DEPARTMENT OF AGRICULTURE

MALTA

INSECT PESTS OF CROP PLANTS IN THE MALTESE ISLANDS

by

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INTRODUCTION.

This work, which was started in 1959, was originally intended to 'provide the Entomological counterpart to Dr. B. E. J. Wheeler's "Plant Disease Survey of Malta" published in 1958, the aims of which were to record the Plant Diseases occurring in the Maltese Islands and to indicate which of these were of sufficient economic importance to require control. However, while very little work on the local mycological flora had been done prior to 1957, the picture is very different from the entomological angle. Comprehensive lists on the Insect Fauna of Malta have been compiled at various intervals between 1858 and the present day, mainly from the taxonomic viewpoint, and instead of a plain survey from scratch, the systematic part of this work has been that of sifting the economic species recorded from those of purely or principally academic value, and checking their incidence in the field. During this check ,which is a survey in its own right, several species not known to be recorded in previous literature have been identified.

Again, since at the time of writing, the exhaustive experimental work performed between 1958 and 1963 has resulted in the bulk of economic insects being satisfactorily controlled, the general (as distinct from the systematic) sections present more of a *fait accompli* than an indication of what could possibly be done. The present scope can therefore be defined as the recording of the main Insect and other pests occuring on crop plants in the Maltese Islands, and a brief outline both on general control problems and the remedial measures available to date.

Ornamental plants have been left for a later publication, work on which is already in progress. The lists of Insects given in this edition do not in any way presume to contain every species which to some degree or other depends on crops plants during some stage of its life-cycle, but does nevertheless afford sufficient indication as to the principal problems local Agriculture has to contend with in the field of Pest Control and the manner in which the relevant remedial measures are being carried out.

A considerable number of pests recorded are of minor economic significance, taken as individual entities, and in many cases, no regular preventive control measures are carried out, treatment being confined to those occasions when the population density in any given site reaches a critical value.

In checking earlier records, and in identifying new species, the Insect Collection in the Plant Pathology Section of the department of Agriculture, and the collection made by Mr. J. W. Bryden between 1957 and 1959, provided useful starting points. The author is also indebted both to the many persons who offered valuable help and advice, notably Mr. J. W. Bryden, Mr. L. J. S. Littlejohn, Dr. C. De Lucca, and Mr. A. Valletta; and to the Field Staff of the Plant Protection Section for their enthusiastic work in collecting specimens and without whose help this work would not have been possible.

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HISTORICAL BACKGROUND

What appears to be the earliest recorded work on local Entomology is Professor Gavino Gulia's "Corso elementare di Entomologia Maltese", delivered as a series of lectures to gardeners and amateur horticulturalists at San Anton in 1857 and published in 1858. Several species, both economic and otherwise, are included, and although heavily criticised by later authors, mainly on account of the so-called haphazard method of species-determination, the work does nevertheless afford a tolerably accurate account of the indigenous Insect Fauna. In the book itself, reference is made to still earlier works. A Dr. Leach is described as having amassed a comprehensive collection which was presented to the Zoological Society of London in 1833, while the French Zoologist, Count Dejean, is mentioned as having carried out an Insect Survey of the Maltese Islands in collaboration with unnamed colleagues, but appears to have left no record of his findings.

An interesting item of Gulia's book is his description of what is probably the only recorded locust invasion of Malta. Gulia gives the date as 1850 (the year of the great cholera epidemic) and describes the occurrence as commencing with the appearance of a swarm approaching from the South-East. Apperently the leaders just about made land, because the South-eastern part of the Island (the Marsascala and Zabbar areas) are said to have suffered damage, and the sea around is described as becoming full of locust corpses. Gulia's evidence must be taken as authoritative because it happenned in his day, and the story is confirmed by several farmers questioned by the author. About twenty farmers in the Zabbar-Marsascala area were asked, and all of them remember the story as having been handed down to them by their fathers. The votive procession of St. Gregory, which takes place annually, is said to have its origin in that incidence, as a thanksgiving for liberation from the swarm. (This also was confirmed by farmers). However, although the banner carried in the procession of St. Gregory has a locust depicted on it, there appears to be a good deal of controversy about the whole matter, some authors, notably Stefano Zerafa, ascribing the procession's origin to other incidents. From the Biological standpoint, it is quite feasible that, given favourable conditions, a sworm of locusts from Africa could just reach the Island, in which case, the Zabbar-Marsascala area would certainly bear the brunt of the invasion. Both *Schistocerca gregaria* (the desert locust) and *Locusta migratoria* (the migratory locust) have been recorded in Malta, the former by A. Valletta (1954) and the latter by J. Borg (1922). Both exist only in the solitary phase, and are mainly of uncommon occurrence. The absence of any available records prior to 1850 precludes any determination of whether one of the two species present to-day is a survivor of the alleged 1850 invasion, having failed to re-attain the gregarious phase owing to insufficient population density and adverse climatic condition,s and the whole matter must remain an affair for conjecture, at least for the time being!

In 1891, Dr. A. Caruana Gatto published a list of 17 species of Rhopalocera, followed by a booklet entitled "Common Beetles of the Maltese Islands" (containing about a hundred species) in 1894. The previous year (1893) saw the publication of what is probably the fist advisory booklet on Economic Entomology. Issued by the Economic-agrarian society, over the signature of N. Tagliaferro, it is entitled "Id-Dubbiena tal-Laring" (The Orange Fly), and it is devoted to a description of the ravages of the Mediterranean Fruit Fly. *Ceratitis capitata*, and recommendations for its control. In 1905, Dr. Caruana Gatto published a list of 105 species of Heterocera, while the January issue of the "Entomologist" of the same year carried T. Bainbrigge Fletcher's "Preliminary list of the Lepidoptera of Malta", in which 91 species are described.

One of the most exhaustive lists is that of M. Cameron and A. Caruana Gatto. Entitled "A List of the Coleoptera of the Maltese Islands", and published in the Transactions of the Royal Entomological Society of London in 1907, it contains upwards of 700 species, most of which are said to be indigenous.

In all the literature mentioned so far, mention is made of several amateur collectors whose work is either unavailable or was never published. Among these are the Jesuit Libassi, amd Messrs. J.J. Walker, Pool, Mamo, Schembri, and P. De La Garde. On their own account, Cameron, Caruana Gatto and Fletcher have drawn upon these contributions to varying extents when preparing and publishing their own lists. Since publications of that time never contained reference lists or bibliographies, several "primary" references are impossible to trace.

1922 saw the publication of the best-known local work on Plant Pests ans Diseases — Prof. J. Borg's "Cultivation and diseases of fruits trees." Although a good textbook on the subject, the work is disappointing to the entomologist seeking authoritative records on the indigenous economic insect fauna. Apart from the fact that the work is limited to fruit trees, the wording is so vague at times that one is left in considerable doubt as to whether a particular species mentioned has been recorded locally, or is only present overseas.

The next two lists, both published in 1932, are J. Borg's "Scale Insects of the Maltese Islands", and P. Borg's "Lepidoptera of the Maltese Islands", the latter consisting essentially of a resume of the order's local representatives, additional recordings bringing the total number of species to 187. The former work lists 59 species of scales, and provides the first major deviation from the Lepidoptera-Coleoptera complex so characteristic of earlier works.

The post-war period has produced numerous additions, again principally relating to Coleoptera and Lepidoptera, the only exceptions being a few lists of Orthoptera. Published in various journals (principally the "Entomologist") by Dr. C. De Lucca and Messrs. A. Valletta, G. G. Lanfranco, and others, the papers contain various additions to previous lists, and, like the bulk of earlier contributions, are concerned with the systematic, rather than the economic standpoint.

PART TWO

SYSTEMATIC LIST.

Order I — ORTHOPTERA

ACRIDIIDAE

Anacridium aegyptium L. (Green tree locust, Ġurat kir aħdar)
Rather common, mostly on Citrus and other trees, less common on ground crops.

Calliptamus italicus L. (Italian Grasspopper, Ġurat)
Not very common. a general feeder.

Dociotaurus maroccanus Thunb.
Occasional, mostly on ground crops.

Locusta migratoria L. (Migratory Locust, Ġurat tal-passa)
Not very common. somtimes on Vine.

Oedipoda coerulescens L. (Blue-winged loucust, Ġurat Kahlani)
Generally found on Vine, but is not restricted to this particular crop.

Schistocerca gregaria Forsk. (Desert Locust, Ġurat tad-desert)
Rather rare, mostly found on scrub, but sometimes on potato and other ground crops.

Truxalis nasuta L. (Ġurat ta rasu twila)
Once fairly common, uut now relatively rare.

TETTIGONIIDAE

Phaneroptera quadripunctata Brunner.
Occasional on ground crops.

Tettigonia viridissima L. (Green grasshopper, Ġurat aħdar)
Fairly common on several hosts.

MANTIDAE

Ameles abjecta Cyr.
Comparitively rare.

Mantis religiosa L. (Praying mantis, Debba tal-Infern)
Occasional on Carob and other trees, rarely causes damage.

GRYLLIDAE

Acheta campestris L. (Field cricket, Grillu)
Fairly common on all crops .

Gryllotalpa gryllotalpa L. (Mole-cricket, Bugħarrat)
Very common on all ground crops, especially potato.

Gryllus bimaculatus Deg.
Occasional on ground crops.

Order II — THYSANOPTERA

THRIPIDAE

Thrips tabaci Lindemann (Onion thrips, Nemusa tal-Basal)
Fairly common on Onion and Garlic.

Order III — HEMIPTERA

PENTATOMIDAE

Eurydema oleraceum L. (Harlequin Bug, Zabbella)
Common on tomato and cucuriits.

Eurydema ornatum L. (Harlequin Bug, Zabbella)
Fairly common on tomato and cucurbits.

Eurygaster hottentotta F. (Stink Bug)
Occasional on cucurbits.

Graphosoma italica Muell. (Striped Stink Bug)
Common on tomato, occasional on cucurbits and Citrus.

Nezara viridula L. (Green Stink Bug, Zabbella ħadra)
Common on Tomato and cucurbits.

PSYALIDAE

Psylla mali Schmdg. (Apple sucker, Baqqa tat-tuffieħ)
Occasional on apple.

Euphyllura olivina Costa (Olive sucker, Baqqa taż-Żebbuġ)
Fairly common on olive.

APHIDIDAE

Anuraphis persicae Fonsc. (Black Peach Aphid, Bergħud tal-ħawħ)
Common on Peach and Plum, occasional on vine.

Aphis frangulae Kalt. (Melon Aphid, Bergħud tal-bettieħ)
Common on cucurbits.

Aphis fabae Scop. (Black Bean Aphid, Bergħud tal-ful)
Extremely common on Pea and Broad Bean.

Aphis pomi De Geer. (Green Apple Aphid, Bergħud aħdar)
Very common on Apple and Pear.

Aphis pyri Kock (Pear Aphid, Bergħud tal-Langas)
Not very common. Found occasionally on Apple, Pear and Pomegranate.

Brevicoryne brassicae L. (Mealy cabbage aphid, Bergħud tal-kaboċċi)
Very common on all brassicae.

Capitophorus fragaefolii Cockll. (Strawberry Aphid, bergħud tal-frawli)
Fairly common on strawberries.

Eriosoma lanigerum Hausm. (Woolly Apple Aphid, Bergħud sufi)
Occasional on Apple.

Myzus cerasi Fab. (Black Cherry Aphid, Bergħud taċ-ċirasa)
Not very common.

Phylloxera vitifollii Fitch. (Vine Louse, Fillossra)
Once very common on vines, now only found on "wild" varieties.

Toxoptera aurantii Boy. (Black Citrus Aphid, Bergħud tal-Laringġ)
Extremely Common on Citrus.

COCCIDAE

Ceroplastes floridensis Comst. (Florida Wax Scale)
Fairly common on Citrus.

Ceroplastes rusci L. (Fig Wax Scale, Miskta tat-Tin)
Very common on Apple, Citrus, Fig, Mulberry and Pear.

Coccus hesperidum L. (Brown Soft Scale, Miskta Kannella)
Occasional on Mulberry.

Saissetia haemispherica Targ. (Hemispherical scale)
Fairly common on Citrus.

Saissetia oleae Bernard. (Olive Black Scale, Miskta sewda)
Very eommon on Orange, fairly common on other Citrus, Apple, Pear, Olive, Cherry and Muleerry.

PSEUDOCOCCIDAE

Pseudococcus citri Risso (Citrus Mealybug)
Common on Citrus, Pear, Vine, and Mulberry.

MARGARODIDAE

Icerya purchasi Mask. (Fluted Scale, l-Icerja)
Very common on Citrus, less so on Pear and Mulberry

DIASPIDIDAE

Anidiella aurantii Mask. (Californian red scale, Miskta ħamra)
Common on Orange

Aspidiotus hederae Vallot (Oleander scale, Miskta tal-Oljandri)
Common on Almond, Cherry, Citrus, Carob, Mulberry, Peach, Pear and Plum.

Chionaspis ceratoniae Marchal (Carob scale, Miskta tal-ħarrub)
Faily general on carob.

Chrysomphalus aonidum L. (Egyptian Black Scale, Miskta sewda)
Fairly common on Citrus.

Chrysompallus dictyospermi Morgan. (Palm scale, Miskta tal-Palm)
Common on Citrus, occasional on Pear.

Diaspidiotus viticola Leon. (Vine scale, miksta tad-dwieli)
Occasional on Vine.

Epidiaspis leperii Sign. (Pear scale, miskta tal-lanġas)
Occasional on Apple, Pear and Plum.

Lepidosaphes beckii Newman (Purple scale, Miskta kaħlanija)
Occasinoal on Orange.

Lepidosaphes conchyformis Gemlin
Uncommon, mostly on Fig.

Lepidosaphes ulmi L. (Mussel scale, miskta mħara)
Common on Apple, Pear and Plum. Fairly common on Citrus.

Leucaspis riccae Targ. (Olive scale, miskta taż-Żebbuġ)
Occasional on Olive.

Parlatoria oleae Colvee (Olive parlatoria)
Common on Olive, Almond and Plum.

Parlatoria pergandii Comst. (Chaff scale)
Fairly common on Citrus,

Parlatoria zizyphi Lucas (Orange black scale, Miskta sewda tal-Laring)
Very common on Orange

Pseudalacaspis pentagona Targ. (Mulberry scale, miskta taċ-Cawsli)
Common on Almond, Citrus, Peach, and Mulberry.

Pulvinaria vitis L. (Red vine scale, miskta ħamra tad-dwieli)
Fairly common on vine.

Quadraspidiotus ostraeformis Curtis (Oystershell scale)
Occasional on fig and Mulberry.

Order IV — LEPIDOPTERA.

COSSIDAE

Zeuzera pyrina L. (Leopard Moth, Baħrija tal-Langas)
Very common on Apple, Loquat, Pear, Plum, Pomegranate, Quince, and Walnut,

GELECHIIDAE

Gnorimoschema operculella Zell. (Potato Tuber Moth, Susa tal-patata)
Very common on Potato. Occasional on Tomato.

YPONOMEUTIDAE

Prays citri Miller (Citrus Flower Moth)
Occasional on Orange.

Prays oleaellus Standt. (Olive Moth, Susa taż-Żebbuġ)
Fairly common on Olive.

TINEIDAE

Plutella maculipennis Curtis (Diamond-black Moth)
Uncommon, occasionally on Brassicae.

TORTRICIDAE

Cydia pomonella L. (Codling Moth, Susa tal-Frott)
Extremely common on Apple and Pear.

Cydia molesta Busck (Oriental Fruit Moth, Farfett tal-ħawħ)
Occasional on Peach.

Enarmonia formosiana Scop. (Cherry Bark Tortrix Moth)
Uncommon. Usually on Apple.

Laspeyresia dorsana Fab. (Pea Moth, Farfett tal-Piselli)
Common on Pea

Laspeyresia leplastriana Curt. (Cauliflower Moth, Susa tal-Pastard)
Very common on Cabbage and Cauliflower.

Polychrosis botrana Schiff. (Grape Moth, Susa tal-Għeneb)
Fairly common on Grapes.

OLETHREUTIDAE

Polychrosis viteana Clemens (Grape Berry Moth, Susa tal-Għeneb)
Fairly common on Grapes.

Phycitidae

Acrobasis obtusella Hubner (Pear Leaf-roller)
Uncommon.

Myelois ceratoniae Zell. (Carob Moth, farfett tal-Harrub)
Fairly common on Carob.

Pyralidae

Cryptoblabes gnidiella Miller (Honeydew Moth, farfett tal-Laring)
Occasional on Orange.

Scopula ferruginalis Hubner (Rusty Pearl Moth)
Fairly common on strawberry.

Lasiocampidae

Gastropacha quercifolia L. (Lappet Moth)
Not very common. Found mostly on Apple.

Pieridae

Pieris brassicae L. (Large White Butterfly, Farfett tal-kromb)
Very common on Brassicae.

Pieris napi L. (Green-veined white Butterfly)
Common on Cabbage and Cauliflower.

Pieris rapae L. (Small White Butterfly)
Common on Brassicae.

Geometridae

Cheimatobia brumata L. (Winter Moth)
Occasional on Apple and Pear.

Hybernia defoliaria L. (Mottled Umber Moth)
Rare. Sometimes seen on Pear.

Sphingidae

Acherontia atropos L. (Death's Head Hawk Moth, Baħrija ta ras il-mewt)
Fairly common on Apple, Pear, Plum, Potato and Vine.

Celerio livornica Esp. (Striped Hawk Moth, Baħrija tal-Qara)
Fairly common on Vine.

Hippotion celerio L. (Silver striped Hawk Moth, Baħrija tad-Dwieli)
Common on Vine.

Notodontidae

Episema caerulocephala L. (Figure-of-eight Moth, Baħrija tal-Lewż)
Common on Almond, fairly common on Peach and Plum.

Noctuidae

Agrotis pronuba, L. (Common yellow Underwing, Baħrija safra)
Common on Lettuce, Potato and Tomato.

Brotolomia meticulosa L. (Angle-shades Moth)
Occasional on Almonds.

Calocampa exoleta L. (Sword-grass Moth)
Occasional on Almond and Pea

Euxoa segetum Schiff. (Turnip Moth, Baħrija tas-saqwi)
Very common on Beetroot, Lettuce, Potato, Radish and Vine.

Lycophotia saucia Hubner. (Pearly Underwing)
Uncommon. Mainly on Vine.

Mamestra brassicae L. (Cabbage moth, Baħrija tal-ġdur)
Occasional on Brassicae.

Mamestra trifolii Rott (Nutmeg Moth, Baħrija tal-Gdur)
Very common on Brassicae.

Phytometra gamma L. (Silver Y Moth)
Common on Beetroot, Potato and Marrow.

Triphaena comes Hubner (Lesser Yellow Underwing)
Common on Lettuce, Potato and Tomato.

Triphaena fimbria L. (Broad-bordered yellow underwing)
Fairly common on Potato.

LYMANTRIDAE

Orgyia trigotephras v. corsica Stgr. (Tussock Moth)
Fairly common on Plum.

Order V — COLEOPTERA

COCCINELLIDAE

Coccinella septempunctata L. (Seven-spot Ladybird)
Common on cucurbits.

Epilachna chrysomelina F. (Twelve-spot Ladybird)
Common on Cucurbits.

HYDROPHILIDAE

Megempleurus rugosus Oliver (Turnip Mud Beetle)
Common on Cabbage.

BUPRESTIDAE

Capnodis tenebrionis L. (Peach Buprestid, Susa tal-Għeruq)
Very common on Apricot and Plum. Less common on Almond, Apple and Pear.

BRUCHIDAE

Acanthoscelides obtectus Say. (Bean Weevil, Bumunqar tal-Ful)
Fairly common on Pea and Broad Bean.

Bruchus Pisorum L. (Pea Beetle, Ħanfusa tal-Piżelli)
Common on Pea and Broad Bean.

Bruchus rufimanus Bohem. (Bean Beetle, Ħanfusa tal-Ful)
Fairly common on Pea and Broad Bean.

Bruchus signaticornis Gyll.
Uncommon. Mostly on Broad Bean.

CHRYSOMELIDAE

Labidostomus taxicornis Labill. (Vine Beetle, Ħanfusa tad-Dwieli)
Common on Vine.

HALTICIDAE

Phyllotreta nemorum L. (Turnip Flea Beetle, Ic-Ċomba)
Common on Brassicae.

CURCURLIONIDAE

Baris coerulescens Scop. (Cabbage Weevil, Buunqar tal-Kaboċċi)
Occasional on Cabbage.

Brachycerus undatus F. (Onion Weevil, Ħanfusa tal-Basal)
Fairly common on Onion.

Ceuthorrhynchus quadridens Panz. (Cabbage Stem Weevil)
Fairly common on Brassicae.

Otiorrhynchus cribricollis L. (Olive Weevil, Bumunqar taż-Żebbuġ)
Common on Olive, fairly so on Brassicae.

Otiorrhynchus singularis L. (Clay-coloured weevil, Ħanfusa taflija)
Common on strawberry and vine.

Otiorrhynchus sulcatus F. (Vine Weevil, Bumunqar tad-Dwieli)
Fairly common on Vine.

Sitona lineatus L. (Pea & Bean Weevil, Bumunqar tal-Piżelli)
Fairly common on Pea and Broad Bean.

SCOLYTIDAE

Phlaeotribus scarabeioides Bernard (Olive Scolytid)
Occasional on Olive.

Scolytus mali Becht. (Apple scolytid)
Common on Apple, Pear, and Plum.

Scolytus rugulosus Ratz. (Fruit Bark Beetle)
Occasional on Plum.

CERAMBYCIDAE

Cerambyx dux Fald. (Lon-horned borer, Susa taz-Zokk)
Common on Apple and Pear.

Cerambyx miles Bonelli (Long-horned borer, Susa taz-Zokk)
Common on Apple and Pear.

Cerambyx scopolii Fussl.
Uncommon. On Pear.

SCARABEIDAE

Geotrupes laevigatus F. (Dor Beetle)
Uncommon, mostly on Vine.

Melolontha melolontha L. (Cockchafer, Bukaghwar)
Very common on Potato, Tomato and Globe Artichokes.

Oryctes nasicornis L. (Rhinoceros Beetle)
Fairly common on ground crops.

Oxythyrea funesta Poda (Barbary Bug, Busuf)
Common on Peach and Pear.

Tropinota hirta Poda (Barbary Bug, Busuf)
Fairly common on Peach.

Tropinota squalida Scop (Barbary Bug, Busuf)
Common on Peach, Pear and Citrus.

Order VI — DIPTERA

MUSCIDAE

Delia antiqua Meig. (Onion Fly, Dubbiena tal-Basal)
Ocasional on Onion.

Hylemia brassicae Bouche (Cabbage Root Fly, Dudu tal-Pastard)
Fairly common on cauliflower.

LONCHAEIDAE

Lonchaea aristella Beck. (Fig Fly, Dubiena tat-Tin)
Occasional on Fig.

TRYPETIDAE

Ceratitis capitata Wied. (Mediterranean Fruit Fly, Dubbiena tal-Laring)
Very common on Citrus, Peach, Plum, Pear, Fig, Loquat, Medlar, Quince, Prickly Pear, Apricot.

Dacus oleae Rossi. (Olive, Fly, Dubbiena taż-Żebbuġ)
Common on Olive.

CECIDOMIIDAE

Cecidomyia pyri Bouche. (Pear leaf Midge, Nemusa tal-Langas)
Fairly common on Pear.

Contarina nasturtii Kieff. (Swede midge, Nemusa tal-ġdur)
Common on Kohl Rabi.

Dichelomyia oenophila Haimh. (Vine midge, Nemusa tal-Għeneb)
Common on Vine, especially after Berry Moth attacks.

Order VII — HYMENOPTERA

SPHECIDAE

Sphex spirifex L. (Wood Wasp, Żunżan taz-Zokk)
Occasional on Vine.

VESPIDAE

Polistes gallica L.
Fairly common on Vine.

Vespa crabro L. (Hornet, Żunżana kbira)
Common on Vine.

Vespa vulgaris L. (Common Wasp, Żunżana)
Common on Vine.

Order IX — ACARINA

BRYOBYIDAE

Bryobyia praetiosa Koch. (Gooseberry Red Spider Mite, Brimba ħamra)
Common on Apple and Strawberry.

TETRANYCHIDAE

Tetranychus telarius L. (Glasshouse Red Spider Mite)
Fairly common on Tomatoes under cover.

ERYOPHYIDAE

Eryophyes pyri Pagst. (Pear Leaf Blister Mite)
Occasional on Pear.

Phyllocoptus schlechtendali Nal. (Leaf and Bud Mite)
Occasional on Apple.

Vasates lycopersici Massee (Tomato Russet Mite, Mell tat-Tadam)
Very common on Tomato, especially under cover.

Eryophyes vitis Pagst. (Vine Leaf Blister Mite)
Common on Vine.

Phytoptus mali Am. (Apple mite)
Fairly common on Apple.

Phyllocoptes oleivorus Ash. (Citrus Rust Mite)
Occasional on Lemon.

PART THREE

INSECTS AND OTHER PESTS CATALOGUED UNDER

HOST PLANTS

ALMOND (Lewż) *Prunus amygdalus* Batsch. (Rosaceae)

Aspidiotus hederae Vallot (HEM., Diaspididae)	Oleander Scale.
Brotolomia meticulosa L. (Lep., Noctuidae)	Angle-shades Moth.
Calocampa exoleta L. (LEP., Noctuidae)	Sword grass Moth.
Capnodis tenebrionis L. (COL., Buprestidae)	Peach Buprestid.
Episema caerulocephala L. (LEP., Notodontidae)	Figure-of-eight Moth.
Parlatoria oleae Colvee (HEM., Diaspididae)	Olive Parlatoria.
Pseudalacaspis pentagona Targ. (HEM., Diaspididae)	Mulberry Scale.

APPLE (Tuffieħ ta Belludja) *Malus sylvestris* Miller (Rosaceae)

Acherontia atropos L. (LEP., Sphingidae)	Death's Head Moth.
Aphis pomi De Geer (HEMM., Aphididae)	Green Apple Aphid.
Aphis pyri Koch (HEM., Aphididae)	Pear Aphid.
Bryobyia praetiosa Koch. (ACAR., Bryobyidae)	Gooseberry Red Spider Mite.
Capnodis tenebrionis L. (COL., Buprestidae)	Peadh Buprestid.
Cerambyx dux Fald. (COL., Cerambycidae)	Long-horned Borer.
Cerambyx miles Bonelli (COL., Cerambycidae)	Long-horned Borer.
Ceroplastes rusci L. (HEM., Coccidae)	Fig Wax Scale
Cheimatobia brumata L. (LEP., Geometridae)	Winter Moth.
Cydia pomonella L. (LEP., Tortricidae)	Codling Moth.
Enarmonia formosiana Scop. (LEP., Tortricidae)	Cherry Bark Tortrix.
Epidiaspis leperii Sign. (HEM., Diaspididae)	Pear Scale.
Eriosoma lanigerum Hausm (HEM., Aphididae)	Woolly Apple Aphid.
Gastropacha quercifolia L. (LEP., Lasiocampidae)	Lappet Moth.
Lepidosaphes ulmi L. (HEM., Diaspididae)	Mussle Scale.
Otiorrhynchus singularis L. (COL., Curculionidae)	Clay-coloured Weevil.
Phyllocoptus schlechtendali Nal. (ACAR., Eryophyidae)	Leaf and Bud Mite.
Phytoptus mali Am. (ACAR., Eryoplyidae)	Apple Mite.
Psylla mali Schmdg. (HEM., Psyllidae)	Apple sucker.
Saissetia oleae Bernard (HEM., Coccidae)	Olive Black Scale.
Scolytus mali Becht. COL., Scolytidae)	Apple scolytid.
Zeuzera pyrina L. (LEP., Cossidae)	Leopard Moth.

APRICOT (Berquq) *Prunus armeniaca* L. (Rosaceae)

Capnodis tenebrionis L. (COL., Buprestidae)	Peach Buprestid.
Ceratitis capitata Wied. (DIP., Trypetidae)	Mediterranean Fruit Fly.
Myzus cerasi Fab. (HEM., Aphididae)	Black Cherry Aphid.

BEETROOT (pitravi) *Beta vulgaris* L. (Chenopodiaceae)

Euxoa segetum Schiff. (LEP., Noctuidae)	Turnip Moth.
Phytometra gamma L. (LEP., Noctuidae)	Silver Y Moth.

BRASSICAS (Cruciferae)

Brussels Sprouts	— *Brassica oleracea* v. *gemmifera* Zenker
Cabbage (Kaboċċi)	— *Brassica oleracea* v. *capitata* L.
Cauliflower (Pastard)	— *Brassica oleracea* v. *sativa* DC.
Kohl Rabi (Ġdur)	— *Brassica caulorapa* Pasq.
Turnip (Nivew)	— *Brassica rapa* L.

Baris coerulescens Scop. (COL., Curculionidae)	Cabbage Weevil.
Brevicoryne brassicae L. (HEM., Aphididae)	Cabbage Aphid.
Ceuthorrhynchus quadridens Panz. (COL., Curculionidae)	Cabbage Stem Weevil.
Contarina nasturtii Kieff. (DIP., Cecidomyidae)	Swede Midge.
Hylemia brassicae Bouche (DIP., Muscidae)	Cabbage Root Fly.
Laspeyresia leplastriana Curt. (LEP., Tortricidae)	Cauliflower Moth.
Mamestra brassicae L. (LEP., Noctuidae)	Cabbage Moth.
Mamestra trifolii Rott. (LEP., Noctuidae)	Nutmeg Moth.
Megempleurus rugosus Oliver (COL., Hydrophilidae)	Turnip Mid Beetle.
Otiorrhynchus cribricollis L. (COL., Curculionidae)	Olive Weevil.
Phyllotreta nemorum L. (COL., Halticidae)	Turnip Flea Beetle.
Phytometra gamma L. (COL., Noctuidae)	Silver Y Moth.
Pieris brassicae L. (LEP., Pieridae)	Large White.
Pieris napi L. (LEP., Pieridae)	Green-veined white.
Pieris rapae L. (LEP., Pieridae)	Small White.
Plutella maculipennis Curt. (LEP., Tineidae)	Diamond-back Moth.

CAROB (Harrub) *Ceratonia siliqua* L. (Leguminosae)

Acheta campestris L. (ORTH., Gryllidae)	Field Cricket.
Aspidiotus hederae Vallot (HEM., Diaspididae)	Oleander Scale.
Chionaspis ceratoniae Marchal. (HEM., Diaspodidae)	Carob Scale.
Mantis religiosa L. (ORTH., Mantidae)	Praying Mantis.
Myelois ceratoniae Zell. (LEP., Phycitidae)	Carob Moth.

CHERRY (Ċirasa) *Prunus avium* L. (Rosaceae)

Aspidiotus hederae Vallot (HEM., Diaspididae)	Oleander Scale.
Myzus cerasi Fab. (HEM., Aphididae)	Black Cherry Aphid.
Saissetia oleae Bernard (HEM., Coccidae)	Olive Black Scale.

CITRUS (Rutaceae)

Grapefruit	— *Citrus grandis* Osbeck.
Lemon (Lumi)	— *Citrus limon* Burm.
Sour Orange (Laring)	— *Citrus aurantium* L.
Sweet orange (Lumi Laring)	— *Citrus sinensis* Osbeck.
Tangerine (Mandulina)	— *Citrus reticulata* Blanco.

Anacridium aegyptium L. (ORTH., Acridiidae)	Green Tree Locust.
Aonidiella aurantii Mask. (HEM., Diaspididae)	California Red Scale.
Aspidiotus hederae Vallot (HEM., Diaspididae)	Oleander Scale.
Ceratitis capitata Wied. (DIP., Trypetidae)	Mediterranean Fruit Fly.
Ceroplastes floridensis Comst., (HEM., Coccidae)	Floridia Wax Scale.
Ceroplastes rusci L. (HEM., Coccidae)	Fig Wax Scale.
Chrysomphalus aonidum L. (HEM., Diaspididae)	Egyptian Black Scale.
Chrysomphalus dictyospermi Morg. (HEM., Diaspididae)	Palm Scale.
Cryptoblabes gnidiella Mill. (LEP., Pyralidae)	Honeydew Moth.
Icerya purchasi Mask. (HEM., Margarodidae)	Fluted Scale.
Lepidosaphes Beckii Newm. (HEM., Diaspididae)	Purple Scale.
Lepidosaphes ulmi L. (HEM., Diaspididae)	Mussel Scale.
Oxythyrea funesta Poda (COL., Scarabeidae)	Barary Bug.
Parlatoria pergandii Comst. (HEM., Diaspididae)	Chaff Scale.
Parlatoria Zizyphi Lucas (HEM., Diaspididae)	Orange Black Scale.
Pseudalacaspis pentagona Targ. (HEM., Diaspididae)	Mulberry Scale.
Phyllocoptes oleivorus Ash. (ACAR., Eryophidae)	Citrus Rust Mite.
Prays citri Mill. (LEP., Yponomeutidae)	Citrus Flower Moth.
Pseudococcus citri Risso (HEM., Pseudococcidae)	Citrus Mealy Bug.
Saissetia haemispherica Targ., (HEM., Coccidae)	Hemispherical Scale.
Saissetia oleae Bernard (HEM., Coccidae)	Olive Black Scale.
Tettigonia viridissima L. (ORTH., Tettigoniidae)	Green Grasshopper.
Toxoptera aurantii Boy. (HEM., Aphididae)	Black Citrus Aphid.
Tropinota squalida Scop. (COL., Scarabeidae)	Barbary Bug.

CUCURBITS (Cucurbitaceae)

Cucumber (Ħjar)	— *Cucumis sativus* L.
Melon (Bettieħ)	— *Cucumis melo* L.
Pumpkin (Qara aħmar)	— *Cucurbita pepo* L.
Vegetable Marrow (Qara bagħli)	— *Cucurbita pepo* v. *medullosa* L.
Watermelon (Dulliegħ)	— *Citrullus vulgaris* Schrad.

Aphis frangulae Kalt. (HEM., Aphididae)	Melon Aphid.
Coccinella septempunctata L. (COL., Coccinellidae)	Seven-spot Ladybird.
Epilachna chrysomelina F. (COL., Coccinellidae)	Twelve-spot Ladybird.
Eurydema oleraceum L. (HEM., Pentatomidae)	Harlequin Bug.
Eurydema ornatum L. (HEM., Pentatonidae)	Harliquin Bug.
Eurygaster hottentotta F. (HEM., Pentatonidae)	Stink Bug.
Graphosoma italica Muell. (HEM., Pentatomidae)	Striped Stink Bug.
Nezara viridula L. (HEM., Pentatomidae)	Green Stink Bug.
Phytometra gamma L. (LEP., Noctuidae)	Silver Y Moth.

FIG (Tin) *Ficus Carica* L. (Moraceae)

Ceratitis capitata Wied. (DIP., Trypetidae)	Meditterranean Fruit Fly.
Ceroplastes rusci L. (HEM., Coccidae)	Fig Wax Scale.
Chrysomplulus aonidum L. (HEM., Diaspididae)	Egyptian Black Scale.
Lepidosaphes conchyformis Gmelin (HEM., Diaspididae)	Fig Scale.
Lonchaea aristella Bech. (DIP., Lonchaeidae)	Fig Fly.
Quadraspidiotus ostraeformis Curt. (HEM. Diaspididae)	Oystershell Scale

GARLIC (Tewm) *Allium sativum* L. (Amaryllidaceae)

Thrips tabaci Lindemann (THYS., Thripidae)	Onion Thrips.

GLOBE ARTICHOKE (Qaqoċċ) *Cynarus cardungulus* L. (Compositae)

Aphis frangulae Kalt. (HEM., Aphididae)	Melon Aphid.
Gryllotalpa gryllotalpa L. (ORTH., Gryllidae)	Mole-cricket.
Melolontha melolontha L. (COL., Scarabeidae)	Cockchafer.

INDIAN FIG (Bajtar tax-xewk) *Opuntia ficus-indica* Mill. (Cactaceae)

Aspidiotus hederae Vallot (HEM., Diaspididae)	Oleander Scale.
Ceratitis capitata Wied., (DIP., Trypetidae)	Mediterranean Fruit Fly.

KAKI (Kaki) *Diospyros Kaki* L. (Ebenaceae)

Ceratitis capitata Wied. (DIP., Trypetidae)	Mediterranean Fruit Fly.

LETTUCE (Ħass) *Lactuca sativa* L. (Compositae)

Euxoa segetum Schiff. (LEP., Noctuidae)	Turnip Moth.
Mamestra trifolii Rott. (LEP., Noctuidae)	Nutmeg Moth.
Melolontha melolontha L. (COL., Scarabeidae)	Cockchafer.
Agrotis pronuba L. (LEP., Noctuidae)	Large Yellow Underwing.
Triphaena comes Hubner. (LEP., Noctuidae)	Lesser Yellow Underwing.

LEGUMES, FIELD. (LEGUMINOSAE)

Broad Bean (Ful)	— *Vicia faba* L.
Lucerne (Nefel)	— *Medicago sativa*, L.
Pea (Piżelli)	— *pisum sativum* L.

Acanthoscelides obtectus, Say. (COL., Bruchidae)	Bean Weevil.
Aphis fabae Scop. (HEM., Aphididae)	Black Bean Aphid.
Bruchus pisorum L. (COL., Bruchidae)	Pea Beetle.
Bruchus rufimanus Bohem. (COL., Bruchidae)	Bean Beetle.
Bruchus signaticornis Gyll. (COL., Bruchidae)	—
Calocampa exoleta L. (LEP., Noctuidae)	Sword grass Moth.

Laspeyresia dorsana Fa. (LEP., Tortricidae)	Pea Moth.
Pieris brassica L. (LEP., Pieridae)	Large White. Butterfly
Sitona lineatus L. (COB., Curculionidae)	Pea & Bean Weevil.

LOQUAT (Naspli) *Eryobotria japonica* Lindl. (Rosaceae)

Ceratitis capitata Wied. (DIP., Trypetidae)	Mediterranean Fruit Fly.
Zeuzera pyrina L. (LEP., Cossidae)	Leopard Moth.

MULBERRY (Cawsli) *Morus alba* L. (Moraceae)
Morus nigra L.

Aspidiotus hederae Vallot (HEM., Diaspididae)	Oleander Scale.
Ceroplastes rusci Targ. (HEM., Coccidae)	Fig Wax Scale.
Coccus hesperidum L. (HEM., Coccidae)	Brown Soft Scale.
Icerya purchasi Mask. (HEM., Margarodidae)	Fluted Scale.
Pseudalacaspis pentagona Targ. (HEM., Diaspididae)	Mulberry Scale.
Pseudococcus citri Risso (HEM., Pseudococcidae)	Citrus Mealy Bug.
Quadraspidiotus ostraeformis Curt. (HEM., Diaspodidae)	Oystershell Scale.
Saissetia oleae Bernard (HEM., Coccidae)	Olive Black Scale.

OLIVE (Żebbuġ *Olea europea* (Oleaceae)

Aspidiotus hederae Vallot (HEM., Diaspididae)	Oleander Scale.
Dacus oleae Rossi (DIP., Trypetidae)	Olive Fly.
Euphyllura olivina Costa (HEM., Psyllidae)	Olive sucker.
Leucaspis riccae Targ. (HEM., Diaspididae)	Olive Scale.
Otiorrhynchus cribricollis L. (COL., Curculionidae)	Olove Weevil.
Parlatoria oleae Colvee (HEM., Diaspididae)	Olive Parlatoria
Phlaeotribus scarabeioides Bernard (COL., Scolytidae)	Olive Scolytid.
Prays oleaellus Standt. (LEP., Yponomeutidae)	Olive Moth.
Saissetia oleae Bernard. (HEM., Diaspididae)	Olive Black Scale.
Zeuzera pyrina L. (LEP., Cossidae)	Leopard Moth.

ONION (Basal) *Allium cepa* L. (Amaryllidaceae)

Brachycerus undatus F. (COL., Curculionidae)	Onion Weevil.
Delia antiqua Meig. (DIP., Muscidae)	Onion Fly.
Thrips tabaci Lindemann (THYS., Thripidae)	Onion Thrips.

PEACH (Hawħ) *Prunus persica* Batsch. (Rosaceae)

Anuraphis persicae Fonsc. (HEM. Aphididae)	Black Peach Aphid.
Aspidiotus hederae Vallot. (HEM., Diaspididae)	Oleander Scale.
Ceratitis capitata Wied. (DIP., Trypetidae)	Mediterranean Fruit Fly.
Cydia molesta Busck. (LEP., Tortricidae)	Oriental Fruit Moth.
Episema caerulocephala L. (LEP., Notodontidae)	Figure-of-eight Moth.
Eulecanium persicae Fab. (HEM., Coccidae)	Peach Scale.
Oxythyrea funesta Poda. (COL., Scarabeidae)	Baraary Bug.
Pseudalacaspis pentagona Targ. (HEM., Diaspididae)	Mulberry Scale.
Tropinota hirta Poda. (COL., Scarabeidae)	Barbary Bug
Tropinota squalida Scop. (COL., Scarabeidae)	Barbary Bug.

PEAR (Langas) *Pyrus comunis* L. (Rosaceae)

Acherontia atropos L. (LEP., Sphingidae)	Death's Head Moth.
Acrobasis obtusella Hubn. (LEP., Phycitidae)	—
Aphis pomi De Geer (HEM., Aphididae)	Green Apple Aphid.
Aphis pyri Koch (HEM., Aphididae)	Pear Aphid
Aspidiotus hederae Vallot (HEM., Diaspididae)	Oleander Scale.

Capnodis tenebrionis L. (COL., Buprestidae)	Peach Buprestid.
Cecidomyia pyri Bouche (DIP., Cecidomyidae)	Pear Leaf Midge.
Cerambyx dux Fald. (COL., Cerambycidae)	Long-horned Borer.
Cerambyx miles Bonelli (COL., Cerambycidae)	Long-horned Borer.
Ceratitis capitata Wied. (DIP., Trypetidae)	Mediterranean Fruit Fly.
Cheimatobia brumata L. (LEP., Geometridae)	Winter Moth.
Chrysomphalus dictyospermi Mask. (HEM., Dispididae)	Palm Scale.
Cydia pomenella L. (LEP., Tortricidae)	Codling Moth.
Epidiaspis leperii Sign. (HEM., Diaspididae)	Pear Scale.
Eryophyes pyri Pagst. (ACAR., Eryophidae)	Pear Leaf Blister Mite.
Gastropacha quercifolia L. (LEP., Geometridae)	Lappet Moth.
Hybernia defoliaria L. (LEP., Geometridae)	Mottled Umber Moth.
Icerya purchasi Mask. (HEM., Margarodidae)	Fluted Scale .
Lepidosaphes ulmi L. (HEM., Diaspididae)	Mussel Scale.
Oxythyrea funesta Poda. (COL., Scarabeidae)	Barbary Bug.
Pseudococcus citri Risso (HEM., Pseudococcidae)	Citrus Mealy Bug.
Saissetia oleae Bernard (HEM., Coccidae)	Olive Black Scale.
Tropinota sqalida Scop. (COL.. Scaraaaidae)	Barbary Bug.
Zeuzera pyrina L. (LEP., Cossidae)	Leopard Moth.

PLUM (Rosaceae)

Common Plum (Pruna) — *Prunus domestica* L.
Cherry Plum — *Prunus cerasifera* Ehrh.

Acherontia atropos L. (LEP., Sphindigae)	Death's Head Moth.
Anuraphis persicae Fonsc. (HEM., A phididae)	Black Peach Aphid.
Aspidiotus hederae Vallot (HEM., Diaspididae)	Oleander Scale.
Capnodis tenebrionis L. (COL., Buprestidae)	Peach Buprestid.
Epidiaspis Leperii Sign. (HEM., Diaspidadae)	Pear Scale.
Episema caerulocephala L. (LEP., Notodontidae)	Figure-of-eight-Moth.
Lepidosaphes ulmi L. (HEM., Diaspididae)	Mussel Scale.
Orgyia trigoiephras v. *Corsica* Stgr. LEP., Lymantriiae	Tussock Moth
Parlatoria oleae Colvee (HEM., Diaspididae)	Olive parlatoria.
Scolytus rugulosus Ratz. (COL., Scolytidae)	Fruit Bark Beetle.
Zeuzera pyrina L. (LEP., Cossidae)	Leopard Moth.

POMEGRANATE (Rummien) *Punica granatum* L. (Punicaceae)

Aphis pyri Koch (HEM., Aphididae)	Pear Aphid.
Zeuzera pyrina L. (LEP., Cossidae)	Leopard Moth.

POTATO (patata) *Solanum tuberosum* L. (Solanaceae)

Acherontia atropos L. LEP., Sphingidae)	Death's Head Moth.
Anacridium aegyptium L. (ORTH., Acridiidae)	Green Tree Grasshopper.
Dociotaurus maroccanus Thunb. (ORTH., Arcidiidae)	Moroccan Locust.
Euxoa segetum Schiff. (LEP., Noctuidae)	Turnip Moth.
Gnorimoschema operculell Zell. (LEP., Gelechiidae)	Potato Tuder Moth.
Gryllotalpa gryllotalpa L. (ORTH., Gryllidae)	Mole-criket.
Melolontha melolontha L. (COL., Scarabeidae)	Cockchafer.
Phytometra gamma L. (LEP., Noctuidae)	Silver Y Moth.
Triphaena comes Hub. (LEP., Noctuidae)	Lesser Yellow Underwing.
Triphaena fimbria L. (LEP., Noctuidae)	Broad-bordered yelow underwing

QUINCE (Sfargel) *Cydonia oblonga* Miller (Rosaceae)

Ceratitis capitata Wied. (DIP., Trypetidae)	Mediterranean Fruit Fly.
Zeuzera pyrina L. (LEP., Cossidae)	Leopard Moth.

RADISH (Ravanell) *Raphanus sativus* L. (Cruciferae)

Euxoa segetum Schiff. (LEP., Noctuidae)	Turnip Moth.

STRAWBERRY (Frawli) *Fragaria vesca* L. (Rosaceae)

Bryobia praetiosa Koch. (ACAR., Bryobyidae)	Gooseberry Red Spider Mite.
Ceroplastes rusci L. (HEM., Coccidae)	Fig Wax Scale.
Otiorrhynchus singularis L. (COL., Curculionidae)	Clay-coloured Weevil.
Capitophorus fragaefolii Cock. (HEM., Aphididae)	Strawberry Aphid.
Scopula ferruginalis Hubn. (LEP., Pyralidae)	Rusty Pearl Moth.

TOMATO (Tadam) *Lycopersicon esculentum* Mill. (Solanaceae)

Eurydema oleraceum L. (HEM., Pontatomidae)	Harlequin Bug.
Eurydema ornatum L. (HEM., Pentatomidae)	Harlequin Bug.
Graphosoma italica Muell. (HEM., Pentatomidae)	Striped Stink Bug.
Gryllotalpa gryllotalpa L. (NOTH., Gryllidae)	Mole-cricket.
Gnorimoschema operculella Zell. (LEP., Gelechiidae)	Potato Tuber Moth
Melolontha melolontha L. (COL., Scarabeidae)	Cockchafer.
Nezara virdula L. (HEM., Pentatomidae)	Green Stink Bug.
Tetranchus telarius L. (ACAR., Tetranychidae)	Glasshouse Red Spider Mite.
Triphaena comes Hubn. (LEP., Noctuidae)	Lesser Yellow Underwing.
Vasates lycopersici Massee. (ACAR., Eryophyidae)	Tomato Russet Mite.

WALNUT (Gewż) *Juglans nigra* L. (Juglandaceae)

Zeuzera pyrina L. (LEP. Cossidae)	Leopard Moth.

VINE (Dielja) *Vitis vinifera* L. (Vitaceae)

Anacridium aegyptium L. (ORTH., Acridiidae)	Green Tree Locust.
Acherontia atropos L. (LEP., Sphingidae)	Death's Head Moth.
Anuraphis persicae Fonsc. (HEM., Aphididae)	Black Peach Aphid.
Calliptamus italicus L. (ORTH., Acridiidae)	Italian Grasshopper.
Celerio livornica Esp. (LEP., Sphingidae)	Stripe Hawk Moth.
Dispidiotus victicola Leon., (HEM., Diaspididae)	Vine Scale.
Dichelomyia oenophila Haimh. (DIP., Cecidomyidae)	Vine Midge.
Eryophyes vitis Pagst. (ACAR., Eryophyidae)	Vine Leaf Blister Mite.
Euxoa segetum Schiff. (LEP., Noctuidae)	Turnip Moth.
Geotrupes laevigatus F. (COL., Scarabeidae)	Dor Beetle.
Hippotion celerio L. (LEP., Sphingidae)	Silver striped Hawk Moth.
Labidostomus taxicornis Labill. (COL., Chrysomelidae)	Vine Beetle.
Locusta migratoria L. (ORTH., Acridiidae)	Migratory Locust.
Lycophotia saucia Hubn. (LEP., Noctuidae)	Pearly Underwing.
Oedipoda coerulescens L. (ORTH., Acridiidae)	Blue-winged Locusr.
Otiorrhynchus singularis L. (COL., Curculionidae)	Clay-coloured Weevil.
Otiorrhynchus sulcatus Fab. (COL., Curculionidae)	Vine Weevil
Phylloxera vitifolii Fitsch, (HEM., Aphididae)	Vine Louse.
Polychrosis botrana Schiff. (LEP., Tortricidae)	Grape Moth.
Polychrosis viteana Clemens. (LEP., Olethreutidae)	Grape Berry Moth.
Polistes gallica L. (HYM., Vespidae)	—
Pseudococcus citri Risso. (HEM., Pseudococcidae)	Citrus Meal Bug.
Pulvinaria vitis L. (HEM., Diaspididae)	Red Vine Scale.
Sphex spirifex L. (YHM., Sphecidae)	Wood Wasp.
Tettigonia viridissima L. (ORTH., Tettigoniidae)	Green Grasshopper
Vespa crabro L. (HYM., Vespidae)	Hornet.
Vespa vulgaris L. (HYM., Vespidae)	Common Wasp

PART FOUR

INSECT CONTROL IN MALTA

The economic insect fauna of the Maltese Islands is typically Mediterranean, consisting in the main of an abridged edition of the characteristic fauna of Southern Europe and North Africa. It is safe to assert that the problems facing the local farmer in the field of Pest Control are largely similar to those his Sicilian counterpart has to contend with. A number of species, notably the American Grape Berry Moth, *Polychrosis viteana* Clemens, are not indigenous to the zone, and have been imported over the years. On the other hand, a considerable number of species of common occurrence in the Mediterranean area are not known to exist in Malta. This situation is easily explained. The position of Malta in the Mediterranean trade-route provides easy facilities for the introduction of those insects generally carried from place to place with agricultural produce and other "Baggage", and it is probable that practically every species of significant occurrence has been introduced at some time or other. The comparative lack of vegetation locally, especially the dearth of trees, must have contributed in no small way to their lack of survival.

Some of the more noxius Insect types, particularly the Colorado Beetle, *Leptinotarsa decemlineata* Say. and the San Jose Scale , *Quadraspidiotus perniciosus* Comst. are conspicuous by their absence, although they are both rampant on the continent. The possibility of their introduction is now further reduced by strict legislation which has been in force for a large number of years. As early as 1876, an Ordnance to control Plant Imports was enacted, the regulations issued under it being largely responsible (by virtue of their observance) for the continued absence from local fields of the pests in question.

The History of Insect Control in the Maltese Islands provides the characteristic story of a gradual transition from pre-chemical to chemical control methods. In the late nineties, the recognised method of controlling Mediterranean Fruit Fly was to pick off the individuals one by one, first attracting them by smearing the fingers with honey. The same method (without the use of honey) was in general use against caterpillars, mainly on Brassicae, well into the twentieth century. Up to 1957, power-operated machinery was relatively unkown, equipment in general use being confined to hand-operated knapsack sprayers, syringes, and bait-bottles. Fruit were covered in muslin or paper bags to protect them from Fly damage well into the thirties. The first organochlorines, DDT and Lidane, appeared on the local market after the war, their "effectiveness" being supplemented by sulphur and petroleum oils. The last few years have been revolutionary from the pest control aspect. Not only has the introduction of the newer organochlorines, organophosphates and carbamates marked the turning point in crop-survival, but the radical change in application methods from manual to motorised, coming simultaneously, has rendered the efficacy of the new materials all the more conspicuous.

At the time of writing, practical methods of chemical control are available for nearly all major economic pests, and a very large proportion of those of minor significance. The est are all under experimental control, and trials have reached the stage where only confirmatory tests are required to issue the relevant recommendations for general application. By and large, chemicals effective against specific insects abroad have a similar effect, at the same rates of application , in Malta. A few chemicals have failed to achieve contro to achieve control in this respect, while others with "Blanket" recommendations have had variable results against different pests. On the whole, however, adapting a chemical for local use is more a question of determining the time of application and intervals between successive sprays, and correlating it with other treatments on the same crop than starting tests from scratch.

The geographical conditions of the Maltese Islands provide considerable handicaps in the achieving of accepted Pest Control Techniques. The hilly nature of the country and the thin stratum of soil over the major portion of the land has led to the prevailing arrangement of small-sized individual units, bounded by stones or rubble walls, mostly terraced at different levels. This precludes tractor-driven sprayers, and limits the suitability of barrow-type models, so that the only type of apparatus which can be put to anything like general use is the man-pack. Most sprayers used in gardens are the syringe or bucket type, while the 3-gallon hand-operated knapsack sprayer and the 2¼ gallon

motorised knapsack sprayer are used in fields and large orchards. In the old "high-volume", days, before the latter type was introduced, spraying was a distinctly laboriuos business and the new machines, apart from saving water (which the average local farmer is in dire need of), effect a considerable saving in both time and labour.

Any Pest Control method evolved must necessarily be adapted to its ultimate user, in this case the farmer. Here, the relatively low educational standard of the average farmer, particularly the older generation who have never set foot inside a classroom in their lives, renders the position fraught with difficulties. Coming from typical peasant stock who have cultivated the island for generations, the local farmer has a conservative outlook. He learns by experience more than by anything else, and is loth to discard old-established techniques, even if laborious and quasi-ineffective, until he has actually seen the results of the new ones, and proved their advantages for himself. Possibly as a necessary consequence, he tends to be impressed by spectacular short-term results, rather than by the gradual, sometimes long-drawn out, effects of a sound long-term policy. Apple and Pear growers who by dint of patient and back-breaking labour had succeeded in keeping down the ravages of wood-boring larvae to some extent by inspecting every inch of tree-trunk in their orchards at regular intervals, and destroying — or rather attenpting to destroy — the larvae in their burrows by introducing a length of wire into the hole, invariably failed to appreciate the significance of gradually reducing the overall population of the pests and preventing new infestations by annual trunk and soil spraying. What they wanted was something to kill the larvae in their holes — at once. On the other hand, the same people were quick to notice the effect of a Codling Moth campaign on the same crop. In the latter case a visible result — in the form of an undamaged crop at harvest time — was evident after two months of treatments, while in the former case, tangible results would not be evident for two or three years. As a matter of fact the, farmers' reaction on the recommendations for wood-borer control have been disappointing. The wood-borer problem was one of the major academic grievances of the fruit-growing farmimg community. When the problem was solved, and the recommendations were published, the response was infinitesimal. Instead of the new trunk spray, applied only once a year, and representing an enormous saving in labour and tree-damage, most farmers still went on assiduously carrying out the old probing technique, and the new measure is only superseding the old very slowly.

This attidude can be very awkward as, barring legislation, co-operation is necessary for efficient pest control, and some problems can only be solved by long-term measures which have to be complete and widespread for the duration.

By the same criterion, the farmer, used to handling the more inocuous types of pesticide with comparative impunity, fails to grasp the elementary fact that pretty nearly every modern chemical requires at least some form of safety-precaution, and that some chemicals are positively dangerous if mishandled. The fact that there has been no more serious incident than a few cases of poisoning where the chemical was mistaken for something else and a small quantity ingested further complicates matters, since the farmer cannot learn by experience in this instance, having never had the opportunity of observing the results of misuse. This attitude is probably not restricted to Malta. It does however restrict the range of chemicals available for use, as owing to the risks involved, chemicals in the high mammalian-toxicity group have to be absolutely ruled out, and a fair proportion of those in the medium-toxicity range only recommended with reservation. This reflects on the range of chemicals available for experimental use, since it is no use testing any specific insec- ticide which, even if completely satisfactory in its performance, cannot be recommended to farmers on hazard grounds.

It has been suggested that the difficulty could be overcome by restricting the nse of the more toxic chemicals to properly-organised Pest Control personnel operating under adequate supervision. This is easier said than done. Local climatic conditions, particularly between May and September when most operations against insects are carried out, make it impossible for the operator to wear protective clothing and a rubber mask for anything but a very short space of time, and the fact that spraying equipment has to be carried on the back further increases the discomfort. The lack of proper washing facilities is another factor to be taken into consideration. A properly organised station (research or commercial) could use any chemical *on its own land* without hazard, but the contamination-risk precludes toxic chemicals from being used further.

Actually, this restriction in availability of materials is more apparent than real. So far it has been found possible to establish control of practically every insect pest without having to resort to Parathion or any material of similar toxicity. The present international trend towards safer pesticides is gradually easing the problem still more.

In Malta, control of pests (and diseases, for that matter) is limited to treatment of the actual crop, if at all. Field hygiene and particular methods of cultivation which facilititate control of undesirable organisms are, to a very large extent, limited to private gardens. Weed-control is still in its infancy, the accepted method being hand-picking at irregular intervals, and in many fields it is difficult for the sprayer to get an adequate coverage. In most fields, even if weeds actually among the crop plants are removed, they are left standing at the peripheries, which encourages pest build-up by providing a ready source of food materials and/or shelter.

Another source of irritation to the pest control operator is the crop-cramming practised by farmers in an effort to get the most out of every available inch of land. In some instances, it is impossible to treat crops without damaging them, and in the case of trees, only those on the edges can be sprayed. This stage represents an extreme not commonly encountered, but lesser degrees are common. Whether the extra trees or seedlings planted make up for the damaged ones, and which is the more economic proposition — to sow as much as possible, or to sow less and take good care of them — are questions nobody seems to have worked on.

In a small Island such as Malta, where the only species whose entry cannot be controlled are the migratory ones, detailed eradication programmes could solve a great number of problems. As things stand at the moment, every major economic species is only kept off the actual crop by rigorous spraying. That there has been no appreciable drop in the overall population level is proved by the fact that any individual tree or plant left unsprayed generally suffers heavily. No attempt is made to spray alternate hosts, where these do not constitute an economic crop. Thorough measures, consisting in:

A/ Treatment of every host plant.
B/ Treatment of every alternative host.
C/ Exhaustive Field Hygiene.
D/ Strict control of plant imports.

should yield quasi-complete results against any individual species after a period of three to four years. The last measure would then be the only one necessary, (the third, Field Hygiene, being advocated in any case) The elimination of any economic species would mean that it would no longer be necessary to carry out large scale, often expensive, control measures. As a result, crops could be grown at less cost, meaning a lower price to the consumer and facilitating export. On the other hand, the lesser amount of chemicals imported would help the Island's adverse Trade Balance.

These advantages are all too obvious to require further elaboration.

PART FIVE.

MAJOR ECONOMIC PESTS

A pest of major economic importance can be defined as one which will almost certainly cause a serious loss of the particular crops or crops it attacks if no remedial measures are employed. Some pests are important from the short-term angle — i.e. their ravages will be felt with respect to one particular season. Others, particularly on trees, will not cause quite the same spectacular effect in any one season. but will have more serious consequences in the long run.

The following species can be described as major economic pests in the Maltese Islands.

a/. *Long term.*

Wood-borers on stone and pome fruit.
Scale Insects.

b/. *Short-term.*

Mediterranean Fruit Fly on nearly all fruit.
Potato tuber Moth.
Codling Moth on Apples and Pears.
Grape berry moths.

Several other species are of general occurrence, and are responsible for a variable amount of damage, but do not quite come up to the above category.

1. Wood-boring Insects.

Cultivation of stone and pome fruits in the Maltese Islands has been severely handicapped by the depredations of four species of Wood-borers — *Cerambyx miles* Bon., *C. dux.* Fald., *Capnodis tenebrionis* L., and *Zeuzera pyrina* L. Practically uncontrolled, except by relatively-primitive methods until 1960, the four between them have contributed in no small measure to the steady decline in the number of Apples, Pears, Plums, and other stone-fruits grown locally, and to the ever-increasing reluctance of the farmer to replace dead trees with new stock.

It is relevant to mention the fact that control of Wood-borers is (or rather, was) only one of the main limiting factors in fruit tree cultivation. There are other factors, such as lack of water, which are as serious and should be taken into account when assessing the problem as a whole, but which fall entirely outside the field of insect control.

The damage done by all the species is characteristic of each. *Cerambyx* adults emerge in mid-April or early May, depending on the onest of the warm Spring weather, and commence ovipositing approiimately four weeks later. The neonate larvae burrow into the trunk at the point of oviposition, or somewhere near it, which point can be anywhere on the main trunk from the base up to a height of two feet, sometimes more, Entry holes are also found on the main branches. The direction and route of the gallery varies slightly between the two species, both ending in the heartwood.. There is a traditional saying among local farmers that the galleries have an upward direction in summer and a downward one in Winter but this has not been confirmed by observation, but, on the contrary. proved erroneous. The general direction of the galleries is upwards. The life-cycle (adult-adult) is of roughly two years duration, but cases where this has taken three years are on record. Pupation takes place in the Autumn., an metamorphosis is usually complete by mid-Winter, the newly-formed adult remaining inside its "cell", deep in the heartwood, until the Spring.

Prior to 1959, various attempts at controlling *Cerambyx* were in vogue. Nearly all were aimed at the larval stage. The most popular was the introduction of a long strip of thin wire into the borrow, and the eventual destruction (sometimes) of the larva by probing. Another method advocated was the introduction of Lysol. or even Kerosene, into the bur-

row — a method which must not have improved the tree's health! A technique sometimes used by the more irascible and less prudent section of the community was the shaving away of strips of the bark, cambium, and wood, until the larva was exposed in its burrow. A later method, which was a little more efficient than its predecessors, was the introduction of a small quantity of BHC powder into the burrow near the entry hole, and plugging the hole with clay or cotton-wool. The only method advocated against the adults was the spraying of milk of lime on to the lower 18 inches of trunk, or painting it with the same chemical. The method was not very effective, soon falling into disuse - in this case, the method being good, but not the particular chemical available.

In 1960, experiments against the larval stage were abandoned as a long-term policy, mainly for the following reasons:

i. The labour involved in finding each individual entry-hole is prodigious, especially in groves with a heavy infestation of long standing.

ii. The entry hole can be detected only after an appreciable amount of "frass" has fallen on to the soil. As a matter of fact most holes are only found after a minute survey of the soil around the trees, the probable point of origin in the trunks being calculated from the position of each small heap of frass. Apart from this, the presence of frass in itself indicates that an appreciable amount of damage has already been done.

iii. The method is not effective enough to affect the overall position to any great extent. Even after the entry-hole has been detected, the length and tortuousness of the gallery often prevents successful "wiring" of the larvae, while collection of frass and other debris (which collection is considerable) at various points within, or throughout the whole length of, the burrow usually succeeds in blocking the penetration of insecticidal fumes.

Control methods against adult beetles and newly-hatched larvae were started in 1960, and were based primarily on R. G. Tapley's successful control of the White coffee borer, *Anthores leuconotus* Pasc. in Tanganyika. A Dieldrin spray on the lower part of the trunk and main limbs, and the surrounding soil gave very good control of the beetles, a large percentage of ovipositing females and practically all larvae (except those of the preceding year, deep in the heartwood at the time of treatment) dying on treated trees. The only infestations developing were at points above the spraying level, and where low-hanging fruit had prevented the point of the trunk in question from being adequately covered by the spray. Various systemic insecticides were tried concurrently, but gave only mediocre results at best.

During the first and second year's trials, Dieldrin was used at a concentration of 0.5% a.i. (The E.C. formulation giving a slightly better result than the W.P.). Chlordane, tried during the second year at the same dilution gave good results, but not as well as Dieldrin. In 1962, both materials were applied as a High volume spray only (some of the tests in 1960 and 1961 utilised Low-volume techniques, which were discarded owing to insufficient coverage) at a final concentration of 0.4% a.i. Both materials gave very satisfactory results, which have been re-confirmed in 1963. Tests were carried out on various units totalling about 1,000 trees.

Since the results of spraying do not become tangibly evident until at least two treatments have been effected, the general reaction among farmers was one of disappointment, since they expected all the larvae inside the trees to die. In sites where three annual treatments have been carried out, the quasi-complete absence of frass on the soil-surface has gone a long way towards changing this reaction. As an additional measure, principally for psychological reasons, an ancillary method aimed at the larval stage is being provisionally recommended together with the "adult" operation. This consists in applying a small tube containing paradichlorobenzene paste to the entry hole, and squeezing a little of its contents into the burrow, the hole being plugged with clay. This has both rendered the old method slightly more effective, and comforted the recipients!

Recommendations for control of *Cerambyx* were given to farmers as follows:

1. During the Autumn, plug each entry-hole with clay, after applying a small quantity of fumigant.

2. The main operation — As soon as the first adult beetles are seen in the grove (usually April/May) spray or paint the lower portions of the trunk and the surrounding soil with an 0.4% a.i. dilution of Dieldrin or Chlordane Emulsifiable concentrate. One annual treatment is sufficient.

Precautionary measures given include the wearing of rubber gloves and boots and as much clothing as possible (the maximum worn is denim overalls). A strong warning to discard any fruit hit accidentally by the spray has been given.

Tapley included a heavy dose of sticker, plus methylene blue for coloration, in his recommendations against *Anthores*, the former because heavy seasonal occured soon after application. As no rain usually occurs before October in Malta, any showers occurring before that date being generally insignificant, the need for sticket was felt to be superfluous. It was also felt that a good coverage was obtained without adding dyes to the mixture, experiments performed by individual farmers under the Department's supervision confirming this view.

Control of *Capnodis* is rendered more difficult (as compared to *Cerambyx*) by the fact that the larva has the roots as its main sphere of activity, and leaves no visible sign of damage until it is far too late to do anything worthwhile. The accepted method of controlling the pest was, like *Cerambyx*, applying a thin piece of wire into the burrow, with the uncomfortable additive of having to dig the soil around the trunk and expose the main roots before starting to look for the entry holes. Various experiments with soil insecticides and soil fumigants were tried against *Capnodis*, but the effect against the larval stage was negligible, the only casualties being a few individuals who migrated from one root to another via the soil. Tolerable control of the adult beetle and newly-hatched larvae has now been obtained by applying Dieldrin or Clordane to the lower few inches of the trunk and drenching the soil. It has been found essential to expose at least the junction between the trunk and main roots and part of the latter for control to be in any way satisfactory, which means that the method is more laborious than that used against *Cerambyx*.

Zeuzera infections present a different problem in that the site of damage is high in the branches and twigs, and it is impossible to apply a high-concentration spray without rendering the fruit unfit for harvest due to toxic residues. The problem has been satisfactorily solved by utilising the standard Colding-Moth programme, which is applied on the same crop at the same time of the year, spraying the whole tree thoroughly instead of paying special attention to fruit-bunches only. The same principle, utilising the low concentration (0.2%) Dieldrin spray against Mediterranean fruit fly, has led to a similar reduction in *Zeuzera* infestations on other crops.

2. Scale Insects.

It has never been really difficult to achieve some form of control over the numerous species of scale insects which infest every tree-crop and some ground crops, but the practice of spraying trees against scales only when infestation becomes so heavy as to constitute an eyesore has led to little reduction in the overall population. Some trees left unsprayed for two or more years develop such an infection that the trunk is invisible, and the problem has been slightly more complicated in the past by the fact that most amateur gardeners did not really know that the scales were pests. Prior to 1958, Light Petroleum oils were the only chemicals used for control, and the scale problem is interesting in that the only successful attempt at Biological Control is found in this field. The Fluted Scale, *Icerya purchasi*, introduced from Sicily during the early part of the century, spread to such an extent that Government passed a regulation compelling owners of infested trees to destroy them, and Officials of the Department of Agriculture had the right to enter any site to see that the law was enforced. Matters were eased by introducing the ladybird *Novius cardinalis*, breeding it in the Government Laboratory, and distributing it throughout the Island. After some years, the predator established itself, and the law was no longer enforced. The introduction of Malathion in 1958 finally solved the scale problem, two applications at 0.1% a.i. being sufficient to achieve complete control.

Since 1960, control has become a matter of choice of chemical. Dimethoate (Roger), Diazinon, Chlorthion, Fenthion, Folithion, and Trichlorphon have all given results as good as Malathion, most of them at lower dosage rates, and on one single application.

3. Mediterranean Fruit Fly.

The climatic conditions of the Maltese Islands provide the Mediterranean Fruit Fly, *Ceratitis capitata* Wied. with an uninterrupted host-sequence for eight months a year. Adults are very much in evidence between April and November, and in exceptionally mild Autumns, have been known to persist up to early December. The major sufferers are Citrus, Peach, Fig, Apricot, Medlar, Loquat, and Indian Fig (Prickly Pear). Attacks on the main crop of Pears are negligible, but are heavy on fruit maturing after July. Infested Apple fruits have been recorded, but the incidence is so slight as to be of academic rather than economic importance.

Ceratitis capitata is calculated to have first reached economic proportions in Malta round about 1975. (Bodenheimer, 1951). Allowing a few years for its build-up, this sets a probable date of introduction at 1870, possibly slightly earlier. There is no mention of the fly in Gulia's 1858 text-book, and the first official publication available is Tagliaferro's leaflet, issued in 1893. Since that time, and up to 1957, no practical remedy was discovered, and it is only since 1958 that infestations have been brought under control.

According to Borg (1922), there are four generations per year, the first adults emerging in two waves — one (in the orthodox method) from overwintering pupae, and the other from overwintering eggs. Citrus fruit left on the trees from the preceding Autumn are the recipients of this generation, becoming infested in April. By the same author's account, the second generation attacks early varieties of Fig, Peach, and Apricot, the third later varieties of the same fruit, and the fourth Citrus fruits in Autumn.

This account is not quite correct. Between April and June (possibly July), generations are easily idenifiable, but from July to October, the overlapping of host-material, the longevity of the adult fly, and the short development cycle due to the hot humid weather, makes it difficult, to say the least, to distinguish between different generations and assign these to particular hosts. Citrus fruit are subjected to a practically continuous infestation between August and November, and there are *at least* two generations on this crop alone.

Infestation on Indian Fig (*Opuntia ficus indica*) are left to develope unchecked, principally because of the uneconomic cost of applying control measures. As a result the fly finds an abundant breeding ground between August and September on both standing and (mainly) fallen fruit, and the practice of planting Indian fig on tthe borders of Citrus and other groves for wind-break purposes has contributed in no small measure to the eventual infestation of Citrus. It is difficult to gauge exaetly when the practice of planting *Opuntia* on grove-perimeters started, but the following extract from a "Report on Agriculture in Malta" by J. Dawson Shepherd in 1920 affords a probable clue. The author states "For protection from wind there is to hand a most effective wind-break in the Prickly Pear, which forms an excellent hedge and is itself a revenue producer. "There is no doubt as to the very good value of *Opuntia* as a wind-break, but the facts that (a) the price of the fruit cannot stand the cost of a spraying programme, and (b) a large proportion of the fruit, being full of seed, are not altogether fit for human consumption and are therefore left to rot beneath the trees, have resulted in the local farmer unconsciously creating a splendid alternate host for the fruit fly to proliferate upon. The fruit fly also utilises the Wild Caper, *Capparis sativa* v. *rupestris* as an alternate host. The Wild caper grows practically all over the island, along roadsides, on rocky ground, and on old, ill-maintained, rocky fortifications. The larvae often hibernate there, completing their metamorphosis inside the dried fruit. (Borg, (P), 1933).

Between 1893 and 1957, several methods of control were attempted, each method following the current international trend. In rough chronological order, these were as follows:

a) Killing the flies off one by one by squashing them between the finger and thumb, after first attracting them with honey (smeared on the finger). The author of this technique has claimed to have destroyed upwards of hundred adults in two hours.

b) Spraying with arsenicated syrup, and formalin-syrup mixtures.

c) Prompt removals of windfalls, and their destruction with quicklime.

d) Injecting carbon bisulphide into the soil around the trees.

e) Spraying with a 1 in 32 solution of soft soap in water, or dusting heavily with sulphnr.

f) protecting the fruit with muslin or paper bags.

g) Hanging bait-bottles from the branches.

Each of these methods was better than nothing, and some of them have achieved satisfactory, if not entirely successful results, especially in small private gardens, and when more than one method was used simultaneously. Spraying with DDT and Lindane in the early post-war period yielded no appreciable results. Since DDT is still in use in several parts of the Mediterranean basin against *Ceratitis* with good results, several theories have been advanced to account for its local failure. No plausible theory has as yet been offered, but research into the matter, started recently, has already produced what appears to be a valid explanation, and field tests this year are expected to yield a satisfactory solution to the problem.

In 1957, Dieldrin 50% Wettable Powder was applied as an experimental measure, and three to four sprays at 0.1% a.i. were found to be ettremely effective at 4-week intervals. This with regard to Citrus. The same spray proved effective for all other fruit, but as the danger-period is much shorter than for Citrus, 2 sprays at the same interval are usually sufficient. The treatments became a regular measure in 1958, and since that year there has been excellent control of the fly wherever treatments were carried out. In many cases, not even one single fruit dropped.

The necessary measure being achieved, attention was turned to the long-term implications of the problem. Dieldrin for control of Mediterranean Fruit Fly has a number of disadvantages. It presents the applicator with a text-book remedy against a particular pest, but has never really been designed, as it stands, to synchronise itself with other measures, and its use has solved the primary problem and raised several secondary ones, the main ones being the resultant scale insect infestations on Dieldrin-treated trees, the potential residue problem, and the risk of pest resistance. In 1960, experiments were initiated with the view of eliminating these side-effects to the greatest extent possible. Tests with combination sprays, principally Fenthion plus Dieldrin, Diazinon plus DDT. and Rogor plus Dieldrin have both achieved simultaneous control of Fruit Fly and scale insects, and increased the residual effect of the spray to 6 weeks, reducing the total number of sprays from 5/6 (including 2 against scale insects) to 2. This has been restricted to Citrus. Research against the pest on other fruit is still in progress.

4. Potato Tuber Moth.

Gnorimoschema operculella Zell., the potato Tuber Moth, is the only insect of major economic importance on potatoes in the Maltese Islands, and has been a long-standing headache to the local Export Trade. It has also been recorded on Tomatoes, but not to any extent.

According to P. Borg (1932), there are five to six generations per year, the earlier ones developing on the haulms and exposed tubers, and the later ones on stored tubers. The first adults are noted by the Author as appearing on the Spring crop in the middle of May, by which time (according to the author in question) the bulk of the crop has already been lifted and exported.

This might have been the case in the early '30s, but in actual fact, at present the

Spring crop of potatoes reaches its export peak (at the local quay) in the latter half of May, and sometimes extends into the first week of June. Emergence of the first Moths depends on climatic conditions, but is usually during early May. As a result, the crop suffers rather heavily.

Potato Tuber Moth represents the only major economic pest against which no properly-organised method of control is generally available, This is probably due to the low priority the pest has been given. A line of approach has now been worked out, and is being put into operation during the 1964 season.

The main difficulty is the storage aspect. Most potatoes are stored underneath a convenient tree, usually covered by layers of seaweed. Other storage-sites are caves, abandoned pill-boxes, and a variety of permanent structures. The period of storage is indefinite. Produce packed for export within a short time of harvest generally remains unamaged unless it has already been attacked in the field (Tubers lying near the soil surface are particularly prone to infectation) but any produce left in storage for any particular length of time is apt to degenerate to the point of worthlessness after some weeks.

As these "storage-depots" are used for the same purpose year after year, and hardly any control or disinfestation measures are carried out, a considerable moth population may pass all the stages of its life-cycle inside the building, hibernation taking place in rotten potatoes left lying about, or among the tangle of seaweed and other debris.

In the field, although the Spring crop is generally all harvested by the end of May or early June at the latest, there is always a small Summer crop in irrigated areas, and the pest develops and propagates on this crop. In favourable conditions, particularly during dry Autumns, the last generation of adults has been known to persist until late October.

Recommendations being given to farmers for next season include:

a) Complete and thorough disinfestation of storage sites.

b) The addition of a foliage insecticide to the last spray application against Potato Blight. This will be followed by one spray of insecticide on its own if the residual effect of the chemical used is of short duration.

c) Application of haulm-killers.

Insecticides envisaged for use are Malathion, Diazinon,and Dieldrin. Owing to the residue problem, it would not perhaps be appropriate to use any systemic chemical more toxic than Malathion. Provided co-operation is forthcoming, there is no valid reason why Tuber Mothe should not come under satisfactory general control within the next two years.

5. Codling Moth

Cydia pomonella has been firmly established locally as a serious pest of Apples and Pears for a considerable period. The control problem, though still acute, has always been slightly easier than other major ones. Up to the late 1950s, DDT sprays were in common use, having superseded the standard early post-war Lead Arsenate treatments. The overall effect achieved was never spectacular. In 1958, a U.K.-type combination programme involving DDT and Malathion was tried, but found ineffective. In the same year, a small pilot trial using Malathion only at 10 to 15 day intervals proved highly successful, and is the standard treatment at the present time.

Cydia adults emerge in early May, and are active until early July. Their peak of activity is reached around late June, infestation gradually decreasing after that time. The short residual effect of Malathion necessitates a spray-programme of at least five and sometimes up to seven applications, and during the peak season, the heat and resultant increase in the pest population requires the interval between successive sprays to be cut down to eight days.

The unwieldy spray-programme enforced by Malathion has led to experiments with residual chemicals to try and increase the intervals between sprays. The fact that, unlike citrus, Apples and Pears are harvested over a period, raises no problem from the residue aspect, as the residual chemicals can be used in the initial period, Malathion being reverted to as harvest time approaches. So far, Dimethoate has given the most spectacular results, an 0.15% concentration (of the 30% E.C. formulation) cutting down the number of sprays to two. The same result has been achieved with Diazinon, Fenthion and Chlorthion. Sevin has reduced the number of applications to three. Field-scale tests have been performed over the 1963 season, and will require at last another season' full-scale experimentation before any general recommendations are issued to farmers.

6. Grape Berry Moths

Polychrosis botrana Schiff. and *Polychrosis viteana* Clemens are mentioned in early local entomological literature as being major pests of Grapes in Europe and North America respectively. It was in fact only in 1959 that the former was officially identified in the Government Laboratory, so that introduction has taken place only in the recent past.

The Lepidoptera constitute a group which has been the favourite of amature entomologists the world over, and a study of local contributions to the "Entomologist" revealed that one individual of *Polychrosis botrana* had been recorded by De Lucca in 1949, in the Naxxar area. This can be taken as the approximate date of introduction into Malta. A survey held in 1959 produced the information that the characteristic damage to grapes started being noticed by growers round about 1955. As the secondary effects-rotting of the bunches, are far more noticeable than the puncturing of the fruit by the larvae, the trouble was attributed to some disease, the culprit escaping official notice for four years.

By 1958, although the pest was not officially recorded, its presence was suspected, and DDT was tried as a routine control measure. Although this is the recommended measure in the Mediterranean area, no results were achieved, and Malathion was tried in 1959 with better results. This, however, has not been recommended for wine-grapes, as laboratory tests on treated grapes resulted in a peculiar tang on vinification. This is being confirmed, and the results will determine whether Malathion will be recommended as an official control for next season. Chlorthion and Dimethoate have given satisfactory results.

The first adults of *Polychrosis botrana* have not, so far been encountered before August, and there appear to be two generations of the pest per year, the first emerging at the end of July, the second a month later.

In 1960, a survey carried out in vines during winter revealed the presence of considerable amounts of small oval pupal cases lying in crevices in the bark. On breeding, these turned out to be *Polychrosis viteana* Clemens, the American species of berry moth. In the summer, examination of the foliage revealed the characteristic oval holes, made by the larva in preparation for pupation. The first generation of *P. viteana* emerges in April, and two more generations, in July and August respectively, have been confirmed.

As the damage done by both species is characteristically similar, the only difference being that *P. viteana* starts its activities considerably earlier, a survey yielded little information, as the comparatively light,early damage is hardly noticed. The date of introduction of this species must therefore remain a matter for conjecture.

A regular spraying programme, based on the U.S.A. recommendations for *P. viteana* and consisting of a series of sprays at monthly intervals between April and July, and two sprays in August, has been found satisfactory for both species.

PART SIX

INSECTICIDES AND OTHER CHEMICALS IN GENERAL USE IN MALTA.

As has already been explained, No insecticide in the high mammalian-toxicity group is recommended for use in Malta. The list below gives those chemicals which are now in general use.

Organochlorines.

Aldrin — used against soil insects, principally mole-crickets and cutworms. The more widely-used formulation is the 40% Wettable Powder, which is either mixed with bran, then scattered in the form of baits, or (sometimes) used broadcast, or mixed with irrigation water. The 4% dust formulation is also used, but not very much.

BHC — Usually called Agrocide, after the first brand to be introduced on the local market, it has very much the same uses as Aldrin, except on potatoes. It is also used against wood-boring larvae, a small amount of powder or dust being put on a bit of cotton-wool, and the borer's entry hole plugged. There are several formulations of BHC on the local market.

DDT — There are two "popular" formulations, the 50% W.P., and the 25% E.C. DDT is used mostly against Lepidopterous larvae on brassicae, on olives for weevils, and some other foliage feeders. It is used on Citrus in April for control of Aphids.

Dieldrin — The 50% Wettable Powder formulation is used almost exclusively against Mediterranean Fruit Fly on various crops. The 20% E.C. formulation is used against Wood-boring beetles on Apples and Pears. Dieldrin is used against grasshoppers or locusts whenever the number of individuals in any field or garden demands it.

Gamma-BHC — The 20% E.C. is the most widely used formulation for variety of crops. mostly against foliage feeders and aphids.

Organophosphates.

Dimethoate (*Rogor*) — There is only one formulation of Dimethoate, the Emulsifiable concentrate, which is used in Malta. The Wettable Powder has still to be introduced into general use. The chemical is used for a variety of purposes, mostly against Aphids, scale insects, and some Lepidopterous larvae.

Malathion — Sold principally in the 50% E.C. formulation at present, Malathion can be described as the most widely used insecticide in the Maltese Islands. There are very very few pests it does not control, its only snag consisting in its short residual effect.

Miscellaneous.

Sulphur — used for control of russet mite n tomatoes, either as a dust, or in the 80-99% wettable formulation. Sulphur is of course also widely used in Malta as a fungicide.

Oils — Several brands of the "light summer" type are used for scale control, mostly on Citrus.

Apart from these, several combinations are used by amateur gardeners, usually imported in small packs from U.K. Most of the brands of these used in England are on the local market.

Insecticides which have only recently passed the experimental stage, and are still in the process of gradually ousting the better-known types for certain operations, are Chlorthion, Fenthion, Diazinon, Sevin, Methoxychlor, Chlordane, and Kelthane.

Specialised formulations, such as Atomising concentrates, Fog solutions, smokes, and aerosols, are still in the experimental stage. It is doubtful whether those types requiring special machinery for their application will ever become general, as the price of fogging machines, etc., is not an economic proposition for the local farmer, the more so when one considers the restricted use the machines will be put to. Several large-scale growers, however, are already realising the value of specialised machinery and insecticide formulations which do not leave a visible deposit on the fruit (which is a factor of considerable importance in glasshouse crop production) and it is expected that the new materials will soon be in general field use, at least among this particular section of the community.

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