
INSECT PESTS ON CAULIFLOWER (*BRASSICA OLERACEA* VAR. *BOTRYTIS*) IN GOZO (MALTESE ISLANDS, CENTRAL MEDITERRANEAN).

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ABSTRACT

A total of twenty-two insect species were found feeding on different parts of cauliflower plants (*Brassica oleracea* var. *botrytis*) at some stage of their life cycle. The species are distributed in five insect orders as follows: **Coleoptera** (7), **Lepidoptera** (6), **Homoptera** (6), **Diptera** (2) and **Thysanoptera** (1). After reviewing earlier literature on cauliflower pests in the Maltese Islands, the present work gives a species list, with global distribution and additional notes where appropriate. Six species are recorded for the first time from the Maltese Islands.

INTRODUCTION

Faunistic studies on insects associated with brassica crops have been carried out in several countries, (Bodnaryk, 1991; Brandt & Lamb, 1993; Kirk, 1992; Winfield, 1992). Published work on insects associated with brassica crops grown in the Maltese Islands is rather limited and requires updating. This has encouraged the present author to carry out this work as part of his B.Sc. dissertation (Farrugia, 1995).

During the period September to March 1995, continuous sampling was carried out to determine the insect pests associated with cauliflower plants in a field in Gozo. Essentially, the key pests found on cauliflower are common to all closely related brassica crops; cauliflower was chosen for the study because it is a main crop and has the longest maturation time, thus being most susceptible to insect damage.

Borg (1927) mentions the pests of brassica crops as including *Haltica oleracea* (= *Phyllotreta cruciferae*), *Aleurodes brassicae* (= *Aleyrodes proletella*), *Delia Brassicae* and *Pieris brassicae*.

Saliba (1963) listed the following economically important pests of brassicas:

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Coleoptera: Curculionidae: *Baris coerulescens* Scopoli, *Ceuthorrhynchus quadridens* Panzer, *Otiorrhynchus cribricollis* L.; Chrysomelidae: *Phyllotreta nemorum* L.; Hydrophilidae: *Megempleurus rugosus* Olivier.

Homoptera: Aphididae: *Brevicoryne brassicae* L.

Diptera: Cecidomyiidae: *Contarina nasturtii* Kieffer; Muscidae: *Hylemia brassicae* Bouche.

Lepidoptera: Tortricidae: *Laspeyresia leplastriana* Curtis; Noctuidae: *Mamestra brassicae* L., *Mamestra trifolii* Rott., *Phytometra gamma* L.; Pieridae: *Pieris brassicae* L., *Pieris napi* L., *Pieris rapae* L.; Plutellidae: *Plutella maculipennis* Curtis.

Recently the whiteflies *Bemisia tabaci* (Gennadius) and *Aleyrodes proletella* L. were confirmed as serious pests of brassica crops (Mifsud, 1995).

MATERIALS AND METHOD

In order to obtain representative samples of all possible pest species, the area of study was selected on the basis that no pesticides had been recently applied. The area chosen was a field, measuring fifteen by thirty metres, located at Il-Wilga, Ghasri, Gozo. It forms part of a large tract of arable land and is cultivated all the year round; there are no buildings in the immediate vicinity. In mid-August 1994, cauliflower seedlings which had been grown in a typical nursery were planted at 60cm spacing in rows 90cm apart. The crop was watered by drip irrigation and cultivated with the normal processes of weeding and tilling until maturation. All insects examined in this study were collected and reared by the author from this field. Insects were searched for on both upper and lower surfaces of cauliflower leaves, on the roots and stalks, and inside the main stem and leaf petioles. Larval instars of the insects collected were reared to the adult stages prior to identification.

Identification of aphids, thrips and whiteflies was carried out by the author using several keys (Blackman & Eastop, 1984); (Stroyan, 1984); (Kirk, 1992); (Palmer *et al.*, 1992); (Mifsud, 1995). Identifications of Coleoptera, Diptera and Lepidoptera were carried out by Dr. Michael Cox, Dr. Martin J. Ebejer and Mr. Paul Sammut respectively.

In the Species List which follows, principle synonyms are cited in square brackets below the species name.

SPECIES LIST

ORDER COLEOPTERA

CHRYSOMELIDAE

Phyllotreta cruciferae (Goeze, 1777)
[*Chrysomela cruciferae* Goeze, 1777]

Material examined: 10 exs., 14/VII/94; 5f, 5m, 15/IX/94; 6 exs., 24/XII/94; 3f, 3m, 23/II/95.

Distribution: Throughout Europe, Cyprus, North Africa to Egypt, Sudan, Ethiopia, Caucasus, Asia Minor and Central and North America including Canada. Its presence in other Mediterranean Islands is doubtful (Douget 1994).

Notes: *P. cruciferae* is especially injurious to plants in the seedbed. Its feeding damage is characteristic of many Chrysomelidae, and results in numerous small pits in the leaf tissue. During severe infestations the growth rate of the plants is significantly reduced (Bodnaryk, 1991). The larvae feed on the roots of the host plant.

Phyllotreta consobrina (Curtis)
[*Haltica consobrina* Curtis, 1837]

Material examined: : 3 exs., 23/IX/94; 1 exs., 1/II/95.

Distribution: Throughout Western Europe, North Africa, and U.K. (Douget, 1994).

Notes: This species is not as common as *P. cruciferae* and only single individuals were occasionally found.

Phyllotreta variipennis Boield

New record.

Material examined: : 20 exs., 15/X/94.

Notes: This species has probably been previously misidentified as *Phyllotreta nemorum* L., which is mentioned by both Borg (1927) and Saliba (1963). The two species are very similar in having a longitudinal yellow band on each elytron. The most apparent distinction is the size difference between the two species, *P. variipennis* being 2.3 - 3.0mm long and *P. nemorum* 1.8 - 2.0mm (Kirk, 1992).

Psylliodes chrysocephala L.

Material examined: : 1 ex., 15/XI/94; 1 ex., 2/II/95.

Distribution: Throughout Europe and Scandinavia, Russia, Siberia, Caucasus, Crete, Cyprus, Sicily and Madeira (Douget, 1994).

Notes: The larvae of *P. chrysocephala* feed inside the petioles of cauliflower leaves and inside the main stems of younger plants, where they tunnel through the tissues, leading to a reduction in yield (Ebbe-Nyman, 1952). They can be distinguished from the larvae of *Ceutorhynchus pallidactylus* (see below) by the possession of three pairs of thoracic legs. Adults of this species are rare and were never collected from the field.

CURCULIONIDAE

Ceutorhynchus pallidactylus (Marsham, 1802)

[*Ceuthorrhynchus quadridens* (Panzer, 1795)]

Material examined: : 1 ex., 12/XI/94; 1 ex., 6/I/95; 1 ex., 2/IV/95.

Distribution: Throughout Europe, Algeria, Morocco and Canada (Hoffmann, 1954).

Notes: The larvae of *C. pallidactylus* cause damage by mining the leaf stalks and the main stems of young cauliflower plants. They are more easily encountered than the adults which only appear for a short period during the breeding season and are often overlooked. Although the species may not seem to cause appreciable damage in larger plants, it was observed that infested young plants often lose their terminal bud while still in the seedbed.

Rhytideres plicatus (Olivier, 1790)

[*Rhytidoderes plicatus* Olivier, 1790]

Material examined: : 1f, 1m, 30/IX/94; 1f, 12/X/94; 3f, 2m, 5/XII/94; 1m, 8/I/95.

Distribution: Throughout Europe and North Africa, Asia Minor, Madeira and Canary Islands.

Notes: Up to 35 larvae have been observed in the roots of a single plant. Wilting and consequent death of infested plants occurs prior to maturation resulting in considerable losses. Thus *R. plicatus* may be regarded as a serious pest. However, populations do not often reach high levels because the soil is normally rotavated immediately after crop maturation. This kills the larvae due to food deprivation and exposure to predators at the soil surface.

Baris coerulescens Scopoli, 1763

[*Baris virens* Olivier, 1790]

Material examined: : 1 ex., 23/II/95; 1 ex., 30/II/95 (found dead).

Distribution: Throughout Europe, North Africa, Syria (Hoffmann, 1954).

Notes: This species was only obtained on two occasions from the foliage of cauliflower and is probably of no economic importance on this crop locally. *B. coerulescens* is reported as a pest in France (Balachowsky & Mesnil, 1936), the larvae developing in the root crown or the tap root (Koubaiti & Lerin, 1992). Two other *Baris* species have been reported from the Maltese Islands (Cameron & Caruana-Gatto, 1907).

ORDER LEPIDOPTERA

PIERIDAE

Pieris brassicae L., 1758

Material examined: : 2f, 23/XII/94; 1f, 2m, 26/II/95; 1f, 5/III/95.

Distribution: From North Africa across Europe and Asia to the Himalayas (Higgins, 1975).

Notes: The larvae of *P. brassicae* are important pests, causing damage by devouring large amounts of foliage, hence reducing productivity. During severe attacks, the whole plant is defoliated, leaving only the stalk and leaf petioles.

Pieris rapae L., 1758

[*Artogeia rapae* (L., 1758)]

Material examined: : 1f, 14/VII/94; 2ff, 29/X/94.

Distribution: Originated in Canada but is now cosmopolitan, (P. Sammut, *pers. comm.*).

Notes: This species is one of the most ravaging pests, both in Malta and worldwide. Although the eggs and larvae of *P. brassicae* are encountered more often, giving the impression that it is more abundant, *P. rapae* is in fact more common (P. Sammut, *pers. comm.*). This is because *P. rapae* lays its eggs singly, while *P. brassicae* lays large clutches of yellow eggs. Also, its green larvae are less conspicuous than those of *P. brassicae* which are more brightly coloured.

NOCTUIDAE

Autographa gamma (L. 1758)

[*Plusia gamma* L., 1758]

Material examined: : 2 f, 21/XII/94; 1 f, 10/XII/94; 2 m, 1 f, 2/II/95; 1 f, 15/III/95; 1 m, 29/II/95.

Distribution: Common throughout the whole Palaearctic region, except the far East.

Notes: This species is rather polyphagous and attacks many different field crops. As it is a migratory species, its population may fluctuate greatly from year to year, and hence also the damage it causes (P. Sammut, *pers. comm.*).

Noctua pronuba L., 1758

[*Triphaena pronuba* (L., 1758); *Agrotis pronuba* (L., 1758)]

Material examined: : 1 ex., 5/IV/95, 1 m, 10/V/95.

Distribution: Whole Palaearctic region, except far North.

Notes: This species is very widely distributed, and is one of the commonest moths in the Maltese Islands. It feeds on most vegetable crops (P. Sammut, *pers. comm.*) and is regarded as a pest in many countries.

TORTRICIDAE

?*Selania leplastriana* (Curtis, 1831)

[*Cydia leplastriana* (Curtis, 1831)]

Material examined: : 5 exs., (larvae), 26/X/94; 2 exs., (larvae), 12/X/94.

Distribution: Germany, England, France, Hungary, Italy, North Africa, Malta (Nye, 1975).

Notes: The identification is not definite as adults could not be reared from the larval stages and no mature moths were captured. The larva starts to feed at the terminal bud of the host plant and immediately mines into the tender main stem (Borg, 1932). Consequently the plants lose their apical growth and will not form a curd. The presence of the larvae is indicated by their habit of exuding brown frass through the point of entry, but they frequently cause considerable damage because their presence is not immediately detected.

PLUTELLIDAE

Plutella xylostella (L. 1758)

[*Plutella maculipennis* (Curtis, 1832)]

Material examined: : 2 ex., 12/XI/94; 1 ex., 23/XI/94; 2 exs., 4/I/95; 1 ex., 16/I/95; 1 ex., 20/I/95; 1 ex., 15/III/95.

Distribution: Of European origin but now cosmopolitan (A. Aziz, *pers. comm.*).

Notes: The larva of this moth is rather injurious (Saliba, 1963). Its presence is betrayed by the characteristic feeding patches on the leaf, only the upper epidermis being left untouched. In dry weather, even the remaining upper epidermis breaks, leaving an irregular hole in the leaf (Abro *et al.*, 1992).

ORDER HOMOPTERA

ALEYRODIDAE

Bemisia tabaci (Gennadius, 1889)

[*Bemisia gossypiperda* Misra & Lamba, 1929]

Material examined: : 4 exs., 22/I/94; 12 exs., 14/IX/94; 10 exs., 23/X/94; 10 exs., 6/XI/94; 6 exs., 30/XI/94; 6 exs., 12/XII/94.

Distribution: Pan-tropical.

Notes: *B. tabaci* is a very common pest of brassica crops especially during the period when plants are transplanted from the nursery. During heavy infestations, the larvae cover the lower surface of older leaves almost completely.

Aleyrodes proletella (L., 1758)

[*Aleyrodes youngi* Hempel, 1901]

Material Examined: : 12 exs., 10/I/94; 7 exs., 17/II/94.

Distribution: Palaearctic region: U.K., Sweden, France, Spain, Czechoslovakia, Germany, Switzerland, Austria, Italy, Yugoslavia, Poland, Hungary, Finland, USSR, Canary Islands, Egypt, Morocco; Ethiopian Region: Kenya, Angola, Mozambique; Neotropical region: Brazil; Pacific region: New Zealand (Mound & Halsey, 1978).

Notes: During the present study this whitefly was very abundant in December, January and February when the population of *Bemisia tabaci* was relatively low. Its population fell sharply with increasing ambient temperature.

APHIDIDAE

Smynthuodes betae Westwood, 1849

[*Triphidaphis phaseoli* Passerini]

New record.

Material examined: : 3 exs., 6/I/95.

Distribution: Widely distributed in Europe from Southern Scandinavia to the Mediterranean; Egypt.

Notes: This species was found on the roots. It is polyphagous, feeding mainly on the cotyledons. In Italy *S. betae* has been recorded from roots of potato and bean crops (Barbagallo & Stroyan, 1982). Only three specimens were recovered and the species probably does not affect the crop owing the small population size. The primary hosts are *Pistacia atlantica* and *P. mutica*, where it lives in galls it induces in the leaves.

Lipaphis erysimi Kaltenbach, 1843

New record.

Material examined: : 2 exs., 19/XI/94; 3 exs., 9/X/94; 1 ex., 10/X/94.

Distribution: Cosmopolitan (Blackman & Eastop, 1984).

Notes: *L. erysimi* is a vector of about ten persistent plant viruses, including Black Ring Spot and Mosaic Diseases of cauliflower. The European form of *L. erysimi* is not normally a pest of *Brassica* crops (Blackman & Eastop, 1984) and during this study it was only noted in small colonies on cauliflower.

Brevicoryne brassicae (L. 1758)

Material examined: : 6 exs., 12/X/94; 2 exs., 2/X/94; 3 exs., 26/XII/94.

Distribution: Cosmopolitan.

Notes: The species is a pest of cruciferous plants and is not ant-attended. In Malta it is found all the year round but during the winter its population dwindles drastically. This pest is often found in hundreds on a single leaf. Infested leaves show marked deformation.

Myzus persicae (Sulzer, 1776)

Material examined: : 3 exs., 30/X/94; 1ex., 19/XI/94.

Distribution: Probably of Asian origin, now cosmopolitan.

Notes: The primary host plant of *Myzus persicae* is the peach, *Prunus persicae*, but it can also live on plants in forty other families. It is an important vector of more than a hundred plant viruses (Blackman & Eastop, 1984). On cauliflower it forms numerous small colonies.

CERCOPIDAE

?*Philaneus* sp.

New record.

Material examined: : 1 ex., 23/X/94; 2 m, 2 f, 10/XI/94.

Notes: The specimens collected are still awaiting definite identification. The species was found living underground where it sucks sap from the roots. It was observed that ants are always in attendance, often constructing their nest around the root system. In one instance, it was observed that a mature adult emerged to the soil surface and followed an ant trail to the roots of an adjacent plant. This insect is probably of no economic importance unless it is capable of transmitting viral diseases. During this study it was found on individual plants, numbering up to sixty on each plant at the time of hatching of the nymphs.

ORDER DIPTERA

AGROMYZIDAE

Liriomyza bryoniae (Kaltenbach, 1858)
[*Liriomyza solani* (Hering)]

New record.

Material examined: : 1 ex., 12/X/94.

Notes: The larva of this species mines between the epidermal layers of the leaf. It normally infests tomato, *Lycopersicon esculentum*, and was only found once on cauliflower.

Phytomyza horticola Goureau, 1851

New record.

Material examined: : 1 ex., 28/XII/94; 1 ex., 25/I/95; 1 ex., 15/III/95.

Distribution: Whole Palaearctic region.

Notes: This is a very polyphagous species (Spencer, 1972). Up to eight larvae were observed mining a single leaf.

ORDER THYSANOPTERA

THRIPIDAE

Thrips tabaci Lindemann

Material examined: : 6 f, 30/X/94; 4 f, 2/I/95.

Distribution: Neotropic, Nearctic and West Palaearctic regions (Metcalf & Flint, 1962).

Notes: The species is only abundant in warm weather; males are wingless and very rare. Damage is confined to the lower surface of larger leaves which offer more shelter. *T. tabaci* is more damaging to cabbage cultivars, where feeding injury results in a rough, bronzed edema on the leaves inside the head (Hoy & Kretchmann, 1991).

DISCUSSION

The insects associated with brassica crops have a complicated network of interactions. Root (1972) divided insects feeding on collards into strip-feeders that chew plant material (e.g. butterfly caterpillars), 'pit-feeders' that rasp small pit-holes in the leaves (e.g. adult chrysomelids), and 'sap-feeders' that suck the plant's sap (e.g. aphids). Apart from the feeding strategies mentioned by Root, "miners", which feed by boring into plant tissue also occur (e.g. agromyzid larvae).

The relationship between feeding methods, plant parts attacked and stage of life-cycle for the species encountered in the present study is summarised in Table 1.

Brassica pests not encountered during the present study. The moth *Mamestra brassicae* was recorded only once in Malta, as an errant visitor (Borg, 1932). The much commoner *Mniotype deluccai* (Berio, 1976), an endemic species, is very similar and it is highly probable that it was confused with the latter species by Saliba in his work of 1963 (Sammut, *pers. comm.*).

Saliba (1963) mentions two other moths as pests of brassica crops: *Mamestra trifolii* [= *Discestra trifolii* (Hufnagel 1766)] and *Agrotis segetum* (Dennis & Schifferuller, 1775). *D. trifolii*, is rather rare and is not regarded as a pest (Sammut, *pers. comm.*). *A. segetum* is very widespread, the larvae being mainly subterranean where they possibly feed on roots of crop plants. It is known that populations of *A. segetum* fluctuate considerably from year to year (Nye, 1975) and may sometimes reach pest proportions, particularly on crops of *Brassica rupestris*, which this species prefers.

TABLE 1. Feeding relationships of phytophagous insects found on cauliflower. (A, adult; L, larva)

SPECIES	LEAVES	ROOTS	STEM
<i>Phyllotreta cruciferae</i>	Pit-feeders (A)	Strip-feeders (L)	
<i>P. consobrina</i>	Pit-feeders (A)	Strip-feeders (L)	
<i>P. variipennis</i>	Pit-feeders (A)	Strip-feeders (L)	
<i>Psylliodes chrysocephala</i>	Miners (petiole) (L)		
<i>Ceutorhynchus pallidactylus</i>	Pit-feeders (A) Miners (petiole) (L)		Miners (L)
<i>Baris coerulescens</i>	Strip-feeders (A)	Miners (L)	
<i>Rhytideres plicatus</i>	Strip-feeders (A)	Strip-feeders (L)	
<i>Pieris brassicae</i>	Strip-feeders (L)		
<i>P. rapae</i>	Strip-feeders (L)		
<i>Autographa gamma</i>	Strip-feeders (L)		
<i>Noctua pronuba</i>	Strip-feeders (L)		
<i>Plutella xylostella</i>	Strip-feeders (L)		
<i>Selania leplastriana</i>			Miners (L)
<i>Liriomyza bryoniae</i>	Miners (lamina) (L)		
<i>Phytomyza horticola</i>	Miners (lamina) (L)		
<i>Myzus persicae</i>	Sap-feeders (A,L)		
<i>Brevicoryne brassicae</i>	Sap-feeders (A,L)		
<i>Lipaphis erysimi</i>	Sap-feeders (A,L)		
<i>Smynthuroides betaea</i>		Sap-feeders (A,L)	
<i>Bemisia tabaci</i>	Sap-feeders (A,L)		
<i>Aleyrodes proletella</i>	Sap-feeders (A,L)		
<i>Thrips tabaci</i>	Sap-feeders (A,L)		

Borg (1932) recorded *Laspeyresia leplastriana* (= *Selania leplastriana* Curtis) as an important tortricid moth pest occurring on brassicas. The adult of this pest was not found during the present study and so no material was available to confirm identifications of larvae obtained from the damaged stems of cauliflower. Attempts to rear adult moths from the larvae were not successful: instead, the ichneumonid *Venturia canescens*, a well-known parasite of tortricid moths was reared from the larvae.

Important dipterous pests, namely rootflies of the genus *Delia*, were not encountered in the present study although they are known to occur locally (Schembri *et al.*, 1991). At least four rootfly species of have been recorded from the Maltese Islands including: *Delia antiqua* Meig; *Hylemia brassicae* Bouche (Saliba, 1963); *Delia cepetorum* Meade (Cilia, 1973) and *Delia platura* Meigen (Schembri *et al.*, 1991). However, it is known that populations of *Delia* occur

sporadically with much annual variation. This also applies to *Phytomyza rufipes* which, according to Spencer (1972) is a cosmopolitan leafminer of brassica crops (Ebejer, *pers. comm.*).

Both Borg (1927) and Saliba (1963) recorded *Phyllotreta nemorum* as occurring locally. However, as already mentioned, this is probably due to misidentification of *P. variipennis* which is morphologically very similar.

A number of other serious brassica pests have never been recorded from the Maltese Islands and it is important, from the agricultural point of view, to prevent their introduction. These species include the curculionids *Ceutorhynchus pleurostigma* Marsham and *Ceutorhynchus assimilis* Paykull and the chrysomelid *Entomoscelis americana* Brown, (Gerber, 1994).

ACKNOWLEDGEMENTS

I am extremely grateful to Dr. Martin J. Ebejer, Mr. Paul Sammt and Dr. Michael Cox for their help in identification and their useful comments. I would also like to thank Mr. David Mifsud who has contributed advice and useful information throughout the study. Special thanks to Mr Edwin Lanfranco for his support prior to and during this work.

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(Received 18th April 1997; accepted 30th May 1997)