Neotropical, Oriental, Palaearctic.

MATERIAL EXAMINED. None.

RELATION TO THE HOST. Gall-making. Smooth pustules (blisters) are induced in leaf lamina, raised on both surfaces, 1-5 mm across, with opening below; yellowish green in

May, later red, purple or black, maturing in August; pustules more or less solid with mites between the cells. The mite overwinters in the buds.

REMARKS. This species was reported by CARUANA GATTO (1926) on the authority of BORG (1922). It was recorded by SALIBA (1963) who stated that the species is occasionally found on pear and it was also listed in CAB distribution maps (1970). The species epithet has been often incorrectly written. It is a widely distributed species, which has been recorded for several other rosaceous host plants.

SUBFAMILY PHYLLOCOPTINAE NALEPA, 1892

TRIBE ANTHOCOPTINI AMRINE & STASNY, 1994

**20. *Aculops lycopersici*** (Tryon, 1917)

*Phytocoptes anthobius* NALEPA, 1892; *Anz.*, 28(19): 198 - nomen nudum; NALEPA, 1892; *Rev. Mens. Hist. Nat.*, sér. 3, 22(258): 122, no. 55; NALEPA, 1894; *Nova Acta*, 61(4): 309-310, pl. 3, figs 5-6.

TYPE DATA. *Lycopersicon esculentum* Mill. (Solanaceae); Queensland (Australia).

GENERAL DISTRIBUTION. Australian, Ethiopian, Nearctic, Neotropical, Oriental, Pacific, Palaearctic.

MATERIAL EXAMINED. None.

RELATION TO THE HOST. Vagrant. The mites feed on all green organs (leaves, stems and fruits) causing browning and rusting of their surfaces; leaves can be folded up; fruits can remain small and not suited for commerce.

REMARKS. This species was indicated as present in Malta by CARMONA (1962). SALIBA (1963) recorded this species under the synonym *Vasates lycopersici* Masee and indicated its abundance as very common on tomato, especially under cover. One of the authors has frequently encountered symptoms of this species on tomatoes but no eriophyoid material of this species was available during this study to confirm the identity of this species. It was also included in the distribution map by CAB (1987). *Aculops lycopersici* is widely distributed in the world affecting also other spontaneous and cultivated solanaceous plants.

**21. *Aculus anthobius*** (Nalepa, 1892)

*Phytocoptes anthobius* NALEPA, 1892; *Anz.*, 28(19): 198 - nomen nudum; NALEPA, 1892; *Rev. Mens. Hist. Nat.*, sér. 3, 22(258): 122, no. 55; NALEPA, 1894; *Nova Acta*, 61(4): 309-310, pl. 3, figs 5-6.

TYPE DATA. *Galium verum* L. (Rubiaceae); Lorraine, France.

GENERAL DISTRIBUTION. Palaearctic.

MATERIAL EXAMINED. Malta: Dingli, 14.iii.2006, on *Galium* sp., leg. D. Mifsud.

RELATION TO THE HOST. Gall-making. Greening of blossoms, bulging of leaves, whole inflorescence appears to be deformed and compact, formed by green and leaf-like flowers with shortened stalks (Fig 1g).

REMARKS. This species was originally recorded from Malta (Ghajn Tuffieha and Imtahleb) in Spring by CARUANA GATTO (1926) on *Galium saccharatum* All. (= *G. aparine* L. and *G. verrucosum* Huds.). The species has been widely recorded in Europe (DE LILLO, 2004) on several *Galium* species.

**22. *Aculus convolvuli*** (Nalepa, 1891)

*Phyllocoptes convolvuli* NALEPA, 1890; *Anz.*, 20: 213 - nomen nudum; NALEPA, 1891; *Denks.*, 58: 881, pl. 2, figs 13-14.

TYPE DATA. *Convolvulus arvensis* L. (Convolvulaceae); Hinterbrühl near to Mödling, Austria.

GENERAL DISTRIBUTION. Palaearctic.

MATERIAL EXAMINED. None.

RELATION TO THE HOST. Gall-making. Mites cause wrinkling and twisting of leaves which appear provided with reddish hairs along ribs.

REMARKS. This species was recorded from Malta (no specified locality) from March onwards, on *Convolvulus althaeoides* L. (CARUANA GATTO, 1926). The species is known in Europe on *C. arvensis*. In the scientific literature there is considerable confusion concerning this species. DAVIS *et al.* (1982) and AMRINE and STASNY (1994) erroneously combined *Aceria convolvuli* (Nalepa, 1898) with *Aculus convolvuli* but these should be two separate species. Later, BOCZEK and PETANOVIC (1994) redescribed *Aculus convolvuli* but, they did not provide any figure; they listed the mite as *Vasates convolvuli* (Nalepa) and listed *Eriophyes convolvuli* as a synonym.

**23. *Aculus minutus*** (Nalepa, 1890)

*Phyllocoptes minutus* NALEPA, 1890; *Sitzb.*, 99(2): 60-61, 67 no. 43, pl. 3, figs 3-4.

TYPE DATA. *Asperula cynanchica* L. (Rubiaceae); Wiener-Neustadt Canal, Wiener-Neustadt, Austria.

GENERAL DISTRIBUTION. Palaearctic.

MATERIAL EXAMINED. None.

RELATION TO THE HOST. Gall-making. The flowers become greenish and leaf-like, with short stalks on a shortened and compact inflorescence.

REMARKS. This species was recorded from Malta (no specified locality) in Spring and Autumn, on *Asperula longiflora* Walldst. e Kit. (synonym of *Asperula aristata* L. f. subsp. *scabra* [J. Presl & C. Presl] Nyman) (CARUANA GATTO, 1926). The species has



been recorded in Central Europe (DE LILLO, 2004) and the Maltese report is the southernmost one among them. A few other reports are on other Rubiaceae of the genera *Asperula* and *Galium* (NALEPA, 1891; CANESTRINI, 1892; COTTE, 1924; BAUDYS, 1928; BALAS, 1941).

24. *Aculus schmardae* (Nalepa, 1889)

*Cecidophyes schmardae* NALEPA, 1889; *Sitzb.*, 98(1): 147-148, pl. 9, figs 1-2.

TYPE DATA. *Campanula rapunculoides* L. (Campanulaceae); from St. Magdalena to Linz am Donau (Danube), Austria.

GENERAL DISTRIBUTION. Palaearctic.

MATERIAL EXAMINED. None.

RELATION TO THE HOST. Gall-making. Apical leaves thickened, with a white erineum; flower deformations; leaves and flower forming compact aggregation.

REMARKS. This species was recorded by CARUANA GATTO (1926) from Malta (Wied Babu) in April on *Campanula erinus* L. The epithet was often modified in *schmardai* and definitely emended in *schmardae* (LIRO & ROIVAINEN, 1951). This mite is known for many European countries and it has been associated to many other Campanulaceae of the genera *Asyneuma* and *Campanula*. Its morphometrical description should be improved.

25. *Aculus tetanothrix* (Nalepa, 1889)

*Cecidophyes tetanothrix* NALEPA, 1889; *Sitzb.*, 98(1): 145-146, pl. 7, figs 1-4.

TYPE DATA. *Salix fragilis* L. (Salicaceae); Wiener - Neustadt, Hassabach am Wechsel R., the banks of the Traun R., and Gmunden, Austria.

GENERAL DISTRIBUTION. Nearctic, Oriental, Palaearctic.

MATERIAL EXAMINED. Malta: Marsa, Ghammieri, 1.x.2004, on *Salix alba* L., leg. D. Mifsud.

RELATION TO THE HOST. Gall-making. The mites cause beadlike galls, often irregularly rounded, usually on upper leaf surfaces. The galls are variable in size, the colour being yellowish green, pink or dark red. Mites cause leaf margin rolling (Fig. 1h) and, often, lamina distortion.

REMARKS. New record for the Maltese Islands. The mite is quite common on several willow species. It is widely distributed in Europe and it was recorded also in China, Greenland, Syria and the USA (FOCKEU, 1892; ROSTRUP, 1900; BAKER *et al.*, 1996; HONG & ZHANG, 1996).

26. *Ditrymacus athiasella* Keifer, 1960

*Ditrymacus athiasella* KEIFER, 1960; Bull. Calif. Dept. Agric., [B 1], 43: 13-14, pl. 11.

TYPE DATA. *Olea europaea* L. (Oleaceae); Mascara, Algeria.

GENERAL DISTRIBUTION. Palearctic.

MATERIAL EXAMINED. Malta: Msida (University grounds), 20.ii.2007; Xemxija (Simar Nature Reserve), 8.ii.2007. Gozo: Xewkija, 8.ii.2007; Mgarr, 27.ii.2007, all on *O. europaea*.

RELATION TO THE HOST. Vagrant on leaf surface, inducing rusting and deformations of green organs.

REMARKS. The above cited material was originally recorded by HABER and MIFSUD (2007). This mite has been recorded only on olive. Its presence in the Maltese Islands is consistent with its reports for Algeria, Croatia, Greece, Italy, Portugal, Spain and former Yugoslavia (DE LILLO, 2004).

27. *Tegolophus hassani* Keifer, 1959

*Tegonotus hassani* KEIFER, 1959; Occas. paps. Cal. Dept. Agric., [E. S. 27], 1: 3-4, pl. 2.

TYPE DATA. *Olea europaea* L. (Oleaceae); Giza, Egypt.

GENERAL DISTRIBUTION. Palearctic.

MATERIAL EXAMINED. Malta: Msida (University grounds), 20.ii.2007; Lija, 21.ii.2007, Marsa (Ghammieri), 23.ii.2007; St. Thomas Bay, 10.i.2007. Gozo: Xewkija, 8.ii.2007; Mgarr, 27.ii.2007. All on *O. europaea*.

RELATION TO THE HOST. Vagrant, causing rusting on leaves and flower shoots, together with deformation and drying of these organs.

REMARKS. The examined material was originally recorded by HABER and MIFSUD (2007). This mite has been recorded only on olive from few Mediterranean countries (DE LILLO, 2004).

TRIBE PHYLLOCOPTINI NALEPA, 1892

28. *Phyllocoptruta oleivora* (Ashmead, 1879)

*Typhlodromus oliiioorus* ASHMEAD, 1879; *Canad. Entomol.*, 11(8): 160 (no fig.); KEIFER, 1938; *Bull. Calif. Dept. Agric.*, [E. S. 1], 27: 193, pl. 20.

TYPE DATA. *Citrus limon* (L.) Burm. (Rutaceae); Jacksonville, Florida (USA).

GENERAL DISTRIBUTION. Australian, Ethiopian, Malgascia, Nearctic, Neotropical,

Oriental, Pacific, Palearctic.

MATERIAL EXAMINED. Malta: Wied Hazrun, limits of Dingli, 24.ii.2005, symptoms on lemon fruit, leg. A. Porta-Puglia; same data but 14.iii.2006, leg. D. Mifsud; B'Kara, 1.ix.2004, symptoms on lemon fruit, leg. A. Porta-Puglia.

RELATION TO THE HOST. Vagrant on fruits and leaves of citrus, causing rusting, silvering and bronzing (Fig. 1i).

REMARKS. This species was recorded by SALIBA (1963) as occasionally found on lemon and CAB (1970) listed Malta in the distribution map of this mite. A huge geographical distribution can be considered for this species and it is known to occur on other host plants.

TRIBE TEGONOTINI BAGDASARIAN, 1978

29. *Oxycenus maxwelli* Keifer, 1939

*Oxypleurites maxwelli* KEIFER, 1939; E. S. 3, *Bull. Cal. Dept. Agric.*, 28: 152-153, pl. 52.

TYPE DATA. *Olea europaea* L. (Oleaceae); Sacramento, California (USA).

GENERAL DISTRIBUTION. Australian, Nearctic, Palearctic.

MATERIAL EXAMINED. Malta: Marsa (Ghammieri), 23.ii.2007; Msida (University grounds), 20.ii.2007; Xemxija (Simar Nature Reserve), 22.ii.2007, all on *O. europaea*.

RELATION TO THE HOST. Vagrant on leaves, flowers and small fruits.

REMARKS. The above cited material was originally recorded by HABER and MIFSUD (2007). This mite has been recorded only on olive. Its presence in the Maltese Islands is consistent with its reports for other Mediterranean countries (Algeria, Egypt, Greece, Portugal, Sicily, Sardinia, other Italian regions, and Spain) (DE LILLO, 2004).

ADDITIONAL UNCERTAIN REPORTS

MASSALONGO (1911) and CARUANA GATTO (1926) referred to an *Eriophyes* sp. on *Galium murale* (L.) All. MASSALONGO (1911) described the galls from samples collected at Gozo by S. Sommier on the 16 of April, 1906. The distal leaves are reduced in size; they appear to be wider than long, subovate, a bit curved, and slightly more pilose than the usual. The internodes appear to be short giving to the stem a compact appearance. None of the known species has been found on this host plant, and the symptoms are similar to those of at least a couple of mites associated to other *Galium* spp.

CARUANA GATTO (1926) also listed deformation on *Salix alba* L. as small galls on the edge of the leaves, ascribing the mite to an *Eriophyes* sp., and distinguishing the galls from those caused by *Aceria salicina* on the same host and localities (Girgenti). Considering the large eriophyoid fauna of *Salix*, this mite cannot be assigned to a

definite species even though the symptoms appear to match the deformations caused by *Aculus craspedobius* (Nalepa).

An *Eriophyes* sp. was recorded by MASSALONGO (1911) and CARUANA GATTO (1926) on *Sherardia arvensis* L. from the island of Gozo (29.iv.1907, l. Sommer), and from Imtahleb and Wied il-Qlejgha. The authors referred to a witch's broom. No eriophyoids have been reported for this host plant and for the genus *Sherardia*.

Finally, SALIBA (1926) added *Aculus schlechtendali* (Nalepa), as occasional on apple, and *Eriophyes mali* (Nalepa) as fairly common on apple in his report without further information. Although the presence of these species in the Maltese Islands could be reasonable such records require confirmation.

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### RIASSUNTO

ACARI ERIOFIOIDEI (ACARI: PROSTIGMATA: ERIOPHYOIDEA) DELLE ISOLE MALTESI (MEDITERRANEO CENTRALE): NUOVE SEGNALAZIONI E CHECK-LIST PRELIMINARE

Circa 20 specie di eriofioidei sono state segnalate per le Isole Maltesi nel XX secolo a seguito di indagini svolte esclusivamente su piante che manifestavano sintomi evidenti. Negli ultimi quattro anni, sono state effettuate raccolte di campioni di piante al fine di disporre di una più ampia conoscenza degli eriofioidei presenti in Malta e Gozo. Molte delle prime segnalazioni sono state confermate e altre otto specie sono rinvenute per la prima volta: *Aceria caulobia* (Nalepa) galligeno su *Suaeda vera* Gmelin; *Aceria onychia* (Nalepa) su *Phlomis fruticosa* L.; *Aceria sheldoni* (Ewing) su limone; *Aculus tetanothrix* (Nalepa) galligeno su *Salix* sp.; *Cecidophyopsis hendersoni* (Keifer) su yucca; e tre specie associate all'olivo, *Ditrymacus athiasella* Keifer, *Oxycenus maxwelli* (Keifer) e *Tegolophus hassani* (Keifer).

Vengono fornite osservazioni aggiuntive per *Acalitus phloeocoptes* (Nalepa), raccolto su ciliegio selvatico, la cui segnalazione precedente era apparsa dubbio, e una descrizione morfometrica completa per *Aceria carlinae* (Nalepa).

Parole chiave: faunistica, acari galligeni, nuove segnalazioni, Malta.

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