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PESTS AND DISEASES ASSOCIATED WITH OLIVE TREES IN THE MALTESE ISLANDS (CENTRAL MEDITERRANEAN)

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ABSTRACT

A detailed study was carried out on pests and diseases of the olive tree in 31 different localities in the Maltese Islands (18 in Malta, 11 in Gozo and 2 in Comino). The work was mainly carried out between June 2006 and April 2007. A total of 16 species of insects, 3 species of eryophid mites, 2 fungal diseases and 1 bacterial disease were recorded. Two insects, the olive thrip, *Liothrips oleae* and the pollinia scale, *Pollinia pollini* and three eriophid mites, *Ditrymacus athiassella, Oxycenus maxwelli* and *Tegelophus hassani* were recorded for the first time from Malta. Additionally, five hymenopteran parasites were also recorded for the first time from Malta. These include *Psyttalia concolor*, *Pnigalio agruales* and *Eupelmus urozonus* as parasites of the olive fly, *Bactrocera oleae*; *Angitia armillata* as a parasite of the olive moth, *Prays oleae*; and *Eupelmus* sp. which was associated with the olive bark midge, *Reseliella oleisuga. Aleurolobus olivinus* and *Reselliela oleisuga* were previously recorded on the basis of a single record. *Otiorynchus moriger,* a weevil endemic to the Maltese Islands was here recorded for the first time as a pest of olives.

INTRODUCTION

The olive tree, *Olea europaea* L. is a species of small, evergreen tree in the family Oleaceae, native to the coastal areas of the eastern Mediterranean Region, from Lebanon and the maritime parts of Asia Minor to northern Iran at the south end of the Caspian Sea. Its fruit is of major agricultural importance in the Mediterranean Region and other Mediterranean type climates as a source of olive oil and table olives.

Olive culture in Malta has its origins in antiquity. It is not known when or by whom the first olive trees were introduced to the Maltese islands. Various symbolic icons that depict olive branches and leaves, olive groves and olive wreathes are found dating to different periods. The earliest example is afforded by the olive wood beams thought to have covered the Neolithic temples of Malta, the world's oldest free standing monuments. Borg (1922) indicates that according to prominent local historians, the cultivation of the olive tree was introduced in these islands by the first Phoenician settlers. Cultivation of olives was largely extended under the Roman and Byzantine domination. Under the Roman Empire and later during the Arabian period, Malta was considered as an olive rich nation. However, during the latter half of the eighteenth century there arose a large demand for cotton from Spain, and vast olive groves and vineyards where sacrificed to make room for the cotton plants. Borg (1922) stated that in the last decade of the eighteenth century over 80,000 olive trees where destroyed and the plains around Zebbug, where this tree flourished, became practically treeless. The production of olive oil had ceased altogether in the beginning of the nineteenth century, the produce of the remaining olive trees being pickled or salted for consumption.

Many villages throughout Malta and Gozo bear names associated with olive cultivation to the present day, indicating that olive culture was important in these localities. These include "Zebbug" that literally means olive in Maltese and is given to two localities, one situated in Malta and the other in Gozo. "Birzebbuga" means olive meadow, whilst "Zejtun" is the Arabic name for the olive, and "Ghasri" derives from the word "ghasar" and "ghasir" meaning squeezing, referring to olive pressing. It is worth mentioning that in some remote areas of the Maltese islands one can

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still find very old olive trees and one of the most important site is in Bidnija where some 30 olive trees are present including some over 1000 years old.

In recent years there has been an increase in the promotion of local olive culture so much so that a number of producers and entrepreneurs have imported modern presses and now offer olive grading and pressing services.

HISTORICAL REVIEW OF OLIVE PESTS AND DISEASES

The catalogue of organisms potentially harmful to the olive tree includes over 255 species at the present time and the number is increasing with the identification of new ones, especially mites, nematodes, and pathogenic micro-organisms (Haniotakis, 2003). About half of these are animal pests while the rest are disease causing micro-organisms and pathogenic fungi. However, only a small number of these are capable of causing damage of economic importance on the olive tree.

Local studies and information on the occurrence of pests and diseases of olive trees are very limited. The work of Borg (1922) entitled *"Cultivation and diseases of fruit trees in the Maltese Islands"* provided, among other things, some details with respect to olive pests and diseases. A major shortcoming of this book is that it is not always clear whether the species mentioned were actually recorded in Malta. Saliba (1963), in his work on the insect pests of crop plants included a list of insect pests that attack the olive, with general comments on the occurrence of the species listed. An important work carried out exclusively on olives in Malta was that by Pace-Lupi (2005), which focused on the incidence and distribution of the fungal pathogen *Verticillium dahliae.*

Most other works are limited to the citing of individual species associated with olives in wider taxonomic lists. In two local studies on scale insects (Borg, 1919; Borg [J.], 1932), seven species were recorded from olives. Cameron & Caruana Gatto (1907) in their work on the Coleoptera fauna of Malta mentioned the local occurrence of two beetles known to be associated with olives. Mifsud (1997), in his work on the jumping plant-lice of the Maltese Islands, documented the occurrence of the olive psyllid, *Euphyllura olivina* on olive trees. The Lepidoptera is a well documented insect order in the Maltese islands due to various works and collections by different entities. Of these, the works of Sammut (1984, 2000) are the most recent and detailed and include species of moths associated with the olive tree. The moth *Prays oleae* was documented as an olive pest by Borg [P.] (1932) and Valletta (1973). The works by Caruana Gatto (1905), Andres (1916), Darlow (1949), Amsel (1951), DeLucca (1965), Sammut (1983), Valletta (1973) and Vella (1991) all record one or few moth species from Malta that are known to be olive pests. In these works however there is no direct mention of the species as occurring on olives. Mifsud & Porta-Puglia (2005) recorded for the first time the olive whitefly, *Aleurolobus olivinus*, on local olive trees. Wheeler (1957) was first to record the fungus *Spilocaea oleaginea* and the bacterium *Pseudomonas syringae* subsp. *savastanoi* on olives in Malta. The fungus *Verticillium dahliae* was first recorded in Malta by Porta-Puglia & Mifsud (2005). The most recent work published to date in which olive diseases are mentioned is that of Porta-Puglia and Mifsud (2006).

MATERIAL AND METHODS

During the present study 45 different sites in 30 localities (Figure 1) were surveyed and sampled for olive pests and diseases. Places surveyed included semi naturalised olive trees present in local maquis communities, plantations of different ages, single or multiple trees in private and public gardens, trees present in coastal areas and trees planted by roadsides and in traffic roundabouts.

Insects associated with olives were collected from the tree canopy using three main methods, visual inspection, beating and sweeping. During visual inspection of the entire olive tree, including trunk, branches and leaves insects were collected by means of an aspirator or a fine-hair brush or occasionally forceps. Specimens collected were placed in small labelled sampling bottles or vials. When foliage or fruit was collected this was placed in labelled sealable plastic bags for later analysis. A list of the samples collected and descriptions of any symptoms was compiled on site. The specimens collected were conserved in two main ways. Most insects were conserved dry mounted but soft bodied insects were preserved in 70% ethanol. Some scale insects, thrips, whiteflies and jumping plant lice were slide mounted (permanent slides) for later examination with the compound microscope. The technique follows Ben-Dov & Hodgson (1997b) with some modifications.

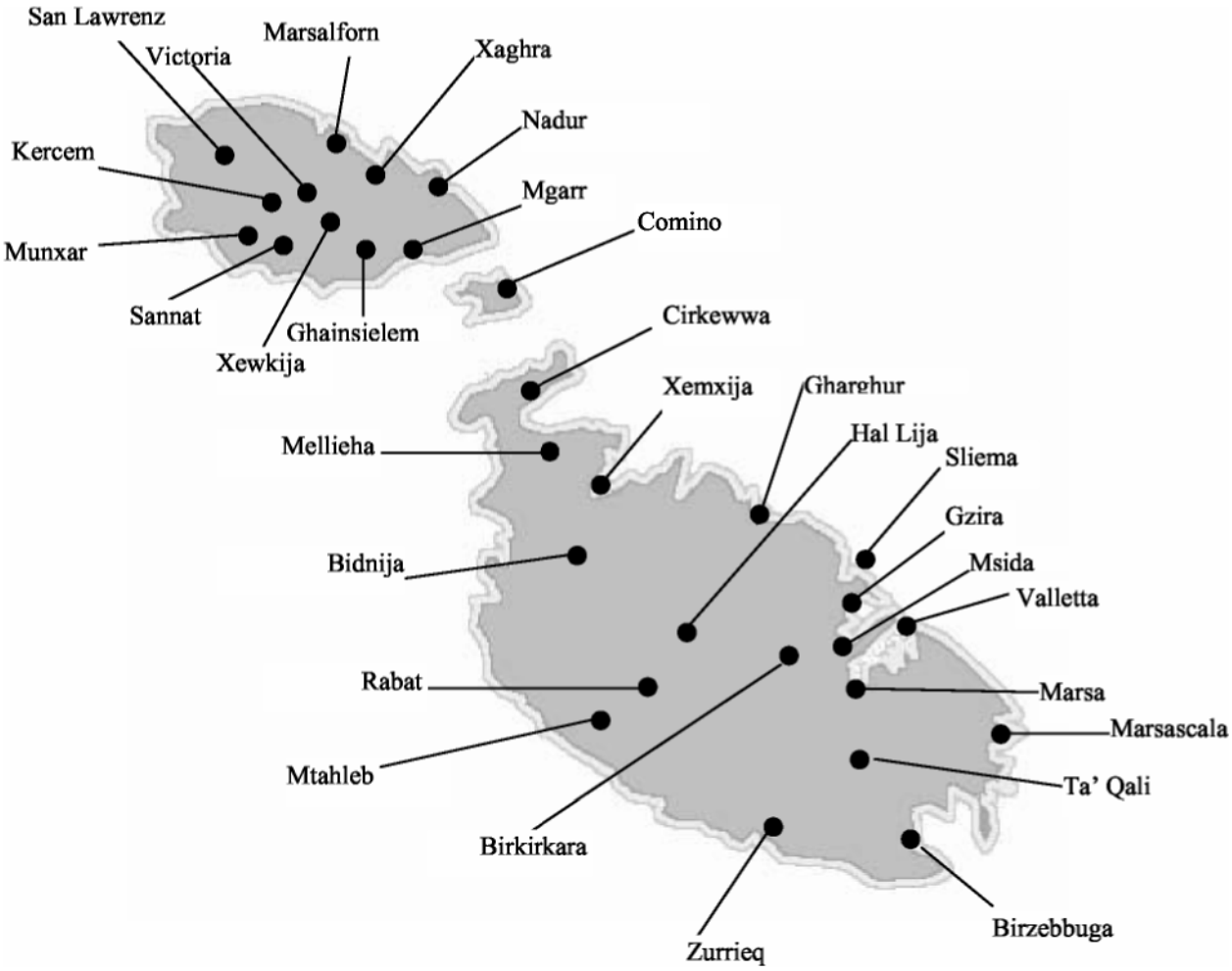

Figure 1: Localities sampled in the present study.

When required, immature insects were reared to adult stage by placing them in appropriately labelled ventilated jars sealed with a fine mesh. Smaller species such as the olive bark midge were cultured in closed Petri dishes. In both cases the bottom of the container was lined with tissue paper to absorb moisture and also to serve as a substratum for the formation of puparia when required. The above methodology was also adopted to rear parasites of olive pest species. The specimens emerging from cultures were left for at least 24 hours in order to harden. They were later preserved either in 70% alcohol or dry mounted. Insect identification was carried out using various works, such as Gill (1997); Guario *et al.* (2001); Hodgson (1994); Kosztarab & Kozar (1988); Marullo (2003); Mound & Kibby (1998); Palmer *et al.* (1992); Pollini (1998); Pollini *et al.* (2002).

Eryophid mite extraction followed de Lillo *et al.* (2001). This method extracts mites that occur free living on plant surfaces including leaves, buds or in crevices along the branches. The mites collected were stored in small vials containing a mixture of alcohol, acetic acid, glycerine and water in the following proportions, 20: 50: 27: 3.

For fungal pathogens, symptomatic and asymptomatic wood samples roughly 15cm long and about 2cm thick were collected from commercial olive groves, nurseries and wood plantations in various localities on the islands. The ideal time to view clear symptoms of *V. dahliae* is in the spring season that is February till May. In the laboratory, the infected stems were washed with water and liquid soap. These were then dried by means of a paper towel and subsequently washed with 70% ethanol. Glassware and instruments were autoclaved (121^{o}C, 15min, 15psi). Autoclaved instruments and disinfested samples were stored under a laminar flow cabinet. Potato dextrose (PDA)

medium was used for isolating and growing of most fungi (Brooks, 2001). This medium was prepared by boiling 200g sliced potatoes in about 1 litre water and then filtered. To one litre of the filtrate 20g dextrose and 12g agar were added. The medium was properly sealed and autoclaved (121^{o}C, 15min, 15psi). The medium was poured in sterilised Petri dishes under a laminar flow cabinet and left to cool. The procedure adopted to induce mycelial growth for deep infections or fungi that sporulate poorly followed Brooks (2001). The method was carried out to isolate *Verticillium dahliae.* All steps were effected under a HEPA class II laminar flow cabinet and basic microbiological procedures were followed to avoid contamination. Microscopic examination of PDA cultures in order to confirm the presence of *V. dahliae* followed Brooks (2001) and involved the observation of dark brown resting mycelium and micro-sclerotia which arise centrally in cultures and consist of dark brown to black spherical masses made up of swollen globular cells. Diagnosis of the olive peacock spot, *Spilocaea oleaginea* was carried out by taking a sample of about 100 leaves from the lower part of the canopy. In the laboratory, these were immersed in a warm solution of 5% sodium hydroxide for 3 minutes. After this treatment the leaves were inspected for any clearly visible brownish spots indicating that infection is present. This method was employed to confirm the presence or absence of this fungus from olive trees with no visible symptoms on site.

Infection of the bacterium, *Pseudomonas syringae* subsp. *savastanoi* was diagnosed by the presence of its symptoms, clearly visible hyperplastic galls on leaf midrib, petiole or young stems of olive (Brooks, 2001; Janse, 2007 *pers. comm.*).

For all olive pests and diseases recorded, information is provided on material examined, local and global distribution, and additional notes. Unless otherwise stated, all material recorded during the present study was collected by the first author.

ANNOTATED LIST OF SPECIES ASSOCIATED WITH OLIVES IN MALTA

INSECTA

***Liothrips oleae* Costa, 1857**
[Thysanoptera: Phlaeothripidae]
English name: Olive thrip.

Material examined: MALTA: Xemxija (Simar NR), 20.IX.2006, larvae and adults, 19.X.2006, adults; Mellieha, 7.XII.2006, adults; Gzira (tal-Qroqq), 14.XI.2006, adults; Msida (University Grounds), 22.IX.2006, adults, 13.X.2006, adults; Ta Qali, 21.XII.2006, adults and larvae; Bidnija, 20.X.2006, adults; Birzebbuga (Has-Sabtan), 30.IX.2006, adults; Marsa (Ghammieri), 14.IX.2006, adults and larvae, 20.III.2007, adults; Zurrieq, 20.III.2007, adults. **GOZO:** Xewkija, 8.IX.2006, larvae and adults, 22.VI.2006, larvae and adults; Mgarr, 5.VII.2006, adults, 14.IV.2007, adults; Marsalforn (Ghajn Barrani), 30.VII.2006, adults, 10.IX.2006, adults; Munxar, 23.VIII.2006, adults, 9.IX.2006, adults, 2.X.2006, larvae and adults; Kercem (Lunzjata), 9.IX.2006, adults, 19.X.2006, adults and larvae; Victoria (Capuccini Valley), 5.X.2006, adults; Victoria (Villa Rundle), 18.VIII.2006, adults. **COMINO:** Wied l-Ahmar, 27.X.2006, adults, 18.III.2007, adults, 28.IV.2007, adults; Southern Part, 27.X.2006, adults, 28.IV.2007, adults.

Distribution: Present throughout the Mediterranean Basin and Eastern Africa (Marullo, 2003).

Notes: This insect is a new record for Malta being host specific on olive trees. In Italy this pest goes through three to four generations per year. Typical leaf deformations (producing semi-circular leaf galls) indicate the presence of this pest. From the observations carried out during the present survey it can be concluded that in Malta this insect, although very common, does not cause damage of economic significance.

***Euphyllura olivina* (O. G. Costa, 1839)**
[Hemiptera: Psylloidea]
English name: Olive Psyllid.

Material examined: MALTA: Msida (University Grounds), 15.VI.2006, nymphs, 22.IX.2006, adults, 13.X.2006, adults, 14.XI.2006, adults, 20.XII.2006, adults and nymphs, 15.II.2007, adults and nymphs; Xemxija (Simar NR), 20.VI.2006, nymphs, 19.X.2006, adults, 19.XII.2006, adults and nymphs; Birzebbuga (Has-Sabtan), 30.IX.2006, adults; Buskett, 30.IX.2006, adults; Bidnija, 20.X.2006, adults; Gzira (tal-Qroqq), 18.VI.2006, nymphs, 14.XI.2006, adults; Ta Qali, 21.XI.2006, adults; Cirkewwa, 7.XII.2006, adults and nymphs; Mellieha, 7.XII.2006, adults and nymphs; Zurrieq, 20.III.2007, adults and nymphs; Marsa (Ghammieri), 20.III.2007, adults and nymphs; Valletta (Argotti Gardens), 30.IX.2006, adults and nymphs. **GOZO:** Xewkija, 15.VI.2006, nymphs, 15.XI.2006, adults, 20.X.2006, adults, 22.VI.2006, adults

and nymphs, 20.X.2006, adults, 05.IV.2007, adults, 10.IV.2007, adults and nymphs, 15.IV.2007, adults and nymphs; Mgarr, 5.VII.2006, adults and nymphs; Marsalforn (Ghajn Barrani), 30.VII.2006, adults; Munxar, 19.X.2006, adults; Kercem (Lunzjata), 19.X.2006, adults; Xaghra (ta Gajdoru), 19.X.2006, adults; Ghajnsielem (Ta Lambert), 29.VI.2006, adults, 9.IV.2007, adults and nymphs. **COMINO:** Wied l-Ahmar, 27.X.2006, adults, 18.III.2007, adults, 28.IV.2007, adults and nymphs; Southern Part, 27.X.2006, adults, 28.IV.2007, adults and nymphs.

Distribution: *Euphyllura olivina* is found in all olive growing regions of the Mediterranean Basin including Italy, Southern France, Spain, North Africa and Canary Islands (Mifsud, 1997).

Notes: The occurrence of *E. olivina* has already been documented for the Maltese Islands (Borg, 1922; Saliba, 1963; Mifsud, 1997). The species is monophagous on *Olea europea.* In Italy the species undergoes two (Fimiani, 1985) or four to six (Silvestri, 1934; Grandi, 1951; Tremblay, 1981) generations per year. Although the species is locally common, no damage of economic significance was ever observed.

***Aleurolobus olivinus* (Silvestri, 1911)**
[Hemiptera: Aleyrodidae]
English name: Olive whitefly.

Material examined: MALTA: Gzira (tal-Qroqq), 14.XI.2006, pupae; Ta Qali, 21.XI.2006, pupae; Gharghur, 15.IV.07, pupae; Birkirkara, 28.III.2007, pupae; Msida (University Grounds), 14.XI.2006, pupae, leg. D. Mifsud, 20.XII.2006, pupae, 15.II.2007, pupae; Mellieha, 7.XII.2006, pupae, Blata l-Bajda, 19.IX.2006, pupae; Hamrun, 11.XII.2006, pupae, leg. D. Mifsud.

Distribution: Typical Mediterranean species, recorded from most countries in this region including Corsica, Crete, Cyprus, France, Greece, Israel, Italy, Jordan, Mallorca, Morocco, Portugal, Sardinia, Sicily, Spain, Syria and Turkey (Martin *et al.* 2000).

Notes: *A. olivinus* was first recorded in the Maltese islands by Mifsud & Porta-Puglia (2005), though its presence was already suspected by Mifsud (1993). Prior to this study this species was previously recorded from one locality and this study has added seven new localities for *A. olivinus.* Its appearance in different localities in such a short period of time may suggest that the species is of recent introduction. *A. olivinus* is mainly associated with oleaceous hosts (*Olea europea*, *Phyllyrea angustifolia* and *P. latifolia*) but it has also been recorded from *Erica* (Bink-Moenen, 1989). This species has only one generation per year with adults emerging in June and July. However, in western Sicily, two generations per year were recorded with adults emerging in June/July and again in Septemper/October (Maniglia, 1985).

***Pollinia pollini* Costa, 1857**
[Hemiptera: Asterolecaniidae]
English name: Pollinia scale.

Material examined: MALTA: Marsa (Ghammieri), 14.IX.2006, adults, 20.III.2007, adults; Zurrieq, 20.III.2007, adults; Lija, 21.II.2007, adults; Valletta (Argotti Gardens), 30.IX.2006, adults; Xemxija (Simar NR), 20.IX.2006, adults, 19.X.2006, adults; Birzebbuga (Has-Sabtan), 30.IX.2006, adults; Msida (University Grounds), 22.IX.2006, adults, 13.X.2006, adults, 14.XI.2006, adults, 20.XII.2006, adults, 15.II.2007, adults; Gzira (tal-Qroqq), 14.XI.2006, adults; Ta Qali, 21.XI.2006, adults; Mellieha, 7.XII.2006, adults; Cirkewwa, 7.XII.2006, adults. **GOZO:** Xewkija, 8.IX.2006, adults, 24.IX.2006, adults, 22.X.2006, adults, 15.XI.2006, adults, 9.IV.2007, adults; Kercem (Lunzjata), 8.IX.2006, adults, 19.X.2006, adults; Victoria (Villa Rundle), 18.VIII.2006, adults; Mgarr, 25.VIII.2006, adults, 4.IV.2007, adults; Xaghra (ta Gajdoru), 20.X.2006, Marsalforn (Ghajn Barrani), 8.IX.2006, adults; Sannat, 11.XI.2006, adults. **COMINO:** Wied l-Ahmar, 27.X.2006, adults, 18.III.2007, adults, 28.IV.2007, adults.

Distribution: This scale insect is found in most olive growing regions of the Mediterranean Region and in California.

Notes: *P. pollini* is a new record for Malta. It is found on leaves, twigs and fruit of its exclusive host, the olive tree. Generally one generation per year. The species is relatively frequent in Malta but no damage of economic significance was observed.

***Lichtensia viburni* Signoret, 1873**
[Hemiptera: Coccidae]
English name: Viburnum cushion scale.

Material examined: MALTA: Xemxija (Simar NR), 19.X.2006, adults; Msida (University Grounds), 22.IX.2006, adults, 13.X.2006, adults and nymphs, 14.XI.2006, adults and nymphs, 20.XII.2006, adults and nymphs; Gzira (tal-Qroqq), 14.XI.2006, adults and nymphs; Mellieha, 7.XII.2006, adults and nymphs; Cirkewwa, 7.XII.2006, adults and nymphs; Marsa (Ghammieri), 14.IX.2006, adults and nymphs; Zurrieq, 20.III.2007, adults; Hal Lija, 21.II.2007, adults. **GOZO:** Kercem (Lunzjata), 8.IX.

2006, adults and larvae, 19.X.2006, adults; Victoria (Villa Rundle), 15.XI.2006, adults and nymphs; Xewkija, 22.X.2006, adults and nymphs, 15.XI.2006, adults and nymphs; Mgarr, 25.VIII.2006, adults and nymphs, 4.IV.2007, adults; Sannat, 11.XI.2006, adults; Marsalforn (Ghajn Barrani), 8.IX.2006, adults and nymphs.

Distribution: *L. viburni* is known from the Czech Republic, France, Germany, Russia, Italy, Yugoslavia, England, Wales, Spain, Portugal and USA.

Notes: Borg (1922), described *Phillipia oleae* (= *L. viburni*) as rather uncommon on olive trees. Borg [J.] (1932), cited again *Phillipia oleae* as present here and there on the olive tree in both islands, more frequent in St. Julians, Sliema and St. Antonio Gardens. *L. viburni* infests leaves, twigs and stems of *Arbutus*, *Olea*, *Hedera*, *Ilex*, *Phillyrea*, *Prunus*, *Rhamnus* and *Viburnum*. Normally the species undergoes two generations per year (Kosztarab & Kozar, 1988; Pollini *et al.* 2002). From the observations made during the present study, damage caused by this scale insect was rarely significant in Malta. *L. viburni* was observed to be widely distributed in the Maltese islands.

Saisettia oleae Olivier, 1791
[Hemiptera: Coccidae]

English name: Black scale.

Material examined: MALTA: Xemxija (Simar NR), 20.IX.2006, adults, 19.X.2006, adults; Birzebbuga (Has-Sabtan), 30.IX.2006, adults; Buskett, 30.IX.2006, adults nymphs; Msida (University Grounds), 22.IX.2006, adults, 13.X.2006, adults and nymphs, 14.XI.2006, adults and nymphs, 20.XII.2006, adults and nymphs, 15.II.2007, adults; Bidnija, 20.X.2006, adults; Gzira (tal-Qroqq), 14.XI.2006, adults and larvae; Ta Qali, 21.XI.2006, adults; Mellieha, 7.XII.2006, adults; Cirkewwa, 7.XII.2006, adults; Marsa (Ghammieri), 14.IX.2006, adults, 20.III.2007, adults; Zurrieq, 20.III.2007, adults; Lija, 21.II.2007, adults; Mtahleb, 26.XI.2006, adults and nymphs; Valletta (Argotti Gardens), 30.IX.2006, adults. **GOZO:** Kercem (Lunzjata), 8.IX.2006, adults and nymphs, 19.X.2006, adults; Kercem (Public Garden), 18.VIII.2006, adults, 21.IX.2006, adults; Victoria (Villa Rundle), 18.VIII.2006, adults; Victoria (Capuccini Valley), 5.X.2006, adults; Marsalforn (Ghajn Barrani), 8.IX.2006, adults; Marsalforn (Valley), 28.VII.2006, adults; San Lawrenz, 8.X.2007, adults and nymphs; Xewkija, 22.X.2006, adults and nymphs, 8.IX.2006, adults, 24.IX.2006, adults, 15.XI.2006, adults and nymphs, 9.IV.2007, adults; Mgarr, 25.VIII.2006, adults, 4.IV.2007, adults; Xaghra (ta Gajdoru), 20.X.2006, adults; Sannat, 11.XI.2006, adults. **COMINO:** Wied l-Ahmar, 27.X.2006, adults, 18.III.2007, adults, 18.IV.2007, adults; Southern Part, 27.X.2006, 18.IV.2007, adults.

Distribution: Found in most Mediterranean countries including Spain, France, Italy and Greece. Recorded also from California and Australia.

Notes: *S. oleae* is a polyphagous insect recorded on different unrelated host plants. It was described by Borg (1919; 1922) as an important pest commonly affecting local olive cultivation. Borg [J.] (1932) described *S. oleae* as very common on Citrus trees, Olive trees, *Cycas revoluta*, *Abutilon*, *Hibiscus*, *Myrtus*, *Nerium*, *Oleander*, *Pistacia lentiscus*, *P. terebinthus*, *Punica granaum* and others. Saliba (1963) also stated that *S. oleae* is very common on olive and other hosts. *S. oleae* normally undergoes one generation per year (univoltine), although an incomplete generation may occur when the weather is mild in the autumn. In this study this species was observed to be very common on olive trees and was recorded in nearly all of the sites sampled. Damage is not very significant since the fruit is rarely affected, but serious damage can result from blackening of leaves due to sooty mould growing on the honeydew secreted by the nymphal instars. Heavy infestations were rarely observed locally.

Aspidiotus nerii Bouche, 1833
[Hemiptera: Diaspididae]

English name: Oleander scale.

Material examined: MALTA: Xemxija (Simar NR), 19.X.2006, adults; Msida (University Grounds), 22.IX.2006, adults, 13.X.2006, adults, 14.XI.2006, adults, 20.XII.2006, adults, Gzira (tal-Qroqq), 14.XI.2006, adults; Mellieha, 7.XII.2006, adults; Cirkewwa, 7.XII.2006, adults; Marsa (Ghammieri), 14.IX.2006, adults; 20.XII.2006, adults; Lija, 21.II.2007, adults. **GOZO:** Kercem (Lunzjata), 19.X.2006, adults; Victoria (Villa Rundle), 20.XII.2006, adults; Xewkija, 22.X.2006, adults, 15.XI.2006, adults; Mgarr, 25.VIII.2006, adults, 4.IX.2006, adults; San Lawrenz, 8.X.2007, adults; Munxar, 2.X.2006, adults; Sannat, 11.XI.2006, adults. **COMINO:** Wied l-Ahmar, 27.X.2006, adults, 18.III.2007, adults; Southern Part, 27.X.2006, adults.

Distribution: *Aspidiotus nerii* has a worldwide distribution, especially in the tropical and subtropical zones (Zahradnik, 1990).

Notes: Borg (1919) described two species, *A. hedereae* (= *A. nerii*) and *A. nerii* as both occurring on olive and other hosts. Borg (1922) and Borg [J.] (1932) recorded *A. hederae* as very common, infesting several plant families including olive, but causing limited damage. Saliba (1963) also cited this insect as common. This polyphagous pest usually goes through three generations. In the present study the occurrence of this scale insect

was rather frequent. It was most often observed in abundance in old trees. Shade and humid conditions favour this insect and in fact it was observed mostly in trees having a dense canopy due to lack of pruning. In table olive crops, the presence of this scale makes fruit unmarketable. Economic loss on table olives due to damage to fruits can be up to 70% (Alexandrakis & Benassy, 1981). In Malta, a heavy infestation by this species was observed in only one locality where the trees looked white-washed due to the presence of this insect.

Hemiberlesia rapax Comstock, 1881
[Hemiptera: Diaspididae]
English name: Greedy Scale.

Material examined: MALTA: Marsa (Ghammieri), 14.IX.2006, adults; 20.XII.2006, adults; Mellieha, 7.XII.2006, adults. **GOZO:** San Lawrenz, 8.X.2007, adults.
Distribution: *H. rapax* is found in all tropical and sub-tropical regions of the world.
Notes: Borg (1919) describes the occurrence of *Aspidiotus rapax* (= *Hemiberlesia rapax*) as present on several tree species and ornamental shrubs with no specific reference to olive trees. This species is a polyphagous pest. During the present study this species was observed affecting the stem, leaves and fruit of olive trees. Most damage was inflicted to the fruit were it caused some form of deformation. In Malta the insect occurred in large numbers especially on the stem.

Leucaspis riccae Targioni Tozzetti, 1881
[Hemiptera: Diaspididae]
English name: White Olive Scale.

Material examined: MALTA: Gzira (tal-Qroqq), 14.XI.2006, adults.
Distribution: Occurs in Israel, Syria, Italy, Yugoslavia, Uzbekistan, Tunisia, Sicily, Morocco, Malta, Cyprus, Argentina, Turkey, Egypt, Algeria, France, Greece and Iran (Pollini, 1998).
Notes: This scale insect was recorded by Borg [J.] (1932), as found 'here and there' on olive trees. It was also mentioned by Saliba (1963) as occasional on olive. In Greece, *Leucaspis riccae* undergoes two generations per year (Argyriou & Kourmadas, 1981). *L. riccae* is known to occur on olive and *Ephedra alata.* In the present survey, only three specimens were observed on ripe olive fruit in one location. The fruit was severely deformed by this insect indicating that its damage is significant. This species seems to be rare in the Maltese Islands.

Prays oleae Bernard, 1788
[Lepidoptera:Yponomeutidae]
English name: Olive moth.

Material examined: MALTA: Birzebbuga (Has-Sabtan), 30.IX.2006, adults; Buskett, 30.IX.2006, adults; Xemxija (Simar NR), 20.IX.2006, symptoms on leaves, 19.IV.2007, larvae; Marsa (Ghammieri), 21.II.2007, larvae, 15.III.2007, adults; Msida (University Grounds), 22.IX.2006, symptoms on leaves, 13.X.2006, adults, 14.XI.2006, adults, 20.III.2007, larvae; Gzira (tal-Qroqq), 14.XI.2006, adults; Mellieha, 7.XII.2006, adults; Cirkewwa, 7.XII.2006, symptoms on leaves; Bidnija, 20.X.2006, adults. **GOZO:** Kercem (Lunzjata), 8.IX.2006, adults, 19.X.2006, symptoms on leaves; Munxar, 8.IX.2006, adults; Marsalforn (Ghajn Barrani), adults; Marsalforn (Valley), 28.VII.2006, symptoms on leaves; Xaghra (ta Gajdoru), 20.X.2006, symptoms on leaves; Victoria (Villa Rundle), 18.VIII.2006, adults; Mgarr, 13.VIII.2006, adults, 20.IX.2007, adults; Xewkija, 8.IX.2006, adults, 24.IX.2006, symptoms on leaves, 2.X.2006, larvae in olive fruit, 9.IV.2007, larvae. **COMINO:** Wied l-Ahmar, 27.X.2006, adults, 18.III.2007, larvae, 28.IV.2007, larvae; Southern Part, 27.X.2006, symptoms on leaves, 28.IV.2007, larvae.
Distribution: *Prays oleae* is present throughout the Mediterranean basin and the Black Sea, the Middle East and Canary Islands (Tzanakakis, 2003).
Notes: This moth was first recorded for Malta by Borg (1922) under the name of *Prays oleaellus*, were he stated that it causes frequent damage. The damage described by Borg (1922) does not entirely correspond to the typical damage by *P. oleae.* Borg [P.] (1932) describes this moth as causing injuries on leaves, flowers and fruit and recorded the species as not common possibly due to the activity of a parasite. The moth was also recorded by Saliba (1963) as fairly common whereas Delucca (1965) mentioned it in his list. Valletta (1973) stated that the moth is not so common and attacks tender leaves, flowers and shoots. Sammut (2000) describes the moth as rare. In the present survey, leaf mining symptoms were commonly observed throughout the islands. Apart from the olive, this moth is also associated with filaria (*Phillyrea* spp.), privet (*Ligustrum* spp.)

and jasmine (*Jasminum* sp.). This moth is considered as a primary olive pest and significant loss in production is attributed to this insect. In Malta, larvae were observed causing some damage to flower buds during early spring and it was from these that adult moths were reared. Infected fruit by the carpophagous generation was only observed once in summer 2006. Thus although this moth is widespread in the Maltese Islands it seems that the damage caused is not very significant and overall population densities are low.

A parasitic wasp of this moth was recorded for the first time in Malta after it was reared as part of the present study. A single specimen of *Angitia armillata* (Grav.) (Hymenoptera: Ichneumonidae), was reared from *P. oleae* larvae that were infecting olive flowers. [Material examined: MALTA: Hal Lija, collected 21.II.2007, emerged 16.III.2007, *Angitia armillata* - adult].

***Lobesia botrana* Denis & Schiffermüller, 1775**
[Lepidoptera: Tortricidae]
English name: Grapevine moth.

Material examined: GOZO: Xewkija, 11.X.2007, larvae and adults; San Lawrenz, 25.X.2007, larvae and adults.
Distribution: *Lobesia botrana* is a significant pest of berries and berry-like fruits in Europe, the Mediterranean, southern Russia, Japan, the Middle East, Near East, and northern and western Africa.
Notes: Borg (1922) stated that this species (as *Polychrosis botrana*) is common throughout Europe but absent in Malta. Delucca (1950) records one specimen from Gharghur. Saliba (1963) stated that this moth is fairly common on grapes. Valletta (1973), Sammut (1984) and Vella (1991) also mentioned the occurrence of this moth locally. Sammut (2000) stated that the species is common on grapes and occurs around Malta. In the present study, this species was found in two sites in Gozo where the moth emerged from cultured olive fruits. This is the first time that this species is recorded from the olive fruit. Worldwide this species feeds primarily on the flowers and fruits of grapevines (*Vitis vinifera*) and is recorded as a serious pest on this commodity. The grapevine moth is a polyphagous insect and can develop on plants belonging to more than 40 plant species (Benyehuda *et al.* 1993; Moleas, 1988). From the present survey it can be concluded that the damage of this moth on olives is negligible.

***Palpita unionalis* Huebner, 1796**
[Lepidoptera: Pyralidae]
English name: Jasmine Moth.

Material examined: MALTA: Xemxija (Simar NR), 20.IX.2006, adults and larvae, 19.X.2006, larvae; Birzebbuga (Has-Sabtan), 30.IX.2006, larvae; Buskett, 30.IX.2006, larvae; Msida (University Grounds), 22.IX.2006, larvae, 13.X.2006, larvae, 14.XI.2006, larvae, 20.XII.2006, larvae, Bidnija, 20.X.2006, larvae; Gzira (tal-Qroqq), 14.XI.2006, larvae; Ta Qali, 21.XI.2006, larvae; Mellieha, 7.XII.2006, adults and larvae; Cirkewwa, 7.XII.2006, larvae; Marsa (Ghammieri), 14.IX.2006, adults and larvae, 20.III.2007, larvae; Zurrieq, 20.III.2007, larvae; Valletta (Argotti Gardens), 30.IX.2006, larvae. **GOZO:** Kercem (Lunzjata), 8.IX.2006, adults and larvae, 19.X.2006, larvae; Kercem (Public Garden), 18.VIII.2006, adults and larvae, 21.IX.2006, larvae; Victoria (Villa Rundle), 18.VIII.2006, adults and larvae; Victoria (Capuccini Valley), 5.X.2006, adults and larvae; Xewkija, 8.IX.2006, larvae, 24.IX.2006, adults and larvae, 22.X.2006, larvae, 15.XI.2006, larvae, 9.IV.2007, adults; Xewkija (Local Council Grove), 25.IX.2007, larvae and adults, Mgarr, 13.VIII.2006, adults and larvae, 4.IV.2007, adults, 9.IX.2007, larvae, 20.IX.2007, adults and larvae; Xaghra (ta Gajdoru), 20.X.2006, adults and larvae; Marsalforn (Ghajn Barrani), 8.IX.2006, larvae; Marsalforn (Valley), 28.VII.2006, larvae. **COMINO:** Wied l-Ahmar, 27.X.2006, adults and larvae, 18.III.2007, larvae; Southern Part, 27.X.2006, larvae.
Distribution: *P. unionalis* occurs throughout the Mediterranean Region (Balachowsky, 1972). It is also present in Asia Minor, North Africa, India, Japan, Australia and South America (Pollini, 1998).
Notes: This moth was first recorded by Caruana-Gatto (1905) as *Glydophodes unionalis* based on one specimen captured from Imtarfa. This moth was again recorded by Andres (1916) at Verdala Barracks. Borg [P.] (1932) recorded this species as *Margaronia unionalis* stating that it is "rare". Darlow (1949) took several specimens from Malta whilst Valletta (1950) records the species from Mriehel. Delucca (1965) also mentions this moth and for the first time it is said to be associated with olive trees in Malta. Valletta (1973) described the local occurrence of this moth, stating that it is an immigrant and feeds on olive and jasmine. Sammut (2000) recorded the species as very common especially between April to July and September to November and he also stated that its larvae feed on olive and jasmine. In the present survey, the moth was recorded during most of the year in many localities. Larvae feeding actively were observed from June up to early December. This species is a polyphagous pest and is known to occur on olive, jasmine (*Jasminum*), privet

(*Ligustrum*), ash (*Fraxinus*), arbutus (*Arbutus unedo*) and others. The species goes through 2 or 3 generations each year. Damage to large olive trees is not very significant but infection of young trees may prevent their healthy development. During the present study most damage was observed on the new growth of olive trees, where not only new leaves and buds were eaten but occasionally entire shoots up to 15cm were completely eroded.

***Resseliella oleisuga* (Targioni Tozzetti, 1887)**
[Diptera: Cecidomyiidae]
English name: Olive bark midge.

Material examined: MALTA: Xemxija (Simar NR), 20.IX.2006, larvae, 19.X.2006, larvae; Cirkewwa, 7.XII.2006, larvae; Mellieha, 7.XII.2006, larvae; Gzira (tal-Qroqq), 14.XI.2006, larvae; Msida (University Grounds), 22.IX.2006, larvae, 13.X.2006, larvae, 14.XI.2006, larvae. **GOZO:** Xewkija, 22.VI.2006, larvae, 5.XI.2007, larvae, 15.XI.2006, larvae, 15.III.2007, larvae; Mgarr, 5.VII.2006, larvae, 19.VII.2006, larvae, 1.VIII.2006, larvae, 2.VIII.2006, larvae, 5.VIII.2006, larvae, 4.IV.2007, larvae; Xaghra, 19.VII.2006, larvae, 5.XI.2007, larvae, 15.XI.2007, larvae; Marsalforn (Ghajn Barrani), 30.VII.2006, larvae, 10.IX.2006, larvae; Xewkija (Local council grove), 12.VIII.2006, larvae; Munxar, 23.VIII.2006, larvae, 9.IX.2006, larvae, 2.X.2006, larvae and adults; Xewkija, 8.IX.2006, larvae, 15.XI.2006, larvae, 15.III.2007, larvae; Kercem (Lunzjata), 9.IX.2006, larvae, 19.X.2006, adults and larvae; Kercem (Public Garden), 18.VIII.2006, larvae, 21.IX.2006, larvae; Xaghra (ta Gajdoru), 2.X.2006, larvae, 20.X.2006, larvae; Victoria (Capuccini Valley), 5.X.2006, larvae; Victoria (Villa Rundle), 18.VIII.2006, larvae. **COMINO:** Wied l-Ahmar, 27.X.2006, larvae, 18.III.2007, larvae, 28.IV.2007, larvae; Southern Part, 27.X.2006, larvae, 28.IV.2007, larvae.
Distribution: This midge is known from most Mediterranean countries. It is recorded from Spain, France, Greece, Lebanon, Syria, Palestine, Morocco and Yugoslavia (Argyriou & Marakis, 1973).
Notes: This gall midge was first recorded in Malta by Skuhrava *et al.* (2002), from one locality: Bajda Ridge. In this survey, the species was observed to be much more widespread. The gall midge was recorded in nearly all sites sampled in Gozo, though its presence in Malta was less frequent. This insect was most common in the warmer months but larvae and typical symptoms were observed nearly all year round. It appears to be specific to olive trees but it may develop on other Oleaceae such as filaria (*Phillyrea* spp.) and ash (*Fraxinus* spp.). The species goes through one to three generations per year depending on climatic conditions. One generation was recorded in Crete (Arambourg, 1966; Argyriou & Marakis, 1973) whilst two were reported in Italy. Each generation lasts about one month and the species over winters in the larval stage. Typical damage symptoms observed in this study were somewhat dry twigs and shoots in the outer parts of the tree canopy. On closer examination larvae were observed under the bark at the base of the wilted shoots. Damage was significant when the twigs affected bore fruit or inflorescences. Significant damage was observed on young olive plantations where dried branches constituted a large proportion of each tree.

The parasite *Eupelmus hartigi* Forester (Hymenoptera: Eupelmidae) was reared from larvae of *Resseliella oleisuga.* The parasite emerged from larvae collected in four sites in Gozo. This species is a new record for Malta. [Material examined: GOZO: Xewkija, collected 22.VI.2006, emerged 4.VII.2006, *Eupelmus* sp. 1 ex; Mgarr, collected 19.VII.2006, emerged 1.VIII.2006, *Eupelmus* sp., 2 exs.; Kercem (Public Garden), collected 18.VIII.2006, emerged 30.VIII.2006, *Eupelmus* sp. 1ex.]. The larvae appear to be ectoparasitic on larvae of the gall midge and their pupation takes place within the tunnels of the midge (Argyriou & Marakis, 1973).

***Bactrocera oleae* (Gmelin, 1788)**
[Diptera:Tephritidae]
English name: Olive Fly.

Material examined: MALTA: Xemxija (Simar NR), 20.IX.2006, adults and larvae, 19.X.2006, adults and larvae; Birzebbuga (Has-Sabtan), 30.IX.2006, adults and larvae; Buskett, 30.IX.2006, adults and larvae; Msida (University Grounds), 22.IX.2006, adults and larvae, 13.X.2006, adults and larvae, 14.XI.2006, adults and larvae, 20.XII.2006, adults and larvae, 15.II.2007, adults; Bidnija, 20.X.2006, adults and larvae; Gzira (tal-Qroqq), 14.XI.2006, adults and larvae; Ta Qali, 21.XI.2006, adults; Mellieha, 7.XII.2006, adults and larvae; Cirkewwa, 7.XII.2006, adults and larvae; Marsa (Ghammieri), 14.IX.2006, adults and larvae, 20.III.2007, adults; Zurrieq, 20.III.2007, adults; Lija, 21.II.2007, adults; Mtahleb, 26.XI.2006, adults and larvae; Valletta (Argotti Gardens), 30.IX.2006, adults and larvae. **GOZO:** Kercem (Lunzjata), 8.IX.2006, adults and larvae, 19.X.2006, adults; Kercem (Public Garden), 18.VIII.2006, adults and larvae, 21 .IX.2006, adults and larvae; Victoria (Villa Rundle), 18.VIII.2006, adults and larvae; Victoria (Capuccini Valley), 5.X.2006, adults and larvae; Xewkija, 8.IX.2006, adults and larvae, 24.IX.2006, adults and larvae, 15.XI.2006, adults and larvae, 9.IV.2007, adults; Mgarr, 25.VIII.2006, adults and larvae, 4.IV.2007, adults; Xaghra (ta Gajdoru), 20.X.2006, adults and larvae; Marsalforn (Ghajn Barrani), 8.IX.2006, adults and larvae; Marsalforn (Valley), 28.VII.2006, adults and larvae; San Lawrenz, 8.X.2007, adults and larvae; Munxar, 23.VIII

2006, adults and larvae, 9.IX.2006, adults and larvae, 24.IX.2006, adults and larvae, 19.X.2006, adults and larvae. **COMINO:** Wied l-Ahmar, 27.X.2006, adults and larvae, 18.III.2007, adults; Southern Part, 27.X.2006, adults and larvae.

Distribution: Throughout the Mediterranean basin, South and North Africa. The olive fruit fly is found in many olive-producing areas in the world (Ramos *et al.* 1982; Van Steenwyk *et al.* 2002). It was detected in California in October 1998 in the Los Angeles area and has since spread to the rest of southern California in 1999 (Rice *et al.* 2003; Van Steenwyk *et al.* 2002).

Notes: Briffa (1933) described this species as a serious olive pest and Saliba (1963) states that this fly is common on olive. The olive fruit fly is a serious pest of olives in most of the countries around the Mediterranean Region. The larvae are monophagous and feed exclusively on olive fruits, causing premature fruit drop and yield reduction. In regions where olive fruits remain on the trees in spring, the olive fly develops one or two spring generations. There may be a wide overlap in generations due to adult longevity and a long oviposition period (Mazomenos *et al.* 2002). Locally the most important problem faced by the olive tree is the havoc caused by the olive fly (Borg, 1922). During the present survey, infected fruit and adult flies were observed from mid July up to early December 2006. Damage is very severe since 80% to 100% of the olives per tree are infected unless appropriate preventive control measures are taken. Large and early ripening olives were noted to be much more susceptible than smaller ones.

Several species of parasites are known to control the olive fly. In this study three of these species, *Pnigalio agraules* (Walker, 1839) (Hymenoptera: Eulophidae), *Eupelmus urozonus* Dalman, 1820 (Hymenoptera: Eupelmidae) and *Psyttalia* (= *Opius*) *concolor* Szépligeti, 1910 (Hymenoptera: Braconidae), were reared from olives infected with *Bactrocera oleae* larva, and constitute new records for Malta. Of these three species, the latter was very commonly observed. The other two species were less frequent and were only recorded from four sites. It was observed that *Psyttalia concolor* started to parasite the fly during an advanced stage of infestation, when most fruit was already affected and was also very prolific as large numbers were observed in a short time. Both *Pnigalio agraules* and *Eupelmus urozonus* were isolated when the infection by the olive fly was at an early stage and when only few olives were infected. Few specimens of these species were observed and when *Psyttalia concolor* appeared, the others were no longer observed. The only local reference to these species is by Briffa (1933) where he states that the most practical way to control infestations by *Bactrocera oleae* was by using the parasitoid *Opius* (=*Psyttalia*).

[Material examined: GOZO: Victoria, collected 20.XI.2006, emerged 22.XI.2006, 1 ex. *Pnigalio agraules*; Marsalforn, collected 06.VIII.2006, emerged 17.VIII.2006, 2 exs. *Eupelmus urozonus*; Munxar, collected 29.XIII.2006 emerged 17.VIII.2006 1 ex. *Eupelmus urozonus*; Xewkija, collected 5.XI.2006, emerged 22.XI.2006, 1 ex. *Psyttalia concolor*; Kercem, collected 12.X.2006, emerged 30.XI.2006, 2 exs. *Psyttalia concolor*; San Lawrenz, collected 11 .X.2006, emerged 3.XI.2006, 2 exs. *Psyttalia concolor.* MALTA: Cirkewwa, collected 7.XII.2006 emerged 12.XII.2006, 2 exs. *Pnigalio agraules*; Cirkewwa, collected 7.XII.2006, emerged 18.XII.2006, 2 exs. *Psyttalia concolor*; Msida, collected 15.XI.2006, emerged 28.XI.2006, 2 exs. *Psyttalia concolor*].

Phloeotribus scarabaeoides scarabaeoides (Bernard, 1788)
[Coleoptera: Scolytidae]

English name: Olive bark beetle, Olive Scolytid.

Material examined: MALTA: Xemxija (Simar NR), 20.VI.2006, adults, 19.X.2006, adults and larvae; Birzebbuga (Has-Sabtan), 30.IX.2006, adults; Buskett, 30.IX.2006, adults; Msida (University Grounds), 15.VI.2006, adults, 13.X.2006, adults; Bidnija, 20.X.2006, adults; Gzira (tal-Qroqq), 14.XI.2006, adults; Ta Qali, 21.XI.2006, adults; Mellieha, 7.XII.2006, adults and larvae; Cirkewwa, 7.XII.2006, adults; Marsa (Ghammieri), 14.VII.2006, adults, 20.III.2007, adults; Zurrieq, 20.III.2007, adults; Lija, 21.II.2007, adults; Valletta (Argotti Gardens), 30.IX.2006, adults. **GOZO:** Kercem (Lunzjata), 14.VI.2006, adults, 8.IX.2006, adults, 19.X.2006, adults; Kercem (Public Garden), 18.VIII.2006, adults, 21.IX.2006, adults; Victoria (Villa Rundle), 1 8.VIII.2006, adults; Victoria (Capuccini Valley), 5.X.2006, adults; Xewkija, 22.VI.2006, adults and larvae, 8.IX.2006, adults, 24.IX.2006, adults, 22.X.2006, adults 15.XI.2006, adults, 9.IV.2007, adults; Xewkija (Local Council Grove), 30.VI.2006, adults; Mgarr, 5.VII.2006, adults, 19.VII.2006, adults, 1.VIII.2006, adults and larvae, 5.VIII.2006, adults, 4.IV.2007, adults; Xaghra (Ramla Valley), 25.VII.2006, adults and larvae, 29.VII.2006, adults and larvae; Xaghra (ta Gajdoru), 20.X.2006, adults; Marsalforn (Ghajn Barrani), 30.VII.2006, adults, 8.IX.2006, adults; Marsalforn (Salvatur Hill), 6.VIII.2006, adults; Marsalforn (Valley), 6.VIII.2006, adults; Munxar, 23.VIII.2006, adults and larvae, 9.IX.2006, adults, 24.IX.2006, adults, 19.X.2006, adults. **COMINO:** Wied l-Ahmar, 27.X.2006, adults, 18.III.2007, adults, 28.IV.2007, adults; Southern Part, 27.X.2006, adults, 28.IV.2007, adults.

Distribution: This beetle is found in all the Mediterranean Region and in Central Europe. It also occurs in North Africa except the Sahara Region, and in the Near and Middle Eastern countries including Turkey, Lebanon, Jordan and Iran (Pfeffer, 1995).

Notes: This insect was first recorded in the Maltese islands by Cameron & Caruana Gatto (1907). Borg (1922) stated that this beetle is often troublesome on olive trees whilst Saliba (1963) describes it as an occasional olive pest. In this study, this beetle has been recorded in practically all sites sampled. It often occurs in small numbers. It was recorded actively feeding and boring from April up till early December, indicating four or possibly more generations per year. This xylophagous (wood boring) pest (both in the larval and adult stages), is known to develop on *Olea europeae, Fraxinus* spp., *Ligustrum* sp., *Syringa* sp. and *Phyllirea* sp. (Pfeffer, 1995). The life cycle involves 1 to 3 generations per year. *Phloeotribus scarabaeoides* is an important insect pest of olive trees, and can lead to losses of up to 75% of the potential harvest (Gonzalez & Campos, 1994; Cuesta & Delgado, 1995). During the present survey it was observed that damage caused by this insect locally is not very significant. Heavy infestations were recorded only twice on living trees, at Mgarr and Marsalforn in summer 2006. Both trees showed severe signs of wilting and eventually died. The cause of their death could not be attributed directly to this insect and most likely *Phloeotribus scarabaeoides* was only a secondary problem.

Otiorhynchus moriger Reitter, 1913
[Coleoptera: Curculionidae]

Material examined: MALTA: Xemxija (Simar NR), 20.VI.2006, adults, 19.X.2006, adults; Birzebbuga (Has-Sabtan), 30.IX.2006, adults; Buskett, 30.IX.2006, adults; Msida (University Grounds), 15.VI.2006, 13.X.2006, adults; Bidnija, 20.X.2006, adults; Gzira (tal-Qroqq), 4.XI.2006, symptoms on leaves; Ta Qali, 21.XI.2006, adults; Mellieha, 7.XII.2006, symptoms on leaves; Cirkewwa, 7.XII.2006, symptoms on leaves; Marsa (Ghammieri), 14.VII.2006, adults, Zurrieq, 20.III.2007, symptoms on leaves; Lija, 21.II.2007, symptoms on leaves; Valletta (Argotti), 30.IX.2006, adults. **GOZO:** Xewkija (Local Council Grove), 1.VII.2006, adults; Kercem (Lunzjata), 14.VI.2006, adults, 8.IX.2006, symptoms on leaves, 19.X.2006, adults; Kercem (Public Garden), 18.VIII.2006, adults, 21.IX.2006, adults; Victoria (Villa Rundle), 18.VIII.2006, adults; Victoria (Capuccini Valley), 5.X.2006, adults; Xewkija, 22.VI.2006, adults, 8.IX.2006, adults, 24.IX.2006, adults, 22.X.2006, adults, 15.XI.2006, symptoms on leaves, 9.IV.2007, symptoms on leaves; Mgarr, 5.VII.2006, adults, 19.VII.2006, adults, 1.VIII.2006, adults and larvae, 5.VIII.2006, adults, 4.IV.2007, adults; Xaghra (Ramla Valley), 25.VII.2006, adults, 29.VII.2006, adults; Xaghra (ta Gajdoru), 20.X.2006, adults; Marsalforn (Ghajn Barrani), 30.VII.2006, adults, 8.IX.2006, adults; Marsalforn (Salvatur Hill), 6.VIII.2006, adults; Marsalforn (Valley), 6.VIII.2006, adults; Munxar, 23.VIII.2006, adults, 9.IX.2006, adults, 24.IX.2006, adults. **COMINO:** Wied l-Ahmar, 27.X.2006, adults, 18.III.2007, adults, 28.IV.2007, adults; Southern Part, 27.X.2006, adults, 28.IV.2007, adults.

Distribution: Endemic to the Maltese islands (Magnano, 1992).

Notes: Magnano (1992) provided a detailed description of this species and stated that it is endemic to the Maltese islands. Mifsud (2000) also listed this species as endemic. The record of *Otiorhynchus cribricollis* by Cameron & Caruana Gatto (1907) should refer to this species. Saliba (1963) states that *O. cribricollis* is found associated with olive locally but this record should also refer to *O. moriger*. This is the first time that olive foliar damage is being attributed to this species in Malta. The damage is visible on the leaves as small, characteristic semi-circular notches bitten out of the periphery of the lamina. Young leaves and shoots are normally attacked. No serious damage was observed on well developed trees except on the suckers and shoots at the base that are normally heavily degraded by this insect.

ARACHNIDA

Oxycenus maxwelli Keifer, 1939
[Acarina: Eriophyidae]
English name: Olive bud mite.

Material examined: MALTA: Marsa (Ghammieri), 23.II.2007, 1 female; Msida (University grounds), 20.II.2007, 5 females and 4 juveniles; Xemxija (Simar NR), 22.II.2007, 4 females, 1 male and 6 juveniles.

Distribution: *O. maxwelli* is recorded from California, Algeria, Armenia, Brazil, Australia, Egypt, Greece, Italy, Portugal and Spain (Castagnoli & Papaionnou-Souliotis, 1982).

Notes: *O. maxwelli* is a new record for the Maltese Islands. Its only known host is *Olea europaea.* These mites commonly feed on the upper surfaces of olive leaves but infest the under surfaces when populations are high (Keifer, 1939). New buds, shoots, stems and leaves are preferred. It is difficult to estimate the amount and type of damage caused by this eryophid mite since other species often coexist and have similar

feeding habits (Castagnoli & Oldfield, 1996). However, heavy infestations of *O. maxwelli* can cause the premature fall of olive flowers, spotting and distortion of leaves (Russo, 1972).

Ditrymacus athiasellus Keifer, 1960
[Acarina: Eriophyidae]

Material examined: MALTA: Msida (University Grounds), 20.II.2007, 3 males; Xemxija (Simar NR), 2 females, 1 male. **GOZO:** Xewkija, 8.II.2007, 7 males, 9 females; 10.II.2007, 3 males, 5 females; Mgarr, 27.II.2007, 1 male.
Distribution: *Ditrymacus athiasellus* is known to occur in Armenia, Egypt, Greece, Italy and Ukraine (Castagnoli & Papaionnou-Souliotis, 1982).
Notes: *D. athiasellus* is a new record for the Maltese islands. This mite is species specific to olive trees. It occurs mostly on the upper part of the leaf, even in winter. In Italy, it reaches highest densities during mid May (Castagnoli & Papaionnou-Souliotis, 1982).

Tegolophus hassani Keifer, 1959
[Acarina: Eriophyoidea]
English name: Olive rust mite.

Material examined: MALTA: Msida (University Grounds), 20.II.2007, 3 males, 3 females; Lija, 21.II.2007, 2 males, 9 females, 8 juveniles; Marsa (Ghammieri), 23.II.2007, 1 male; St. Thomas Bay, 10.I.2007, 10 females, 3 juveniles. **GOZO:** Xewkija, 8.II.2007, 3 female, 6 juveniles, 2males; Mgarr, 27.II.2007, 2 females, 1 juvenile.
Distribution: Armenia, Egypt, Greece, Italy and Ukraine (Castagnoli & Papaionnou-Souliotis, 1982).
Notes: *Tegolophus hassani* is a new record for the Maltese islands. In the present survey, this species was the most common and abundant eryophid mite associated with olives. The biology of *T. hassani* is largely unknown. It does not normally occur in high population densities and is usually found on the upper leaf surface and on new shoots. It is known to cause leaf deformation and russeting (Castagnoli, 1982).

FUNGI

Spilocaea oleaginea (Castagne) S. Hughes
[Dothideomycetes: Pleosporales]
English name: Peacock spot.

Material examined: MALTA: Xemxija (Simar NR), 19.X.2006; Birzebbuga (Has-Sabtan), 30.IX.2006; Msida (University Grounds), 14.XI.2006, 20.XII.2006, 15.II.2007; Gzira (tal-Qroqq), 14.XI.2006; Ta Qali, 21.XI.2006; Mellieha, 7.XII.2006; Cirkewwa, 7.XII.2006; Marsa (Ghammieri), 14.IX.2006, 20.III.200; Zurrieq, 20.III.2007; Lija, 21.II.2007. **GOZO:** Kercem (Lunzjata), 19.X.2006; Victoria (Villa Rundle), 18.VIII.2006; Xewkija, 22.X.2006, 15.XI.2006, 9.IV.2007; Mgarr, 25.VIII.2006, 17.XI.2006, 4.IV.2007; Sannat, 11.XI.2006; Munxar, 23.VIII.2006, 9.IX.2006, 24.IX.2006, 19.X.2006.
Distribution: Widespread in the Mediterranean Region and in the major olive growing regions of the World.
Notes: This fungal disease was first recorded in Malta by Wheeler (1957) from Buskett. Porta-Puglia & Mifsud (2006) describe its local abundance as widespread and causing severe defoliation on some cultivars. In the present survey, it was frequently observed mainly on large olive trees, especially in dense groves. The disease was normally observed in the lower parts of the canopy that happened to be the most shaded. Young trees occurring in shaded places such as in internal yards were also observed to be severely infected. *Spilocaea oleaginea*, is among the most common fungal diseases of olive. It causes leaf abscission and eventually, whole tree weakness, resulting in a subsequent loss in crop yield (Gonzalez-Lamothe *et al.* 2002).

Verticillium dahliae Kleb.
[Sordariomycetes: Phyllachorales]
English name: Verticillium wilt.

Materials examined: MALTA: Sliema, 5.I.2007; Marsa; 13.II.2007; Xemxija (Simar NR), 20.II.2007; Birzebbuga, 13.II.2007; Zurrieq, 20.III.2007. **GOZO:** Nadur, 18.XII.06; Victoria (Villa Rundle), 11.II.2007, Xewkija, 10.II.2007. COMINO: Southern part, 18.III.2007.
Distribution: *Verticillium dahliae* occurs in the Mediterranean Region and California. The disease was first recorded in Italy in 1946, and later in California, Greece, Turkey, Spain, Syria, Morocco and Algeria (Levin *et al.* 2003).
Notes: This disease was first recorded on olive in the Maltese islands in April 2004 at Ghaxaq (Porta-Puglia & Mifsud, 2005). In 2005 a survey on the incidence of *Verticillium dahliae* was conducted by Pace Lupi, and

the fungus was isolated from 37 sites. Samples consisted mainly of olive tissue or soil in olive growing regions. Porta-Puglia & Mifsud (2006) recorded this pathogen as very frequent on olives. In the present survey *V. dahliae* was isolated from tissue samples taken from 10 different localities. Locally, damage to olive trees by this disease was observed to be most significant in young commercial plantations. *Verticilium dahliae* affects numerous plant species including olive, redbud, smoke tree, cherry and other stone fruits, barberry and other commodities. Due to the severity of this disease, the damage caused is significant as it greatly affects yield and sometimes is responsible for the loss of large numbers of olive trees. The uprooting and re-planting of trees in infected areas is not an option as the fungus can still occur in the soil for years (Mercado-Blanco *et al.* 2003).

BACTERIA

***Pseudomonas syringae* subsp. *savastanoi (ex* Smith) Janse**
[Bacteria: Gracilicutes]
English name: Olive knot.

Material examined: MALTA: Xemxija (Simar NR), 20.VI.2006, 19.X.2006; Birzebbuga (Has-Sabtan), 30.IX.2006; Buskett, 30.IX.2006; Bidnija, 20.X.2006; Gzira (tal-Qroqq), 14.XI.2006; Ta Qali, 21.XI.2006; Mellieha, 7.XII.2006; Cirkewwa, 7.XII.2006; Marsa (Ghammieri), 14.VII.2006, 20.III.2007. **GOZO:** Kercem (Lunzjata), 14.VI.2006, 8.IX.2006, 19.X.2006; Kercem (Public Garden), 18.VIII.2006, 21.IX.2006; Victoria (Villa Rundle), 18.VIII.2006; Xewkija, 8.IX.2006, 24.IX.2006, 15.XI.2006, 9.IV.2007; Mgarr, 5.VII.2006, 19.VII.2006, 1.VIII.2006, 5.VIII.2006, 4.IV.2007; Marsalforn (Ghajn Barrani), 30.VII.2006, 8.IX.2006; Munxar, 23.VIII.2006, 9.IX.2006, 24.IX.2006, 19.X.2006. **COMINO:** Southern Part, 27.X.2006, 28.IV.2007.
Distribution: Found in all olive growing regions of the Mediterranean basin and in Australia.
Notes: Borg (1922) described this disease as "tubercle" caused by *Bacillus oleae* and said it was common wherever the olive tree is cultivated, however he does not specify its occurrence in Malta. Wheeler (1957) recorded this species only from Girgenti and provided the following comment: "it causes woody galls or knots on the small twigs and distortion and nodulation of the leaves". In the present survey the bacterium was observed to be infecting most olive groves around the islands. This bacterial disease is characterized by hyperplasia formation on the stems and branches of olive plants and occasionally on the leaves and fruits. The disease can cause severe damage in olive groves, mainly when weather conditions favour the survival of epiphytic populations of the pathogen and their entry into the bark. Olive yield and quality can be reduced as a consequence of bacterial infections of the plant by the pathogen (Schroth *et al.* 1973).

CONCLUSIONS

During the present survey a total of twenty-two pests and diseases have been recorded on olives. These comprise sixteen insects, three eriophyid mites, two fungal pathogens and one bacterium. Most of the species recorded by Borg (1922) and Saliba (1963) were also recorded during this survey. However, Borg (1922) does not indicate clearly that the species mentioned in his work were necessarily records that he observed locally. The leopard moth, *Zeuzera pyrina* L., and the scale insect *Parlatoria oleae* Colvee were recorded by both Borg (1922) and Saliba (1963) as occurring on olives but were not found during this study. *Zeuzera pyrina* is not a significant pest of the olive, and has a wide host range. However it is listed by both authors as an olive pest in the Maltese islands. *Parlatoria oleae* appears as typical black blotches on infected drupes (Guario *et al.* 2001). This scale insect was also recorded by Borg [J.] (1932). Borg (1919) does not mention the occurrence of *P. oleae* but provides a morphological description of *P. follicularis* Targioni, and records it from Sliema and St. Julian's. Borg [J.] (1932) recorded this species from St. Julians, Sliema and San Anton. Among the synonyms he provided for this species he included *Phillipia oleae.* However, *Phillipia oleae* is not a synonym of *Philipia follicularis*, but for *Lichtensia viburni* Signoret which was found during the present survey. Taking the above into consideration, it is not sure whether previous records of *Lichtensia viburni* are consistent. It is possible that earlier records of *Philipia follicularis* could be attributed to *Philipia oleae* since none of the two studies on scale insects of Malta (Borg, 1919; Borg [J.], 1932) mentioned the similarity of the two species or any features for their discrimination.

The moth species, *Menophra japygiaria* is known to feed on olive leaves and its very characteristic pupae are found along branches of olive trees (Sammut, P., *pers. comm.* 2007). This moth was recorded from the Maltese islands (Rabat, Buskett, Fomm ir-Rih and L-Armier) by Sammut (1983; 1984; 2000). In the present survey this moth was never found on olives in any of the sites surveyed. Considering that the order Lepidoptera has been thoroughly studied, the few documented records of this species and its absence from the present study can be assumed that currently this is only

an occasional species on olive. However, authorities should be aware of its presence because it could be a potential pest of olives in future.

With respect to fungal pathogens, Porta-Puglia & Mifsud (2006) included eight species as occurring on olives. Apart from *Spilocaea oleaginea* and *Verticillium dahliae* which were found during the present study, the following were also recorded: *Caldariomyces fumago* Woron., *Cylindrocarpon* sp., *Fusarium oxysporum* Schltdl., *Macrophomina phaseolina*, *Nectria haematococca*, and *Thanatephorus cucumeris* (A. B. Frank) Donk.

During this study, *Othiorrhynchus moriger* was for the first time documented as a pest on olives. *O. moriger* is a species of weevil endemic to the Maltese Islands (Magnano, 1992; Mifsud, 2000) and the damage it causes on olive trees is identical to that caused by *O. cribricollis* Gyllenhal. In fact, previous authors such as Cameron & Caruana Gatto (1907), Borg (1922) and Saliba (1963) recorded *O. cribricollis* and never mentioned *O. moriger*. *O. cribricollis* is a serious pest of olives in most olive growing regions of the world and can be controlled by placing a band of synthetic acrylic fibres around the base of the olive trunk. The weevils that attempt to get to the leaves are usually trapped in these fibres. This practice is also used in Malta to control *O. moriger*.

Table 1 lists all species recorded in this survey and summarises some of the relevant information on each species.

Table 1: Species recorded in this survey and summarises some of the relevant information on each species.

Pest species	**Specificity to Olives**	**Previous records of the species locally**	**Occurrence on olives in Malta**
Liothrips oleae	Specific	New Record	Common
Euphyllura olivina	Specific	Borg (1922), Saliba (1963), Mifsud (1997)	Common
Aleurolobus olivinus	Normally Specific	Mifsud & Porta-Puglia (2006)	Frequent
Pollinia pollini	Specific	New Record	Common
Lichtensia viburni	Polyphagous	Borg [J.] (1932), Borg (1919)	Frequent
Saissetia oleae	Polyphagous	Borg (1919; 1922) Borg [J.] (1932), Saliba (1963)	Common
Aspidiotus nerii	Polyphagous	Borg (1919; 1922) Borg [J.] (1932), Saliba (1963)	Common
Hemiberlasia rapax	Polyphagous	Borg (1919)	Rare
Leucaspis riccae	Normally Specific	Borg [J.] (1932), Saliba (1963)	Rare
Prays oleae	Normally Specific	Borg (1922), Borg [P.] (1932), Saliba (1963), DeLucca (1965), Valletta (1973), Sammut (2000)	Scarce
Lobesia botrana	Polyphagous	Borg (1922), DeLucca (1950), Amsel (1951), Saliba (1963), Valletta (1973), Vella (1991), Sammut (2000)	Rare
Palpita unionalis	Polyphagous	Caruana Gatto (1905), Andres (1916), Borg (1922), DeLucca (1950), Darlow (1949), Valletta (1950; 1973), Sammut (2000)	Common
Resseliella oleisuga	Normally Specific	Skuhrava *et al.* (2002)	Common
Bactrocera oleae	Specific	Borg (1922), Aguis (1926), Briffa (1933), Saliba (1963)	Very Common
Phleotribus scarabaeoides scarabaeoides	Polyphagous	Caruana-Gatto (1907), Borg (1922), Saliba (1963)	Common
Otiorynchus moriger	Polyphagous	Magnano (1992)	Very common
Oxycenus maxwelli	Specific	New Record	Scarce
Ditrymacus athiasellus	Specific	New Record	Frequent
Tegolophus hassani		New Record	Common
Spilocaea oleaginea	Specific	Wheeler (1957), Porta-Puglia & Mifsud (2006)	Common
Verticillium dahliae	Polyphagous	Porta-Puglia & Mifsud (2005; 2006), Pace Lupi (2005)	Very common
Pseudomonas syringae subsp. *savastanoi*	Specific	Borg (1922), Wheeler (1957)	Common

Many pest species that infect the olive tree in other countries were not recorded during the present study. Of these, some are of economic importance and are found in countries geographically close to Malta. Guario *et al.* (2001) lists thirteen important olive insect pests as occurring in Italy. Of these, two species, *Hylesinus oleiperda* Fabricius [Coleoptera: Scolytidae] and *Coenorrhinus cribripennis* Desbrochers [Coleoptera: Curculionoidea], have not been recorded locally, *Hylesinus oleiperda* superficially resembles *Phleotribus scarabeoides scarabeoides* in the damage caused to the olive tree. It occurs in all olive growing regions of the Mediterranean, England and Russia (Pollini, 1998). *Coenorrhinus cribripennis* causes significant damage to olive fruit whatever the growth stage. This beetle bores through young drupes, eroding the stone when still soft. When the stone hardens, most injury is caused to the pulp, making the fruit unmarketable. One of us (DM) has observed olive fruit at Wied Has-Sabtan which had most likely been attacked by this pest. Thus, it is probable that this species is locally present. Apart from Italy, this insect was also recorded from Russia, Turkey, Greece and Asia Minor (Pollini, 1998).

Two gall midges [Diptera: Cecidomydae], *Prolasioptera berlesiana* Paoli and *Dasineura oleae* (Loew) affect the olive and are distributed all over the Italian peninsula. The first species is associated with the olive fly as it tends to oviposit its eggs at the opening of galleries of the olive fly larva in the fruit. During oviposition the midge transmits a fungal disease that results in the formation of a large dark and shrivelled patch on the olive fruits. *D. oleae* larva mine through leaves and also damage buds. More serious damage is caused by larvae feeding inside flower buds causing galling and their desiccation (Pollini, 1998).

The olive aphid, *Prochiphilus oleae* (Leach ex Risso) [Hemiptera: Aphididae] is mainly associated with *Oleae europea* L. but was also recorded from *Phillyrea media* (Blackman & Eastop, 2000). It is often observed as compact colonies covered in white waxy wool, on shoots near the base of the trunk in spring. It has been recorded in several sub tropical countries but it has not yet been observed in Malta.

Nine species of Eriophid mites are known to be associated with olives, some of which are specific to this host (Nuzzaci & Parenzan, 1983). Of these nine species, five are known to occur in Italy. *Aceria oleae* (Nalepa) and *Aculus olearius* Castagnoli have been recorded in Italy and other Mediterranean countries but have not been found locally. The other three species recorded in Italy were also found locally.

Olive pest species do not cause equal levels of damage wherever olive trees are cultivated. This may be due to differences in climate, topography, different agricultural practices used and others. It is therefore useful to categorise the pest species according to the damage caused for a particular locality. The main olive pests and diseases are classified into four categories depending on their economic significance by the IOOC (International Olive Oil council). From the results of the present survey, this international categorisation of the main olive insect pests is not entirely applicable to olive pests as found in Malta. Taking into consideration the results from this present work and some of the previous studies, this classification can be amended to fit the local scenario. Table 2 shows the species recorded in this work categorised under the same criteria of the IOOC with respect to the situation in the Maltese islands.

Table 2: Species recorded in this work categorised under the same criteria of the IOOC with respect to the situation in the Maltese islands.

Category 1: Major pests, which cause damage of major economic importance, and require annual management.	*Bactrocera olea*, *Verticillium dahliae*.
Category 2: Major secondary pests, cause damage of major economic importance locally or occasionally.	*Palpita unionalis*, *Resseliella oleisuga*, *Saissettia oleae*.
Category 3: Pests of limited importance which cause damage of limited economic importance locally and/or occasionally.	*Aspidiotus nerii*, *Liothrips oleae*, *Phleotribus scarabeoides*, *Lichtensia viburni*, *Prays oleae*, *Othiorrynchus moriger*, *Euphyllura olivina*, *Spilocaea oleaginea*, *Pseudomonas syringae* subsp. *savastanoi*.
Category 4: Pests of no economic importance, which under very rare circumstances cause damage.	*Leucaspis riccae*, *Lobesia botrana*, *Menophra japygiaria*, *Aleurolobus olivinus*, *Zeuzera pyrina*, *Pollinia pollinii*.

Eriophyid mites were not included in the above categories since the damage done largely depends on the population densities that differ during different times of the year and due to the fact that different species often infect the same host. As indicated in Table 2. *B. oleae* and *V. dahliae* are the two most serious threats in olive cultivation. *V. dahliae* is surely far more serious because the disease will lead to the death of the tree and currently there is no proper remedy or means of control against this pathogenic fungus. Further more this disease is widely distributed throughout the Maltese archipelago since intensive cultivation with abundant fertilisation and watering encourages the diffusion of this pathogen (Pace-Lupi, 2005).

The present work is probably the most comprehensive study on olive pests ever carried out in the Maltese Islands. However, despite this there is still further need of research studies on other olive pests such as plant parasitic nematodes. Information on the relationship between pest and cultivar would be useful for all those undertaking olive cultivation. Further research on key parasites (natural enemies) would provide a means of effective pest management leading to a reduction in chemical control.

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