ORGANISATION INTERNATIONALE DE LUTTE BIOLOGIQUE CONTRE LES ANIMAUX ET LES PLANTES NUISIBLES (OILB)

INTERNATIONAL ORGANIZATION FOR BIOLOGICAL CONTROL OF NOXIOUS ANIMALS AND PLANTS (IOBC)

IOBC Newsletter

n° 21-22, 1981
November

IOBC is affiliated to the International Council of Scientific Unions (ICSU) as the Section of Biological Control of the International Union of Biological Sciences (IUBS)

Contents

News from the Secretariat

1. IOBC/WPRS Activities

IOBC/WPRS Integrated Control of Soil Pests Working Group. Summary of the Report of a Meeting held at the Institut für Phytomedizin, ETH, Zurich, Switzerland, 2-4th February 1981.

The meeting was attended by 34 participants from 10 countries. In between the initial and final plenary sessions, the Subgroups met to discuss the past work and future plans of their collaborative projects.

Pathogens of Nematodes Subgroup

In a field trial carried out in the Netherlands, West Germany, Denmark and the UK, application of the fungicide captafol, at 60 kg/ha into the seed bed, increased cyst nematode *(H. avenae, H. schachtii)* multiplication, and parasitism in eggs examined post-cropping was lower in treated plots. *Verticillium chlamydosporium, Cylindrocarpon* sp. and the undescribed « contortion fungus » were identified in eggs.

Following application of chlamydospores of *V. chlamydosporium* at 1500/g soil in plots containing 100 cysts of *H. schachtii*, there was an increase of 14-21 % in infection of nematode eggs from the 16 % parasitised at the start of the experiment. Chlamydospores applied before planting had no effect on numbers or fecundity of *H. schachtii* or on the numbers of eggs parasitised. The great variability between isolates of *V. chlamydosporium* extracted from soil is a major problem in these trials.

Details of a study to follow beet cyst nematode population changes and fungal parasitism under intensive sugarbeet cultivation are outlined.

Secretary-General : G. MATHYS, 1, rue Le Nôtre, *FR-75016 Paris* (France).

A method for extracting spores of the nematophagous fungi *V. chlamydosporium* and *Nematophthora gynophila* which is less time-consuming and more reliable than methods based on recovery of diseased nematodes was described.

A West German researcher is interested in receiving 200 g samples from the surface layers of soil from different habitats as she is making a survey of nematophagous fungi (Ulrike Dürschner, Biologische Bundesanstalt für Land- und Forstwirtschaft, Institut für Nematologie, Toppheideweg 88, D-4400 Münster, West Germany).

Pathogens of Soil Pests Subgroup

The findings of the Subgroup's experiments between 1978 and 1980 are outlined. In a survey of virus infections in *Agrotis segetum* populations, there was a high incidence of NPV and *Tarichium* = *Entomophthora* in 1980 in Poland, and no clear evidence for natural occurrence of segetum GV in Denmark. The following reference antisera to viruses of *A. segetum* are now available for use in examining virus isolates : NPV (Britain), NPV (France) and GV (Denmark). In an investigation into the role of soil as a reservoir for insect pathogenic viruses, although the rates of decline in virus concentration (NPV of *Mamestra brassicae*, GV of *Pieris brassicae)* appeared large, sufficient virus to theoretically kill 1st instar larvae would still be present in 5 years time. Whether this virus is fully available for initiating infection remains in doubt. Outline details are given of a collaborative project with the Sugarbeet Seedling Pests Subgroup to survey the incidence of pathogens in soil-dwelling pests of sugarbeet. Promising microbial agents may be investigated further with regard to their potential use in an integrated control programme.

Integrated Control of Seedling Pests of Sugarbeet Subgroup

Brief individual reports from Switzerland, Great Britain, Netherlands, Belgium, West Germany, Ireland and Austria are given. The main conclusions were as follows : – a late application of herbicide is better than a pre-emergence one ; – continuous sugarbeet greatly increased *Atomaria* attacks and control with lindane and aldicarb, although good, is not completely reliable. Sugarbeet in alternate years would probably be a good compromise ; – organic matter increased seedling establishment, yield and numbers and diversity of arthropods.

Collaborative Work in 1981/82

It was decided to integrate the work of the Subgroups much more, and to concentrate as much as possible on the sugarbeet crop. All groups except Austria agreed to continue the work on the effects of organic matter. It was agreed to pay more attention to the effects of the treatments on nematodes. The effects of predation by carabid beetles on populations of sugarbeet aphids should be looked at more intensively

The next meeting, which will be restricted to 35 residential participants, will be held in January 1982, at the Landesanstalt für Pflanzenschutz, Stuttgart, West Germany, at the kind invitation of Dr A. El Titi.

Management of Arable Farming Systems of Integrated Control of Pests, Diseases and Weeds. Summary of the report of a meeting held on 22-23 July 1981 at the Institute of Phytopathological Research, Binnenhaven, Wageningen, Netherlands. Convenor : C.A. Edwards.

This meeting, which was attended by 9 participants from the UK, Netherlands, France, Belgium and West Germany, was held to discuss how work might be developed within IOBC/WPRS, whereby farming systems and appropriate elements of farming systems could be compared with special reference to their pest management practices. Following an introduction by Drs C.A. Edwards and P.H. Vereijken, the following papers were presented :

- Review of integrated control in the Netherlands, Dr A.K.M. Minks ;
- Rotations and pest control, Dr C.A.A.A. Maenhout ;
- Integrated weed control, Dr H.F.M. Aarts ;
- A pest and disease management system for wheat (EPIPRE), Mrs V. Leeuwen ;
- An integrated arable farming system (Netherlands), Mr P.H. Vereijken ;
- An integrated arable farming system (West Germany) Dr H. Steiner.

There followed a general discussion on management of cropping and farming systems for integrated control.

Summary of Current Projects

i) West Germany, Lautenbach project : Dr Steiner

This project, on a 230 ha commercial farm, has been running for 4 years and is designed to compare productivity in fields in which a full conventional pest, disease and weed control programme is compared with that in fields in which a fully integrated control programme is implemented. The cropping rotation sequence is : sugarbeet, oats and vegetables, winter wheat, sugarbeet, vegetables, winter wheat.

ii) Netherlands, Dr Vereijken

This government funded project on a polder reclaimed 30 years ago was set up 3 years ago under the direction of P.H. Vereijken with 5 employees. The basic plan consists of comparison of conventional pest, weed and disease control, with a full integrated control (IC) system and a no-chemical-input (or biodynamic) system. The conventional and IC plots have a rotation of potatoes, winter wheat, onions and spring barley, and sugarbeet, while the no-chemical plots have a rotation of potatoes, winter wheat, winter rye, grass with Italian rye, red clover/alfalfa, grass/fodder beet/sugarbeet, winter wheat, oats, and clover/grass. The IC system involves minimal use of fertilisers and pesticides, and biological control measures, such as release of sterile male onion flies.

iii) France

Four experiments are being set up to study the effects of rotations of rape, wheat, peas, beans and sunflowers on productivity and integrated control of pests, weeds and diseases.

iv) UK

An experiment is beginning to compare productivity from conventional pest control on winter cereals using all pesticides required, with that from an integrated control programme with minimum input of chemicals.

Possible Inputs into Integrated Control in an Arable Farming System

The problems and possible inputs into a fully integrated system were discussed extensively and the following possible inputs listed :

i) rotations,
ii) minimal use of pesticides,
iii) minimal use of fertilizers,
iv) minimal cultivation,
v) integrated weed control,
vi) addition of organic matter to favour populations of beneficial organisms,
vii) undersowing,
viii) use of resistant crop cultivars,
ix) cultural methods e.g. timing of sowing, cultivations etc.,
x) biological control e.g. release of *Trichogramma*, *Entomophthora*, sterile males, pheromones, microbial pesticides, encouragement of natural control agencies e.g. soil arthropods.

Recommendations

Briefly, the recommendations of the meeting were that :

1. An IOBC/WPRS Study Group be set up for 1-2 years to investigate the possibility of a collaborative project on management of arable farming systems for integrated control of pests, diseases and weeds.
2. The Study Group should discuss the setting up of national collaborative experiments for comparing appropriate farming systems, and should also consider important elements of cropping systems that influence pest, disease and weed incidence and their control, and which could be examined critically in collaborative experiments.
3. Members of existing Working Groups already studying components that may be important in relation to pests and diseases of the overall farming system of which the crop forms a part should be encouraged to participate in the farming system's activities and, where possible, broaden or orientate their work appropriately.
4. The EEC be approached for possible funding for such a project.

Report of the Meetings on « Biological Control of Pests in Orchards » and « Biology and Control of Codling Moth ». IOBC/WPRS Bulletin (1980) III (6), 88 pp (in English)

The first meeting was organised by the IOBC/WPRS Working Party on Integrated Control in Orchards ; it was also accepted as an « exchange of scientists » by the Standing Committee on Agricultural Research of the Commission of the European Communities (EC), as a part of their programme on biological and integrated control of pests. The second meeting was organised by the IOBC/WPRS Group on Codling Moth. Thirty-two people from nine countries attended one or both meetings. This issue of the *Bulletin* contains a summary of the main results (pp 1-2), a proposal for a standardised experimental procedure for field tests on biological control of *Panonychus ulmi* in integrated pest management in orchards (pp 9-12), a set of conclusions and recommendations (pp 3-4), and summaries of the papers presented. There were 42 papers in all and brief outlines of them are given below :

G. Fauvel & P. Atger (FR) : Evolution of pear (Psylla pyri) and beneficial insects in pear orchards of southeastern France in 1979, p 13

Populations of pear psylla and various predators were monitored in two orchards under different management. The only important predator of *P. pyri* was *Anthocoris nemoralis*, although *Deraeocoris (Knightocapsus) lutescens* and chrysopids may have played a role. Management procedures had a marked effect on the predator.

C.A.M. Campbell (GB) : Integration of chemical and biological control of pear psylla in Kent, p 14

Because of a build-up of resistance to organophosphorus insecticides, an integrated control programme has been developed to control *Psylla pyricola*, incorporating the predator *Anthocoris nemoralis* and selective pesticides such as permethrin (at bud-burst) and amitraz (post-blossom).

E. Niemczyk, M. Pruska & R. Olszak (PL) : Role and effectiveness of predators in controlling aphids in apple orchards, p 15

Coccinellids, including *Adalia bipunctata*, *Coccinella septempunctata*, *Propylea quatuordecimpunctata*, can destroy 20-50 % of potential aphid colonies in the spring. Other predators which help reduce numbers of aphids, and therefore damage, include Syrphidae and cecidomyiid midges.

M.G. Solomon (GB) : An electrophoretic method for analysing the diet of predators, pp 16-17

Electrophoresis provides a simpler and quicker alternative to immunological techniques for detecting prey proteins in the gut of a predator. A polyacrylamide concentration gel is used, with subsequent staining for esterases.

E. Niemczyk (PL) : Bark bug, Anthocoris nemorum, as an effective predator of fruit tree red spider mite, Panonychus ulmi on apple, p 18

A. nemorum acts as a density-dependent factor in controlling *P. ulmi*. The predator is seldom numerous enough in Polish orchards to maintain mites at a low level for the season, but by introducing alternative food, such as *Sitotroga cerealella* eggs, better control was obtained.

H. Steiner (DE) : The role of anthocorids and mirids in controlling fruit tree red spider mite in orchards in Baden-Wurttemberg, pp 19-22

Together with gradation-repressing predators (e.g. Phytoseiidae), anthocorids (*Orius* spp., *Anthocoris* spp.) and mirids (*Blepharidopterus angulatus*, *Malacocoris chlorizans* and *Campylomma verbasci*) may build up an effective controlling system against economic losses caused by spider mites on fruit trees.

E. Pasqualini (IT) : The role of Stethorus punctillum in the integrated control of the European red mite in apple orchards, p 23

In 20 % of the orchards observed, chemical treatments against the European mite are no longer necessary as populations are kept low by the predatory coccinellid *S. punctillum*. Methomyl (used against leafminer larvae) is particularly harmful to *S. punctillum*.

M. Baillod (FR) : First experiments with Phytoseiidae in apple orchards, p 24

Releases of *Typhlodromus pyri*, *A. finlandicus*, *A. aberrans* and *A. andersoni* in July and August gave better results than in March to June ; populations of these predators developed around the point of release until autumn but were not evident the following year (June).

G. Fauvel (FR) : Evolution of Panonychus ulmi populations in an apple orchard located near Avignon and receiving no insecticide sprays, with observations on the population dynamics of Amblyseius (Kampimodromus) aberrans (Acari : Tetranychidae, Phytoseiidae), p 25

P. ulmi surpassed the economic threshold in 3 out of 5 years (1975-79). Phytoseiids increased rather slowly in the

first few years and were nearly eliminated by fungicide sprays in 1978. Elm trees played a limited role in recolonisation. There was a decrease in populations each year in summer both on elm and apple.

P. Gruys (NL) : Experience with biological control of fruit tree red spider mite by phytoseiid mites in apple orchards in the Netherlands, pp 26-29

It took 4 years following release of *Amblyseius finlandicus* and *Typhlodromus pyri* to achieve the very low spider mite densities characteristic of this predator-prey system. There was a gradual shift in species composition after colonisation of the orchards by the phytoseiids. Frequent application of certain pesticides, particularly fungicides such as triamiphos and dichlofluanid, will eradicate the predators.

M.G. Solomon (GB) : Predators of spider mite : natural colonisation and artificial introduction, pp 30-31

Two strategies are compared : use of selective insecticides, principally pirimicarb and diflubenzuron, allowing natural colonisation by native predators (mirids, anthocorids and *Typhlodromus pyri)* ; use of OP insecticides and artificial introduction of OP-resistant *T. pyri.*

W.P.J. Overmeer (NL) : A comparative study of the effect of some pesticides on three predatory mite species : Typhlodromus pyri, Amblyseius potentillae and A. bibens, pp 32-34

No differences were found in response to karathane, zineb, maneb, sulphur, pirimor, thiodan, gusathion, plictran and torque. It would thus appear that *A. bibens* is a good substitute for orchard mites for testing the adverse effects of pesticides. Differences in response to benlate, however, were found.

J.B. Ford & F.M. Giboney (GB) : Video recording techniques for studying predatory mite behaviour, p 35

85-95 % of the predators' day is spent at rest. The highest level of feeding is associated with shorter rests and long periods of alternating movement and pause. Feeding is correlated with oviposition, there being a direct linear relationship between the number of prey eggs consumed and the number of predator eggs laid.

P. Genduso (IT) : Integrated pest control in Sicilian orchards, p 36

The most serious pests are *Laspeyresia pomonella* on apple, *Psylla pyri* on pear and *Ceratitis capitata* on peach ; the approaches to biological and integrated control of these insects is described.

P. Gruys (NL) : Abundance and parasitization of leaf rollers in integrated control in the Netherlands, in relation to the pesticides used, pp 37-39

Studies were carried out on 0.5-1 ha plots with four variant IPC programmes : IPC alone, IPC plus Dipel *(Bac. thur.),* IPC plus Dimilin and IPC plus Ro 10-3108/18 (epofenonane). With IPC, *Adoxophyes orana* was less important and *Spilonota ocellana, Pandemis heparana* and *Archips podana* predominated. There were no significant differences in parasitisation by ichneumonids and braconids between the plots. The phenology of *Colpoclypeus florus,* an ectoparasitic eulophid parasitising *Adoxophyes,* was studied in detail.

K.P. Carl (CH) : Observations on the apple leaf-curling midge, Dasineura mali, and a new cecidomyiid on apple, Macrolabis sp., pp 40-43

The status of *Macrolabis* is not certain but studies indicate that it is phytophagous and induces leaf galls which are indistinguishable from those of *D. mali* ; the species may be more widespread and more destructive than realised. The life history and morphology of the two species is described with illustrations.

F. van der Vooren, T. Thym & P. Gruys (NL) : Natural enemies of apple leaf midge in the Netherlands, pp 44-46

Dasineura mali, a minor pest which tends to increase with IPC, will inflict economic damage in nurseries and young orchards. Three Hymenoptera were found to parasitize *D. mali : Platygaster demades, Torymus* sp. and, more rarely, *Inostemma* sp. Regarding predators, *Typhlodromus pyri* and *Amblyseius potentillae* were studied ; however, their effectiveness in reducing *D. mali* is not known.

G. Domenichini (IT) : On some carabids of the orchard soil and the effects on them of tillage, p 47

Preliminary studies in two peach orchards, one with grass and the other bare soil, showed the predominant species captured to be : *Harpalus distinguendus, H. rufipes, H. tardus, Pterostichus cupreus* and *Anisodactylus binotatus* ; all species were caught in significantly higher numbers in the orchard with a grass sod. Predacious species such as *P. melas* var. *italicus, Calathus melanocephalus* and *Bembidion lampros* were caught only in the grass-covered ground.

P. Giunchi (IT) : Possibilities of biological control of pear insects, pp 48-49

The antagonists of *Psylla pyri* recorded in 1977-78 in 8 orchards, two of which were never sprayed with pesticides, included 23 species of predators, 5 parasites and one fungus ; they varied greatly in incidence and composition depending on the agroecosystem involved. While pesticides alone cannot guarantee adequate control of *P. pyri,* biological control does not ensure the high quality pears required by the market.

H. Wilhelm (DE) : Experiences with integrated control in apple orchards, p 50

One ha of apple orchard containing Golden Delicious, Cox's Orange and Boskoop was subjected to an integrated control regimen incorporating fungicide applications against mildew and scab, insecticides and an acaricide ; the development of populations of beneficial insects was followed. With intensive observations and forecasting, it was possible to omit 2-3 treatments ; use of selective pesticides reduced the effect on beneficial insects.

E. Dickler (DE) : Field observations on the leafroller complex on chemical-, CmGV- and untreated apple trees, p 51

Chemical insecticides used for codling moth control also suppressed leafroller damage. In 1977 and 1979, a significantly higher leafroller infestation was found in codling moth granulosis virus treated plots compared with the untreated ones. Trap bands and shoot samples were not very useful for monitoring and predicting leafroller populations. *Adoxophyes orana* and *Pandemis heparana* were the principal damage causing species.

E. Niemczyk (PL) : Effectiveness of Trichogramma against codling moth, p 52

The results of releases of *Trichogramma* throughout the world are reviewed ; from an economic viewpoint, these were not very satisfactory. An experiment carried out in Poland in 1978-79 to explain this low effectiveness is described ; the parasite halved the number of wormy fruits one year but had no effect the next.

E. Mani & Th. Wildbolz (CH) : Pimpla turionellae as a pupal parasite of codling moth in Switzerland, pp 53-54

Reared codling moth larvae were placed in orchards in four localities in Switzerland and subsequent parasites identified. In most batches, only *P. turionellae* was present, parasitism ranging from 0 to 47 %. Parasitism was greatest in larvae exposed mid-May to mid-June.

H. Audemard & P. Ferron (FR) : Codling moth control with Beauveria bassiana in orchards, pp 55-57

A field experiment using *B. bassiana* strain 93 against *L. pomonella* is described ; no significant difference in mortality was found between treated and untreated plots but emerging adults seemed less vigorous. A more concentrated conidial suspension was used the following year, with consequent high mortality.

J. Huber (DE) : Field persistence of the codling moth granulosis virus, pp 58-59

The addition of 0.2 % 2-hydroxy-4-methoxy-benzophenon prolonged virus persistence by one third (a 5-fold difference in virus concentration). Highest persistence was shown by an unpurified, air-dried preparation ; deposits at 10^8 virus capsules/ml persisted 2.8 times longer than the standard formulation, purified virus in 1 % skimmed milk powder (a 200-fold difference in concentration).

C. C. Payne & D.M. Glen (GB) : Codling moth granulosis virus production and preliminary field trials in the United Kingdom, pp 60-61

Mass-rearing on a simplified medium is used. Addition of methoprene at 2 ppm in the diet increases larval weight and extends the time period during which larvae are at their maximum size. Quality control aspects (e.g. purification, assessment of infectivity, biochemical comparison) are described. Assessments of apple damage in preliminary field trials showed that both virus and chemical gave significant reductions in deep damage. Virus treatment also reduced the larval population collected in trap bands at least as effectively as azinphos-methyl.

D.M. Glen, C.W. Wiltshire & N.F. Milsom (GB) : Effects of the use of codling moth granulosis virus on other orchard fauna, pp 62-63

There was an indication that sprays of virus and milk, applied at the time of attack by larvae of *Archips*, could have encouraged increased damage. Virus had no significant effect on damage by pith moth, *Blastodacna atra*. Counts of insect and mite predators and *Panonychus ulmi* at 2-wk intervals after spraying in 1978 showed no consistent differences between virus-sprayed and unsprayed trees.

E. Dickler (DE) : Control of codling moth with granulosis virus in the field, p 64

In 1978 and 1979 in the Heidelberg area, codling moth populations were very low, reaching only 3.3 % in untreated trees. However, the virus was as effective as previously, with reductions of 87 and 90.3 %, respectively. The skimmed milk component of the virus preparation appears to have negated the effect of a subsequent spray of ethephon to hasten fruit ripening.

M.G. Solomon (GB) : Pheromone trap catches of codling moth on a scale of day-degrees, pp 65-66

The warmer the climate, the more day-degrees elapse before the first catches of the overwintering brood. With some exceptions, the number of broods increases in step with the warmth of the climate, up to 4 or 5 per season.

J.E. Cranham (GB) : Timing the first spray against codling moth, p 67

The advisory service issues a regional warning to apply the first spray 10-14 days after the reference week : when 1) catches exceed 5 moths/trap/wk, 2) the heat sum equals or exceeds 100 day °C, and 3) dusk temperatures equal or exceed 14°C. For the heat sum, the simple formula

$$\frac{(\text{max.} + \text{min.})}{2} - 10°\text{C}$$

was shown to have no disadvantages compared with more complex formulae.

D.M. Glen & P. Brain (GB) : Pheromone-trap catch in relation to codling moth phenology, p 68

For first and second generation codling moth, the lag between catching moths in the pheromone traps and penetration of fruit by larvae was around 132-164 day-degrees above 10°C, and the curve for egg-laying lagged about 40-70 day-degrees behind. Combining field and laboratory data to predict the egg-laying curve for the population in the orchard indicated that there was either a shorter pre-oviposition period or shorter female life in the orchard.

A.C. Myburgh (GB) : Codling moth activity under high infestation potential conditions, p 69

Moth activity extends over periods of 6-7 months per annum in South Africa. Significant resurgence of codling moth occurred in ensuing seasons when normal spray programmes were withheld completely, even where the moth had previously been contained to low levels.

A.C. Myburgh (GB) : A monitoring system for codling moth under high infestation potential conditions, p 70

To prevent influx of male moths, a grid system of traps was set up, two ha per trap being optimum, but less than 0.5 ha per trap under high moth populations. In 400 orchards monitored experimentally for two years in South Africa, as many as 8 spray applications were necessary to achieve economically acceptable control where trap catches were consistently high.

M.A. El Idrissi Ammari & H. Audemard (FR) : Effect of temperature on fecundity and development of codling moth (Laspeyresia pomonella) : Application to forecasting methods, pp 71-72

Studies were undertaken in Avignon both in the laboratory and under semi-natural conditions to check certain aspects of a computer simulation model of the life cycle of the codling moth. It was concluded that 2 days above 18°C were necessary in the orchard for laying to occur. Larval and pupal development were also investigated.

R.B. Hutt (USA) : Intra-tree distribution of codling moth populations, p 73

Trapping results showed that the population was concentrated in the upper portion of the tree. Ratios of top to bottom catches ranged from a high of 94.1 to a low of 8.1, with an overall average of 14.5 : 1. In the polytrap trees, the presence of additional traps did not appear to influence the catches of the individual traps.

E. Mani & Th. Wildbolz (CH) : Influence of trap position on catches of codling moth, p 74

Traps at the top of a tree caught more moths than those at two lower levels. Traps in trees were much more attractive than traps placed on sticks a short distance away, while

catches in traps placed in very small trees were as low as in traps on sticks. These results can be explained by the relative ease of contact with pheromone plumes in tree traps.

E. Niemczyk & S. Predki (PL) : The effect of climatic and naturally-occurring biological factors on codling moth populations in South Poland, p 75

Because of unfavourable climatic conditions (night temperatures in May-July frequently below 15°C) and naturally-occurring biocontrol agents (e.g. *Trichomma enecator, Beauveria bassiana, Neoaplectana carpocapsae,* birds, mainly tits, *Anthocoris nemorum*), codling moth is a pest of minor importance in the Nowy Sacz region of south Poland.

D.M. Glen, N.F. Milsom, C.W. Wiltshire & J.A. Pickard (GB) : Effectiveness of diflubenzuron in relation to spray deposits, pp 76-77

In a combined field and laboratory experiment in 1979, the effects were measured of 5 different spray treatments of diflubenzuron on kill of codling moth eggs and neonate larvae, and how this related to spray deposits. Results indicated that ULV sprays gave patchy cover, the oil-based spray being better than the water-based one. Application by mistblower and hand-lance were also studied.

H. Audemard (FR) : Varietal susceptibility of pears to codling moth (Laspeyresia pomonella) injuries : consequences for supervised control monitoring, pp 78-80

The susceptibility of pears to larval injury by codling moth changes with fruit development : during the last 10 days of May, susceptibility was 20-40 % ; it declined and reached the lowest level in June ; then increased and exceeded the standard (Golden Delicious) in July and August. Seven varieties of pear were studied.

P.J. Charmillot (CH) : Four years mating disruption control against codling moth (Laspeyresia pomonella), p 81

Control trials were conducted with success over 18.1 ha from 1976-79 with 10 to 40 g codlemone (E-8, E-10 dodecadien-1-ol) per ha. There was no significant difference in disruption when the attractant was released from the top of tree crowns or lower down at 1.7 m or 1 m. Dispensers can be placed at one per 225 m^2 or even per 400 m^2.

E. Mani & Th. Wildbolz (CH) : A mating disruption experiment with codling moth : first years results, p 82

The disruption experiment, on a 0.9 ha apple orchard, used dispensers (impregnated with 80 mg codlemone) placed in May (1 dispenser/tree at the edge and 1 every second tree within the orchard ; 24 g/ha) with an average evaporation rate of 8 mg/h, range 0.5-17.5. Moth catches were almost totally eliminated in the test orchard ; they were low in the surrounding areas and high in the unsprayed orchard.

H. Audemard, F. Beauvais & B. Sauphanor (FR) : Controlling codling moth by communication disruption method with a synthetic sex pheromone : trials of 1978 and 1979, pp 83-85

Prerequisites for effective codling moth control by communication disruption include a low population level, relative isolation of the orchard from the infestation source, and adequate and regular diffusion of the pheromone, in this case E8 E10 DD-ol. Poor results were obtained when these conditions were not fulfilled.

Working Group on Integrated Protection in Orchards, Zaragoza (Spain), 22-24th April 1980. IOBC/WPRS Bulletin (1980) III (7), 60 pp (mostly in French, some Spanish)

This meeting was attended by 22 participants from Switzerland, Spain, France and Italy, and was the follow-up to a meeting held in Manosque (France) in September 1975, dedicated to the phytosanitary protection of pears in ten European countries.

The conclusions of the meeting are summarised on pages 56-57 :

- In most of the countries represented, *Psylla piri* on pear has been the predominant pest in the past ten years. *P. piri* can now be satisfactorily controlled by 1-3 insecticidal sprays each year ; good results have been obtained with diflubenzuron and insect growth regulators, which should ultimately replace conventional chemical insecticides, thereby favouring natural predators such as Anthocorids. Cultural modifications (tree shape and size, fertilisation, etc.) may also be used to restrict psylla populations.
- The use of varieties differing in susceptibility has facilitated linking treatments with the risk of damage caused by *Laspeyresia pomonella*.
- Further investigations are needed to add to the information accruing on control of polyvoltine tortrix moths : *Adoxophyes orana, Pandemis heparana* and *Argyrotaenia pulchellana*.
- Pests occurring locally require special control measures :
  - in the case of *Synanthedon myopiformis* in Switzerland, capture of adults in food traps negates the need for an autumn application of insecticide ;
  - in southwest Spain, presence of *Zeuzera pirina* necessitates the application of a number of treatments from the end of June. Poor efficacy of organophosphates means that pyrethroids are now being tried.
- A general trend to using synthetic pyrethroids was noted. Although of value, it is desirable that these products, which are not highly selective and tend to favour phytophagous mites, should not be applied more than twice annually.
- Regarding fungal diseases, the two main points of concern to integrated protection are the resistance of *Venturia pirina* to benzimidazoles and fungi causing storage diseases.
- In France, Spain and Switzerland, there is the constant threat of fireblight ; at present, there is no satisfactory integrated protection strategy to restrict spread of *Erwinia amylovora*.
- Cultural techniques should be manipulated to aid control of pests and diseases in pear ; pluridisciplinary studies on integrated production are needed to provide recommendations for implementation at the regional level.

There are 16 papers, divided into 4 sections : a) general information on the phytosanitary situation and initiation of integrated control in pear orchards (4) ; b) specific studies on pests (7) ; c) specific studies on diseases (4) ; d) scheme for integrated protection (1). Brief resumes of these papers are given below :

M. Sampayo (ES) : Integrated control programmes in pear orchards in Aragon, pp 1-11 (in Spanish)

The author outlines an integrated control programme covering scale insects (*Quadraspidiotus perniciosus, Cochinilla roja*), mites (*P. ulmi, Eriophyes pyri, Epitrimerus pyri*), *Psylla piri*, lepidopterans (*Laspeyresia pomonella, Archips*

diversos, Spilonota ocellana, Lyonetia scitella, Zeuzera pyrina, Synanthedon myopiformis), Hoplocampa brevis, Janus compressus, Anisandrus dispar, Venturia pirina, Pseudomonas syringae, Mycosphaerella sentina, Gymnosporangium sabinae, storage diseases, *Erwinia amylovora*. Economic, ecological and toxicological criteria are considered.

J.P. Bassino (FR) : Problems posed by phytosanitary protection of pears in France, pp 12-15 (in French)

Because of many practical difficulties, cultivation of pears in France is tending to decrease. The main phytosanitary concerns of growers are briefly dealt with : *E. amylovora, Ps. syringae, V. pirina, Phytophthora cactorum, Septoria piricola, Podosphaera leucotricha*, wilt of certain varieties, *Psylla piri, Dysaphis piri, Aphanostigma piri* and others ; soil maintenance, chemical weeding

P. Mori (IT) : Phytosanitary protection of pears around Verona, pp 16-17 (in French)

Phytosanitary control is mainly directed against *V. pirina* and *L. pomonella*, as well as *Psylla* spp. and, more rarely, against tortrix moths ; *P. ulmi* is usually of little importance. The insecticide spraying schedules used are summarised.

Ph. Antonin (CH) : Notes on the protection of pear orchards in Switzerland, pp 18-19 (in French)

Pear orchards are found mainly around Lake Leman and in Valais. Plant protection problems have increased since 1970, due largely to insecticide resistance. Pyrethroids give satisfactory control of *Psylla* but tend to favour increases of mites.

P. Atger (FR) : The pear psylla situation in France, pp 20-22 (in French)

The approaches to control up to and during the 1970's are summarised, including the concepts of economic threshold and reduction of insecticide treatments to favour natural predators.

J.P. Bassino (FR) : Activity of pear psylla predators in an orchard from 1974-1979, pp 23-24 (in French)

Psylla populations were assessed by visual inspection in an orchard in the Alpes de Haute-Provence. In the first two years, chemical control was applied when population levels were considered dangerous. However, in the subsequent 4 years, natural predators, especially *Anthocoris* spp., maintained psylla populations below the economic threshold.

A. Staubli & Ph. Antonin (CH) : Control of pear psylla in Switzerland, pp 25-28 (in French)

The general situation in Switzerland is discussed and the tolerance thresholds applied are outlined. Biological control by *Anthocoris nemoralis* alone is not yet envisaged. Studies on control using diflubenzuron (a chitin inhibitor) and insect growth regulators (juvenile hormone analogues) are summarised.

H. Audemard (FR) : Control of codling moth (Laspeyresia pomonella) in pear orchards, pp 29-31 (in French)

The changes in susceptibility, throughout the season, of fruit of different pear varieties to codling moth is described. A control schedule, assuming codling moth is the only pest to be controlled, is given. In order to extrapolate these results to other varieties, attempts will be made to determine if there is a correlation between hardness of the pear tissues and susceptibility to larval attack.

J.P. Bassino (FR) : Sex trapping of the apple and pear Synanthedon myopiformis, pp 32-33 (in French)

Synthetic pheromone comprising the Z3, Z13, EE, EZ and ZE isomers of octade cadien-1-ol acetate proved selective enough to determine the start, height and end of the flight of *S. myopiformis*. When trapping indicates an early end to the flight, it should be possible to then carry out an effective insecticide application against the young larvae

J. Arias (ES) : Problems in protecting pears from attacks by Zeuzera, pp 34-35 (in French)

The majority of fruit orchards in southwest Spain are greater than 40 ha in area and are not directly managed by the owners, which makes the introduction of integrated control difficult. Conventional chemical control presents problems of efficacy and toxicity hazards to personnel. Application of the pyrethroids decamethrin and fenpapatrin gave excellent control of *Z. pirina* but led to an increase in *P. ulmi* populations.

J.N. Reboulet & J.P. Bassino (FR) : Insecticides and entomophagous arthropods in pear orchards, pp 36-40 (in French)

The following conclusions were drawn : heterogeneity and quantitative differences in beneficial arthropod populations between trees within the same experimental plot were marked and often as great as those between treated and control trees ; spraying causes a 20 % drop in beneficial arthropods ; a dichlorvos treatment at double the recommended dose rate is best for estimating the residual fauna ; there were considerable differences between the effects of the products (diflubenzuron, phosalone, phosmet, dichlorvos, dimethoate, permethrin, methidathion) on the beneficial fauna (Hymenoptera, Coccinellids, *Orius*, Anthocorids, Neuroptera).

I.J. Palanzon (ES) : Notes on storage diseases of pears in Aragon, p 41 (in French)

Penicillium, Alternaria, Botrytis and *Rhizopus* occur, while *Gloeosporium* and *Cladosporium* are less frequent on stored pears. Before storage, fruits are routinely treated with a benzimidazole fungicide, but resistance problems now arise. In future, treatment with thiram or captan in the orchard is suggested. As most of the fungi enter by wounds, all packaging materials, etc., could be disinfected.

H. Boué (FR) : The fireblight situation in southwest France, pp 42-44 (in French)

The measures taken to deal with outbreaks of fireblight in southwest France are described. Despite effective action to remove and burn infected trees and material, it seems unlikely that the bacterium will be eradicated since environmental conditions are such as to favour its rapid development and spread.

M. Sampayo & I.J. Palazon (ES) : Fireblight in Spain, pp 45-49 (in Spanish)

The situation with regard to fireblight in Spain is discussed with reference to the roles of the Plant Protection Service, Working Parties, etc., and the measures to be taken in the face of an outbreak.

P. Mori (IT) : A « disease » of unknown cause of pear foliage and fruits, pp 50-52 (in French)

The symptoms of this « disease » are outlined : small dark brown spots gradually enlarge and dessicate part or most of the leaf. Small dark corky spots, 1-2 mm increasing to 1-3 cm occur on the fruits. Older (10-15 years) well-established

orchards likely to suffer stress from poor fertilisation or waterlogging are more usually affected. Attempts to control the « disease » are directed towards manipulating fertilisation.

P. Atger (FR) : Managing phytosanitary protection in pears by improving the main factors in production, pp 53-55 (in French)

The fundamental concept of integrated control is described and means of achieving this end in pear orchards is discussed including resistant varieties, cultural techniques (fertilisation, irrigation, pruning, etc.). A diagrammatic scheme of interactions in a pear orchard is given.

EUCARPIA/IOBC Working Group on Breeding for Resistance to Insects and Mites ; Report of the Second Meeting held from 9-11 April 1980, Maidstone, Kent (UK). IOBC/WPRS Bulletin (1981) IV (1), 156 pp

The Working Group on Breeding for Resistance to Insects and Mites was founded in 1976 under the aegis of both the IOBC/WPRS and EUCARPIA to create a platform for discussion and coordination between entomologists and plant breeders. The Second Meeting was attended by 43 entomologists and plant breeders from 10 countries, including representatives of private breeding companies. The 29 papers presented and included in these Proceedings cover a wide variety of arable, vegetable, fruit and fodder crops. During the time between the two meetings, the Project Group Breeding for Resistance to the Carrot Fly and the Correspondence Group on Resistance to Cereal Aphids have stimulated activities in these particular fields. It should also be noted that, recently, some private breeding companies have initiated programs on resistance to insects and mites.

The papers are briefly summarised below ; texts are in English unless otherwise indicated.

V.F. Eastop (GB) : Implications of inadequate insect identification, pp 7-11

This paper draws attention to taxonomic uncertainties and errors concerning the published host ranges of aphid pests. Failure to recognise that several different species of aphids feed on closely related plants can conceal likely sources of genes for resistance. Specimens should be identified during the early stages of a project, not after the experimental work is completed.

R.L. Blackman (GB) : Aphid genetics and host-plant resistance, pp 13-19

This paper is concerned, not with the genetics of host-plant resistance-breaking mechanisms in aphids, but with those general features of the population genetics of aphids which need to be considered when we try to assess or explain the capacity of these insects to respond genetically to variation in their host plants. The genetical structure of aphid populations is covered first, followed by genetic considerations in particular aphid species of importance in plant breeding (*Amphorophora idaei, Acyrthosiphon pisum, Therioaphis trifolii, Schizaphis graminum, Rhopalosiphum maidis*).

N. Carter & A.F.G. Dixon (GB) : The use of insect population simulation models in breeding for resistance, pp 21-24

The model, describing population development of *S. avenae* on winter wheat, is discussed together with a sensitivity analysis. The results of the latter indicate that it would be more advantageous for plant breeders to select for plant characters affecting antibiosis rather than antixenosis. Models can also be used to screen new varieties as their susceptibility to a pest can be assessed once the basic components have been measured, thus dispensing with the need to grow them over a number of years in different locations. Simulation models can also include other control measures, such as pesticide application, so that an integrated approach to crop management can be formulated.

F.L. Dieleman & A.H. Eenink (NL) : Resistance of lettuce to Myzus persicae : factors influencing the host-parasite relationship, pp 25-28

The method (macrotest) used to evaluate resistance of *Lactuca* to *M. persicae* is outlined. The problems associated with improving resistance are discussed : variation in plant and aphid factors such as plant age and growing conditions, aphid virulence genes, aphid density.

E.J.B. Bintcliffe (GB) : Resistance to the aphid Myzus persicae in potato cultivars, pp 29-34

The aim of this work has been to assess a wide range of existing potato cultivars and species in the laboratory and in experimental plots in order to measure and explain aphid resistance. Embryo complement was mostly used as one of the measures of plant resistance, as well as maturation time, teneral adult weight and nymph production. No correlation between aphid performance and alkaloid quantity or quality have been found. There are strong indications that resistance may be correlated to a certain extent with potato leaf hair density.

G. Massonie & P. Maison (FR) : Resistance to Myzus persicae in the peach, Prunus persica pp 35-39 (in French)

The varieties S2678 and S2605 are resistant to *Myzus persicae* in the conditions around Bordeaux. These varieties are also resistant to artificial infestation by *M. varians* but not to other peach aphids ; they are also less susceptible to inoculation of sharka virus by *M. persicae*.

A.H. Eenink & F.L. Dieleman (NL) : Resistance of lettuce to Nasonovia ribis nigri : Research on the occurrence of differential interactions between host and aphid genotypes and on the inheritance of resistance, pp 41-46

N. ribis nigri is the most common aphid colonising outdoor lettuce. The authors discuss aphid behaviour and screening for resistance, resistance and susceptibility within *Lactuca virosa*, and transfer of resistance to lettuce varieties. There was no clear interaction between 5 plant and 10 aphid genotypes investigated.

H.J.B. Lowe (GB) : Resistance to Sitobion avenae in wheat, pp 47-50

The walkabout method for comparative assessment of cereal varieties in the glasshouse, using immature plants is briefly described. This method appears relatively insensitive to environmental variation within the range commonly experienced. The resistance detected by the walkabout method is likely to be of value in the field by reducing the number of *S. avenae* present at the time of ear emergence.

P. Crisp, P.R. Ellis & J.A. Hardman (GB) : Selection in radish for resistance to cabbage root fly (Delia brassicae), pp 51-53

This paper describes the results of selection for resistance in the field on the basis of root damage at the time of harvest.

Apparent anomalies in the results are discussed and provisional conclusions are drawn. Recommendations for breeding for reduced susceptibility are listed.

P.R. Ellis, J.A. Hardman & B.D. Dowker (GB) : Selection in the carrot cultivar « Long Chantenay » for resistance to carrot fly (Psila rosae), pp 55-57

Results showed that it is possible to improve the resistance to carrot fly attack of a commercially acceptable carrot cultivar by family selection. Five years' screening trials have indicated the greater susceptibility of « Long Chantenay » compared with several other commercial cultivars. If selection within the latter leads to a similar response to that observed in « Long Chantenay », then it should be possible to develop partially-resistant cultivars for use in integrated programmes of carrot fly control.

O.M.B. de Ponti, J.C. Freriks, M. Steenhuis & H. Inggamer (NL) : Improving the resistance of carrot and onion respectively to carrot fly and onion fly by recurrent selection, pp 59-62

Resistance was traced between and within recent varieties and selections which are commercially available (carrot : about 200, and 70 wild *Daucus* spp. ; onion : about 60, and 60 accessions of *Allium fistulosum*). Material was exposed to natural infestation. Carrots were assessed only at harvest, while onions were assessed three times.

P.M. Guerin, F. Gfeller & E. Stadler (CH) : Carrot resistance to the carrot fly - contributing factors, pp 63-65

The authors conclude that the percentage root surface damaged may be a useful index in screening for resistance in a large number of cultivars. Discrimination should be made between resistance based on nonpreference and antibiosis in breeding programmes. Antibiotic mechanisms appear to be of more value in the long term as nonpreference may not be adequate in monocultures exposed to large populations of the pest.

G. Massonie, P. Maison, J.C. Meymerit & Y. Lespinasse (FR) : Observations on hypersensitive resistance to the rosy apple aphid, Dysaphis plantaginea Pass., pp 67-71 (in French)

The results of experiments on naturally or artificially infested trees using different lines of the insect are presented. The problems associated with hypersensitivity, particularly failure to eliminate all aphids, are emphasised. More observations on the effects of surviving aphids on fruit damage are needed.

H. Lyth (GB) : Some techniques for determining resistance to Eriosoma lanigerum and Dysaphis plantaginea in apple, pp 73-77

The drawbacks to a method of screening for resistance to *E. lanigerum* by mass inoculating young seedlings in seedboxes are discussed. An alternative approach using only ten first instar larvae per plant is described. For *D. plantaginea*, seedlings were screened in pots in the glasshouse by inoculating each plant with a first- or second instar larva placed on a young expanded leaf ; hypersensitive plants could be efficiently identified.

E. Keep (GB) : Breeding for resistance to pests of Rubus and Ribes crops at East Malling, pp 79-82

By taking a sometimes opportunist and slightly empirical approach, a small team is able to carry forward resistance breeding against a wide range of pests and diseases (10 organisms in raspberries, 6 each in blackcurrants and gooseberries), thereby establishing the potential for producing varieties needing far fewer sprays or even none at all.

F.H. Alston (GB) : Pest resistance in apple breeding, pp 83-88

The results of extensive surveys for pest resistance among *Malus* spp. are reported, and include *Eriosoma lanigerum, Dysaphis* spp., *Hoplocampa testudinea, Panonychus ulmi, Laspeyresia pomonella, Rhopalosiphum insertum, Psylla mali, Podosphaera leucotricha*. Breeding priorities are listed and breeding policy outlined.

V.H. Knight (GB) : Screening blackcurrants for resistance to the gall mite Cecidophyopsis ribis (Westw.), pp 89-93

Resistance originating in gooseberry (*Ribes grossularia*), due to a single dominant gene, *Ce*, is being used in the blackcurrant breeding programme at East Malling. The blackcurrant progenies segregated for this gene. In the field, gall mite response is assessed by exposing test seedlings to large numbers of mites in an infestation plot. A potential glasshouse test enabling mite-susceptible seedlings to be identified and discarded prior to planting is described. The effect of mite resistance on transmission of reversion virus is discussed.

P. Gregory & W.M. Tingey (USA) : Chemical mechanisms of potato resistance to the potato leafhopper, pp 95-99

The authors' research on chemical mechanisms of leafhopper resistance in wild species is designed to streamline the aggregation of resistance factors into commercial lines through the development of rapid methodology for the identification of leafhopper-resistant clones. Two defense mechanisms were studied, namely resistance mediated by 1) glycoalkaloids and 2) glandular trichomes. This paper reviews present knowledge of these mechanisms and then discusses the relevance of such mechanistic considerations to breeding strategies for improved pest resistance.

M.H. Dickson & C.J. Eckenrode (USA) : Breeding for resistance to lepidopterous pests in cabbage and cauliflower, pp 101-104

The pests considered were *Trichoplusia ni, Pieris rapae* and *Plutella xylostella*, resistance to which has been detected in a dark green glossy leaved cauliflower, PI 234599. The paper compares the merits of two sources of resistance for future use in breeding programmes and describes inheritance studies on them and the effect of plant maturity on selection for resistance.

P. Anglade, S. Derridj & Y. Durand (FR) : First observations upon the preference for oviposition of the European corn borer and their significance in breeding for resistance, pp 105-108

Observations from 1977-79 revealed that oviposition by the European corn borer in plots of experimental hybrids of maize in the Beauce area was not at random ; such heterogenous natural infestation complicates testing new cultivars. The possible mechanisms involved are discussed – further investigations are needed.

O.M.B. de Ponti & J.C. van Lenteren (NL) : Resistance and glabrousness : Different approaches to develop biological control of two cucumber pests, Tetranychus urticae and Trialeurodes vaporariorum, pp 109-113

The development of non-bitter breeding lines highly resistant to *T. urticae* is described, and the inheritance of

resistance and bitterness explained. The benefit of glabrous leaves in the biological control of *T. vaporariorum* is discussed : the parasitic wasp *Encarsia formosa* is more readily able to seek out its host than on hairy leaves.

M.J. Berlinger & O.M.B. de Ponti (IS, NL) : Methods for testing resistance to whiteflies in tomato and related species, pp 115-118

Obstacles in the use of *E. formosa* to control glasshouse whitefly in tomatoes are listed. Various glasshouse and leaf-cage methods of testing for resistance were compared and routine procedures developed. The advantages and drawbacks to the tests are discussed.

P.S. Benepal & M. Rangappa (USA) : Screening beans (Phaseolus vulgaris L.) for resistance to Mexican bean beetle (Epilachna varivestis Mulsant), pp 119-123

An effort was made to develop a fast and reliable method of screening beans to Mexican bean beetle under phytotron and field conditions keeping in view some of the important insect-host plant factors. On the basis of this study, 1 female Mexican bean beetle from natural populations can be used for 2 hours for screening beans in phytotron, whereas 2 females from natural populations need to be used for 24 hours in field studies. Screening beans for resistance to Mexican bean beetle in phytotron is a reliable and rapid method.

J.E. Wyatt, A. Day, P.S. Benepal & M.J. Sullivan (USA) : Breeding snap beans (Phaseolus vulgaris L.) for resistance to Mexican bean beetle (Epilachna varivestis Mulsant), pp 125-127

The objective was to incorporate MBB resistance into a horticulturally acceptable type using a breeding system based on testing genetically stable lines. Several factors may be involved which result in higher levels of MBB resistance. These may include chemical attractants or repellents produced by the plants, decreased ovipositional preference by the insect or interference with adult and larval development.

R. Bournoville (FR) : Variability of the net reproductive rate of clones of the pea aphid on lucerne, pp 129-132

Variation in resistance of lucerne cultivars to *Acyrthosiphon pisum* in different locations prompted this study. Great heterogeneity in aphid populations was detected : variability in NRR of *A. pisum*, under controlled environmental conditions, was observed at three levels : between populations, within a single population and in the descendents of one virginoparous female.

N. Birch & J. Holt (GB) : Aphid resistance in Vicia in relation to non-protein amino acids, pp 133-139

The extent of resistance in the genus *Vicia* including cultivars of *V. faba* to two major aphid pests, *Acyrthosiphon pisum* and *Aphis fabae*, is described. Antibiotic resistance has been measured largely in terms of the aphids' development time, reproduction and survival. Although the link between host protein and non-protein amino acids and aphid resistance is so far circumstantial, it is hoped that a clear pattern will emerge as the study proceeds.

M. Pitrat & H. Lecoq (FR) : Nonacceptance of melon to Aphis gossypii, its inheritance and relation to antibiosis, tolerance and resistance to virus transmission, pp 141-145

Results on the inheritance of nonacceptance and on the relation between nonacceptance and resistance to cucumber mosaic virus transmission are reported : they are controlled by a single dominant gene. Initial results suggest that the gene is also effective for antibiosis but is different from the gene for tolerance.

H. Lecoq, M. Pitrat & G. Labonne (FR) : Resistance to virus transmission by aphids in a Cucumis melon line presenting nonacceptance to Aphis gossypii, pp 147-151

Resistance to virus transmission in Songwhan Charmi musk melon (SC) appears to be specific as far as the vector is concerned (i.e. it is efficient only when the vector is *A. gossypii*), and not to be specific regarding the virus transmitted, providing that the vector is *A. gossypii* (i.e. it protects SC against CMV as well as against WMV I and WMV II). The mechanisms preventing transmission have yet to be elucidated.

IOBC/WPRS Working Group on Biological Control of Citrus Coccids and Aleurodes. Report of the Fifth Meeting held from 11-13 March 1980 in Valencia (Spain). IOBC/WPRS Bulletin (1981) IV (2), 143 pp, 1981 (in Spanish, English or French)

Following an introduction by C. Bénassy (FR), in which he briefly summarises the research efforts since the first meeting in Rabat in 1970, there are 19 papers presented by researchers from Spain, Greece, Italy and France. Reports of the Second (Athens) and Third (Palermo) Meetings of the Working Group can be found in *IOBC/WPRS Bull. 3*, 1974, and *5*, 1975, respectively, while extracts of the fourth meeting (Antibes) can be found in *Fruits 32*, 1977.

A. Melia & J. Blasco (ES). Dangerous Coccidae and their parasites on citrus in Castellon, pp 5-11 (in Spanish, French and English summaries)

The scales attacking citrus in Castellon are listed with short notes on their importance and biology. Twelve indigenous parasites have been found on these scales, and the following have been imported : *Aphytis melinus* versus *Chrysomphalus dictyospermi*, *Aphytis lepidosaphes versus Lepidosaphes beckii*, *Metaphycus helvolus* and *M. bartletti versus Saissetia oleae* and *Leptomastix dactylopii* versus *Planococcus citri*. The former three have acclimatised well ; there is no data yet for *M. bartletti*, while *L. dactylopii* has not been recaptured from orchards although 45,000 adults were released.

V. Alexandris (GR). An attempt to assess damage to orange trees caused by Aonidiella aurantii (Hom. Diaspididae) in Crete, pp 12-24 (in French, English summary)

Observations on a population of *A. aurantii* in a field in Crete confirmed the economic importance of this scale. Presence of the scale on the vegetative parts of the tree does not cause any serious defoliation or fruit fall but tree growth is reduced when densities exceed 6.6 scales/leaf. The cosmetic appearance of the fruit is spoiled by presence of scales while at scale densities of more than 150/fruit, weight loss occurs, up to 20 % in cases of severe attack. In addition, the juice content, % solvents, juice density and rind thickness were influenced by scales on the fruit surface.

J.M. Carrero (ES) : Present status of biological control of citrus scales in Valencia, pp 25-37 (in Spanish, French summary)

The success of biological control was assessed in 5 experimental plots in Valencia in 1979. *Aphytis lepidosaphes*, introduced from Antibes in 1976, appeared to be

effective against *L. beckii*, but a reduction in this species may lead to an increase in *L. gloverii*. Since its introduction in 1976, *Metaphycus helvolus* has satisfactorily controlled *S. oleae*. Other pest/parasite complexes and sampling techniques are discussed.

L.C. Argyriou & A.L. Kourmadas (GR) : The phenology and natural enemies of Aspidiotus nerii in central Greece, pp 38-48 (in English, French summary)

The phenology of *Aspidiotus nerii* was investigated on table varieties of olive trees in two regions of central Greece. Three to four overlapping generations were recorded annually and the insect was active almost all year round. Four predators, *Chilocorus bipustulatus*, *Lindorus lophanthae*, *Scymnus* sp. and *Chrysopa carnea* were found preying on this scale. *Aphytis chilensis* and *Aspidiotiphagus citrinus* were reared from *Aspidiotus nerii*.

V. Alexandrakis & S. Michelakis (GR) : Distribution of Aonidiella aurantii as a function of its position in the tree and citrus variety in Crete, pp 49-58 (in French, English summary)

A. aurantii is among the more important citrus pests in Crete. The distribution of this scale in the different microclimatic conditions which exist within orange and mandarin trees was studied by sampling the leaves, branches and fruits in a mixed orchard. Scale distribution varies with age of the leaves, the plant organ, orientation and position within the canopy and the species of Citrus tree. The differences examined are mostly the result of preference by the mobile larvae rather than of different mortality on different parts.

G. Liotta (IT) : Notes on Aphytis chilensis and Aspidiotiphagus citrinus (Hym. Aphelinidae) against Aspidiotus nerii (Hom. Diaspididae), pp 59-68 (in Italian, French summary)

Parasitism of *A. nerii* was observed in a lemon grove in Sicily from 1975-77 ; parasitism of females was generally above 60 %. *A. chilensis* was more active in the summer months while *A. citrinus* was found throughout autumn. Population increase of *A. nerii* is thought to result from intensive pesticide applications depressing the entomophagous insects. Aphelinid pupae are found in greater numbers than larvae at the start of spring.

A. Tranfaglia (IT) : Morphological observations on the Chinese wax scale, Ceroplastes sinensis, pp 69-76 (in English, French summary)

Several species of *Ceroplastes* infest *Citrus* and are considered to be serious economic pests because of the large quantities of honeydew which often cover the leaves and stems of the host tree, and facilitate growth of black sootymolds, giving an unslightly appearance to the plant. In the last three years, a study on *Ceroplastes* species infesting *Citrus* spp., *Ficus* spp., *Nerium oleander*, ornamental plants and weeds was carried out to investigate the species and their morphological characters in Italy.

L.C. Argyriou & A.L. Kourmadas (GR) : Ceroplastes floridensis (Hom. Coccidae), an important pest of citrus in the Aegean islands, pp 77-81 (in English, French summary)

The phenology of the Florida wax scale, *Ceroplastes floridensis*, was investigated on citrus trees in the Aegean islands, Astypalaea and Rhodos. Two generations develop annually in Astypalaea. Mass appearance of the first-instar larvae of each generation occurs in May-June and September-October, respectively. Two parasites, *Coccophagus lycimnia* (Hym. : Aphelinidae), *Tetrastichus ceroplastae* (Hym. : Eulophidae) and two predators *Exochomus quadripustulatus* (Col. : Coccinellidae) and *Scutellista cyanea* (Hym. ; Pteromalidae) were reared from *C. floridensis*.

A. Panis (FR) : Damage by Coccidae and Pseudococcidae in French citrus crops and the special effects of certain pesticides on the orchard entomocenosis, pp 82-87 (in French, English summary)

Economic importance and distribution of mealybugs, hard and soft scales, cushion scales and wax scales on Mediterranean citrus are outlined. Details on injuries caused by these coccids are given and the recolonization process in an orchard sprayed with methidathion is described, for beneficial insects attacking three *Coccidae*.

A. Panis (FR) : Notes on some auxiliary insects regulating populations of Pseudococcidae and Coccidae in citrus in eastern Provence, pp 88-93 (in French, English summary)

The efficacy of the main indigenous or introduced entomophagous insects attacking mealybugs and the citrus black scale is discussed. The regulatory role of the ladybird *Cryptolaemus montrouzieri* is explained, as is the effect of each chalcid parasite introduced.

A. Krambias & A. Kotsionis (CY) : Establishment of Leptomastix dactylopii in Cyprus, pp 94-99 (in English, French summary)

Leptomastix dactylopii, a parasite of the citrus mealybug, *Planococcus citri*, was introduced into Cyprus ; two year's sampling data show that it has become established. The level of parasitism was 15 %. The *Citrus* plot that received the biological control treatment showed four times less mealybugs on the fruits at harvest than the plot that received three chemical treatments.

A. Panis (FR) : Effect of the Argentine ant on the parasitic biocenosis of the citrus black scale in France, pp 100-102 (in French, English summary)

In the presence of the citrus mealybug, the Argentine ant shows a greater affinity for the Citrus black scale. It reduces the rate of larval endoparasitism of this hard scale, whereas another dolichoderine, *Tapinoma nigerrimum*, induces predominance of *Coccophagus lycimnia* on *Metaphycus* spp. The ladybird *Exochomus quadripustulatus* predominates on *Chilocorus bipustulatus* with Argentine ant and inversely with *Tapinoma*.

P. Neuenschwander & M. Paraskakis (CH & GR). Persistence of dead or parasitised Saissetia oleae (Hom. Coccidae) on olive trees, pp 103-112 (in French, English summary)

In the summer of 1977, a heat-wave killed a high proportion of a declining *S. oleae* population. The loss of the remaining dead scales from the olive trees was followed up by monthly sampling of branches up to March 1978. The mean duration for a 50 % drop of the original population was determined. It varied between 46 and 170 days, according to instar and the site of fixation. L3 scales dropped from leaves, on average, 24 days before the L2, and 45 days before the L1. This sequence was explained by the observation that, in the course of the development of the scale, the stylet grew less fast than the body surface. Under the given conditions, dead females were frequently found on branches, and therefore persisted even longer on the tree

than L1. Parasitized scales were more attached than non-parasitized ones on the same site. In general, the rate of dropping of the scales was higher in the more exposed microhabitats, such as the upper surface of the leaves (42 days earlier) or the exterior canopy (16 days earlier), than in the corresponding protected sites. Loss occurred mainly because of detachment of the dead bodies from their substrates, and less through leaf drop. It was only little influenced by rain. The results point to the difficulties in interpreting the ratio of dead and living scales in a sample in terms of mortalities of the different instars.

A. Garrido, T. del Busto & J. Tarancon (ES) : Effect of some pesticides on immature stages of Aleurothrixus floccosus. I. The egg, pp 113-114 (in French)

Of 24 insecticides, 2 acaricides and a detergent studied in the laboratory, only 5 gave 50 % or more kill and only two (summer oil and methomyl) caused 80-100 % mortality.

A. Garrido, J. Tarancon & T. del Busto (ES) : Effect of some pesticides on the nymphal stages of Cales noacki, a parasite of Aleurothrixus floccosus, pp 115-117 (in French)

Varying degrees of toxicity to *C. noacki* were shown by 32 insecticides, 4 acaricides, 3 fungicides and a detergent tested in the laboratory, the insecticides being the most toxic. The type of formulation, in addition to the active ingredient contributed to the toxic effect.

G. Viggiani & P. Mazzone (IT) : Recent introductions of parasites of Saissetia oleae in Italy, pp 118-119 (in English)

Following introduction of *Metaphycus helvolus* and *M. swirskii* (= *M.* aff. *stanleyi*), a new species, *M. bartletti*, was imported into Italy from Israel for use against *Saissetia oleae*. Multiplication and release of the parasite are discussed ; it appears promising for biological control.

G. Viggiani (IT) : New records on releases and recoveries of Encarsia lahorensis, pp 120-122 (in English)

Results on releases and recoveries of *E. lahorensis* to control *Dialeurodes citri* in certain areas of Italy (Portici, Campania, Calabria, Sicily) and other Mediterranean countries (Greece, Israel, Turkey) contrast with experience from California which showed that there dispersion of the parasite is very slow, only about 6 m annually.

E. Santaballa, C. Borras & P. Colomer (ES). Toxicity of various products for immature stages of Cales noacki, pp 123-131 (in Spanish)

The toxicity of 15 products for *C. noacki* is reported : mean mortality ranged from 0-10 % for zineb, tetradifon, dicofol and butocarboxim to 80-100 % for chlorpirifos and methidathion.

S. Barbagallo, S. Longo & I. Patti (ES) : Preliminary results of biological and integrated control against Planococcus citri and Dialeurodes citri in eastern Sicily, pp 132-143 (in Italian ; French and English summaries)

The authors report preliminary results on the introduction in citrus orchards of eastern Sicily of the two entomophages *Leptomastix dactylopii*, against *Planococcus citri*, and *Encarsia lahorensis*, against *Dialeurodes citri*.

IOBC Panel on Integrated Pest and Disease Control in Hops : Report of the Second Meeting held from 26-28 August 1980, Liblice (Czechoslovakia). IOBC/WPRS Bulletin (1981) IV (3), 179 pp (in English or German, with English, German and Russian summaries)

This second meeting of the Panel was held to assess developments since the previous meeting in Linz (Austria) in 1975 *(IOBC/WPRS Bull. 2 : 66-81, 1976)*. The main goals set in 1975 are outlined. The present volume includes all reports presented at the Liblice meeting, together with a list of participants and a summary of recommendations defining in more detail the long-term objectives adopted by the Panel. Abstracts of the papers are given below :

A. Srp (CZ) : The hop in Czechoslovakia, pp 3-10 (in German)

A historical account of the hop in Czechoslovakia from 1885 to 1980 is given, together with an outline of management techniques and research.

R.C. Muir & J.E. Cranham (GB) : Resistance to pesticides in damson-hop aphid and red spider mite on English hops, pp 11-15 (in English)

From 1966 to 1979, damson-hop aphids and common spider mites were collected from hop gardens and their responses to pesticides were compared in bio-assays with susceptible stocks. Resistance in the aphid has become high to most but not all organophosphates (OPs), is still low to several carbamates, and in 1978-79 developed to endosulfan but not to pyrethroids. Resistance in the mite was high to all OPs and often to dicofol, and was low to carbamates, but those available are poor acaricides ; there was no resistance to cyhexatin and very little to tetradifon.

A.P. Borovoi (SU) : Resistance to insecticides in the two-spotted spider mite and the hop aphid on hops in the Ukrainian SSR, pp 16-20 (in Russian)

The major pests of the hop in the Ukrainian SSR include the two-spotted spider mite, *Tetranychus urticae*, and the hop aphid, *Phorodon humuli*. By laboratory assays using several organophosphorous insecticides, carbamates and pyrethroids, the resistance of field populations of the hop aphid and the two-spotted spider mite was investigated. Rotation of the pesticides applied is suggested to counteract the development of resistance.

I. Hrdy & J. Kuldova (CZ) : A standardised spray-residue method for measuring, and a dip test for monitoring resistance in aphids, pp 21-28 (in English)

The underlying principles and individual steps of two methods are presented : the spray-residue method, a more demanding procedure, for detection and measurement of resistance ; the dip-test, a quick method to obtain guiding data for monitoring resistance in field populations of aphids.

I. Hrdy & J. Kriz (CZ) : Insecticide resistance spectrum in Czechoslovak populations of the hop aphid, Phorodon humuli, pp 29-39 (in English)

Base-line data for susceptible laboratory strains of the hop aphid, *Phorodon humuli*, were determined by the spray-residue test for 31 organophosphorous insecticides, 11 carbamates, 3 pyrethroids and 1 cyclodien-chloro insecticide. A comprehensive survey of knowledge accumulated on insecticide resistance in the « Steknik » population from the Bohemian hop-growing region, and complementary data on resistance in the hop aphid from other hop-growing regions and areas are given. The question of resistance stability in field populations and laboratory strains of the hop aphid is discussed.

R. Buchi & A.K. Beck (CH): Esterase assay for the detection of resistance to insecticides in hop aphids Phorodon humuli Schrank, pp 40-45 (in German)

Both acetylcholinesterase and carboxylesterase activities were measured colorimetrically in hop aphids collected from wild hops and from hops in a plantation. These carboxylesterases were also examined by electrophoresis. The results were compared with those obtained in bioassays on an artificial diet which contained different concentrations of the insecticides demeton-S-methylsulfoxide and acephate. We found a positive correlation between increased carboxylesterase activity and resistance to the insecticides examined. These studies show that time-saving biochemical tests are suitable for rapidly assessing general levels of resistance in field populations of hop aphids.

J. Sula, J. Kuldova & I. Hrdy (CZ): Insecticide resistance spectrum in the hop aphid (Phorodon humuli) populations from different regions : notes on resistance mechanisms, pp 46-54 (in English)

Resistance in hop aphid strains from the Bohemian hop-growing region (Steknik), from Bavaria (Hüll, Hallertau) and from England (Hereford) was investigated by bio-assays and biochemical tests. Several susceptible aphid strains were tested for comparison. The esterases were separated into 5 zones by disc electrophoresis. The resistant and susceptible strains only differed in the activity of the esterase zone 3. The highest esterase activity in proportion to the rest of the esterases was found in the Steknik strain, followed by Hereford and Hüll.

U. Hornung (DE): Problems with resistance of the damson-hop aphid, pp 55-60 (in German)

In the Hallertau region, pest density has become a problem because of the extensive cultivation of a new susceptible cultivar offering favourable nutrient conditions to the pest. The pest control measures which may be necessary in hops result in trouble with resistance of the damson-hop aphid, *Phorodon humuli*.

J. Hurkova & M. Gesner (CZ): Insecticide resistance in Czechoslovak populations of the two-spotted spider mite, Tetranychus urticae, pp 61-68 (in English)

In 24 populations of the two-spotted spider mite, *Tetranychus urticae*, examined from Bohemian hop gardens in 1976-1977, a high level of resistance to thiometon was found. These resistant populations were selected mainly by OP-aphicides used against *Phorodon humuli* since the fifties, and are now controlled with specific acaricides, that must be applied on almost 50 % of the Bohemian hop-growing area.

F. Weyda & J. Hurkova (CZ): Some morphological and bioecological characteristics of insecticide resistant biotypes in the two-spotted spider mite, Tetranychus urticae, pp 69-77 (in English)

Some differences in morphological and bioecological characteristics have been found between 2 susceptible and 2 resistant strains of two-spotted spider mite females : body length, sex ratio, survivorship, fecundity, etc. The resistant strains had some advantageous attributes in comparison with susceptible ones (lower mortality, higher fecundity), while the susceptible strains had a more advantageous sex ratio.

I. Hrdy (CZ): Integrated pest management and the possibilities to cope with insecticide resistance in the hop aphid and the two-spotted spider mite in hops, pp 78-86 (in English)

The major parameters influencing the selection of resistance in field populations may be categorized into genetic, biotic and operational. The development of novel biotypes of pests reflects the integration of resistance into the genome as well as the selection-based fitness for changed conditions of agroecosystems. The genetic and biotic properties in *Phorodon humuli* and *Tetranychus urticae* are described from the point of view of resistance, and possibilities to refine operational measures with the aim of slowing down resistance selection are discussed.

J. Zeleny, I. Hrdy & P.K. Kalushkov (CZ): Population dynamics of aphid and mite predators in hops : Bohemian hop-growing area, pp 87-96 (in English)

The population dynamics of the major predators and parasitoids of *Phorodon humuli* and *Tetranychus urticae* have been observed in commercial hop gardens and on insecticide-free plots since 1967. The main predators include : *Coccinella septempunctata, Propylaesa quatuordecimpunctata, Adalia bipunctata* and the soldier beetles (Cantharidae) ; the syrphid flies (Syrphidae), the aphid midges (Cecidomyiidae), Chamaemyiidae, the green lacewings (Chrysopidae) ; the minute pirate bugs (Anthocoridae). Of far less importance are parasitoids of the order Hymenoptera, the aphids (Aphidiidae). The most frequent predator of the two-spotted spider mite is *Stethorus punctillum*, whose population dynamics are also shown. Examples are given of other predators of aphids and mites with evaluation of their supposed importance. The occurrence of predators is independent of the population density of the host pest. The population density of predators in hop gardens was found to increase only if the population density of aphids exceeded 50 per hop leaf.

P.K. Kalushkov & J. Zeleny (CZ). Toxicity of five insecticides to resistant hop aphid, Phorodon humuli, and its coccinellid predators, pp 97-106 (in English)

A laboratory bioassay study of the contact effect of 5 insecticides (pirimicarb, thiometon, methomyl, permethrin, decamethrin) on resistant populations of *Phorodon humuli* and the ladybirds *Propylaea quatuordecimpunctata, Adalia bipunctata, Coccinella septempunctata*, and *C. quinquepunctata* is described. In tolerable concentrations, thiometon and pirimicarb were insufficiently effective against *P. humuli*. In concentrations effective against the aphid, thiometon was mildly harmful to ladybird imagos but pirimicarb had no harmful effects on ladybird eggs, larvae and imagos. Methomyl was highly effective against the hop aphid, but it was also highly harmful to ladybirds. Both permethrin and decamethrin gave good control of aphids ; ladybird larvae were about as susceptible as the aphids, while ladybird imagos were less susceptible. With a view to this effects, pyrethroids should be applied prior to, or immediately after, the migration of ladybirds into hop gardens, i.e. before egg laying has started.

H. Th. Kremheller (DE): Development of disease (Pseudoperonospora humuli) as a function of meteorological and biological factors, pp 107-109 (in German)

The product of the zoosporangia concentration in the air and the duration of rain wetness was defined, which explains about 80 % of the total variation of the probability

of disease. This parameter was then used to develop a model for the prognosis of disease. The prognosis is employed to determine the dates of control sprays, so that sprays are applied only when the hops are endangered by the disease. This method of controlled sprays has been successfully tested in the field from 1976 to 1980 ; the number of sprays usually applied in practice could be reduced by 50-80 % when this model was used.

Z. Petrlik & Z. Stys (CZ) : Short-term prognosis of Peronoplasmopara humuli, pp 110-117 (in German)

The short-term prognosis of *Peronoplasmopara humuli* uses measurements of relative humidity of the air and rainfall/dry-day counts to calculate the so-called Peronospora Index which permits forecasting the disease on leaves and cones of hops. Danger of damage to the plant is signalled if the Index is < 500 and the average occurrence of spots exceeds one or more per leaf, or if any spots are found on the cones. In the absence of these conditions, one of the five routine sprays can be left out. Tests related to weather conditions in the 1976-1979 period made it possible for one to four of the five usual treatments to be omitted without any risk to the crop.

K. Borde (DD) : Hop protection in the German Democratic Republic, pp 118-121 (in German)

In the GDR, concentration of hop growing has resulted in the establishment of larger production units which provide favourable conditions for effective large-scale crop protection. The constant increase in the number of different chemical treatments, the consequent pressure on the environment, and the increase in consumption of power necessitate the introduction of integrated crop protection in order to arrive at an appropriate combination of cultivation, biological and chemical methods of pest control.

T. Perju (RO) : The present situation in hop protection in Romania, p 124 (in English)

Hop cultivation in Romania extends to 1,000 ha. Pests and diseases which presently require control include *Peronospora humuli, Botrytis cinerea, Fusarium* spp., *Phorodon humuli, Tirodia sylvina, Tetranychus urticae, Melolontha melolontha* and *Otiorrhynchus lingustici*. A combination of cultural, biological and chemical methods are used for control.

B. Micinski (PL) : Present problems with hop protection in Poland, pp 125-126 (in German)

The insect pests and fungal and viral diseases of hops in Poland and means for their control are outlined.

Z. Petrlik (CZ) : Hop protection in Czechoslovakia, pp 127-133 (in German)

The development of plant protection in hops in Czechoslovakia is described. The pesticides used and spraying regimes are outlined. A program for screening plants for virus certification is reported.

J.E. Cranham & R.C. Muir (GB) : Damson-hop aphid : the scope for pest management, pp 134-138 (in English)

Field trials on integrated control combined the use of a soil-applied drench of mephosfolan (1 g a.i./hill) which provided control of aphids until July with control by predators during the remainder of the season. Of a range of predators, anthocorids were the most numerous and effective, especially within the hop cones. Methods of obtaining a selective, partial reduction of aphids in July are being sought.

A.L. Winfield (GB) : Integrated control of damson-hop aphid (Phorodon humuli) in commercial hops in south-east England, 1977-80 (in English)

Six hop gardens in Kent that had been drenched with mephosfolan in late May or early June were visited on up to 14 occasions from mid-June to mid-September in the years 1977-80 inclusive. On each occasion, aphid invasion, multiplication and the degree of control exerted by the insecticide was noted and observations were made on the incidence of parasites, predators and diseases of the pest. At one site, no further treatment than the original drench was needed in any of the four years. A second site was oversprayed in 1979 but received only the drench in 1977, 1978 and 1980. Four other sites were oversprayed in July and August each year and had to be abandoned from the point of view of integrated control of the aphid. The key predators were anthocorid bugs (Anthocoridae), although hover flies (Syrphidae), lacewings (Chrysopidae) and earwigs (*Forficula* spp.) were common at most sites. Coccinellidae were common in 1977 and 1978, almost absent in 1979 and scarce in 1980.

T. Perju & I. Ghizdavu (RO) : Bioecological research and integrated control of hop pests in Romania, pp 147-155 (in English)

During the period 1973 to 1980, integrated crop protection against the main pest species of the hop was studied. Experimental data are presented on hop crop fauna composition, control of *Triodia sylvina* and *Phorodon humuli* by different means and incidence of aphid resistance against pesticides.

U. Schmidt (DD) : Preliminary trials in integrated protection in hops in the German Democratic Republic, pp 156-163 (in German)

To assure high and stable hop yields it was necessary to make as many as 20 fungicide spray applications. The development of a draft program of systematic control is an important prerequisite to the introduction of integrated crop protection. This program provides for the effective control of pests such as alfalfa weevils, hop aphids, common spider mites and downy and powdery mildew.

Concluding Remarks, pp 164-165 (in English)

Briefly, these were that :

- Attention should be focussed on the study of resistance stability and the search for alternative means and methods to retard the development of resistance.
- Further investigations should be based on the systems approach and experiments to reinforce the role of pest antagonists in hop gardens ; to study factors affecting these antagonists and to develop economic thresholds for the major pests and diseases.
- It is now possible to reduce the number of chemical treatments againts *Peronospora*.
- Although integrated control measures are being introduced, adequate solutions must be sought and geared to the specific conditions prevailing in individual regions.
- There remains a need for further information on certain pests and diseases.

It was recommended that the next Panel meeting be held in summer 1982 in Wolnzach-Hüll/München following on from the meeting of the Scientific Commission of the International Hop Bureau.

Russian abstracts of the papers are given on pages 168-176. This is followed by the list of participants : there were 29 from 9 countries.

2. WHO Activities

Funds for Research on Biological Control of Vectors

The Steering Committee of the Scientific Working Group on Biological Control of Vectors of the UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases reminds readers of the availability of funds for research on the development of agents for the biocontrol of the invertebrate vectors of human diseases : Filariasis, Leishmaniasis, Malaria, Schistosomiasis and Trypanosomiasis. Initially the Special Programme considered mainly pathogens, but the range of agents has recently been extended to include predators, parasitoids and competitors. The emphasis is on research of an applied nature which will lead to the implementation of integrated vector control programmes in developing countries, although basic research programmes which facilitate development of appropriate predators, parasites and pathogens are also considered. At present, particular areas of interest include field tests on *Bacillus thuringiensis* variety H-14, tests to explore the recycling of *Bacillus sphaericus* in the environment and projects on the pathogens of vector snails. Research on the safety and effect of promising candidate agents on non-target organisms are also included.

At present, approximately US $ 600,000 per year is available for existing and new projects, although this amount is expected to increase over the next few years. The amount appropriate for a typical grant is in the range of US $ 5,000 to US $ 15,000 per year, with fewer proposals above $ 15,000 being funded.

Proposals involving research and training in developing countries where the target diseases are common receive special consideration.

Proposals for projects are invited. For further information and application forms, prospective applicants should contact the Secretary at their earliest convenience. The latest date for consideration at the next meeting of the Steering Committee is 31 December 1981.

Applications should be addressed to : The Secretary, Scientific Working Group on Biological Control of Vectors, World Health Organization, 1211 Geneva 27, Switzerland.

3. Forthcoming Meetings

International Colloquium : Invertebrate Pathology and Microbial Control, 5-10 September, 1982

The next International Colloquium will be held at the University of Sussex, Brighton, United Kingdom. The area is of great natural beauty and historical interest with a wealth of places to visit. Brighton is situated on the south coast, within easy reach of London. One can expect reasonable weather during early September, so bring your bathing costumes as well as your briefcases.

If travelling from overseas, try to arrive at Gatwick Airport (only 45 minutes from Sussex University). The journey from London's other major airport, Heathrow, will take 2-2½ hours. The university is adjacent to Falmer railway station, with regular trains running from Brighton (3 miles distant).

Single-room accommodation has been booked at the University halls of residence within a short walk of the meeting rooms, shops and banking facilities. For those who prefer hotels, there is a wide selection in Brighton. The Colloquium should provide interest for all, including symposia, open paper and poster sessions. A marine pathology workshop is also planned. There will be a separate programme for accompanying persons.

For nematologists, there is a meeting of the European Society of Nematology the previous week in the U.K. For those with mycological interests, there is a meeting of the British Mycological Society from September 14th, 1982, entitled « Microbe and Animal Interactions ».

We are in the process of appointing conveners for the symposia and hope to have a volume of symposia proceedings ready by the time of the meeting. Abstracts of offered papers will be available at the colloquium. Symposia at present planned are :

1. Microbial control of vectors of human disease organisms.
2. Immunological and diagnostic techniques in invertebrate pathology.
3. Defensive responses of invertebrates.
4. Fungi : *in vitro* cultivation and virulence.
5. Microbial control of insect pests of cotton.
6. Practical use of pathogens in agriculture and forestry.
7. Unusual viruses of terrestrial and marine invertebrates.
8. Advances in genetic studies with pathogens of invertebrates.
9. Environmental persistence of pathogens.
10. Marine invertebrate pathology.

In addition, offered papers will be accommodated in separate sessions, probably arranged under the headings of different types of organisms. There will be a place for all types of contributions, both fundamental and applied. Also, we are very keen to hear from anyone wishing to initiate or arrange other workshops, poster sessions or informal discussion sessions.

The meeting is being organized by Insect Pathology staff at the Glasshouse Crops Research Institute and a visit will be arranged to the Institute during the meeting. For further details, or offers of contributions please contact the joint organizers : H.D. Burges and C.C. Payne, Glasshouse Crops Research Institute, Littlehampton, Sussex 090 64, England.

4. Abstracts

a) Plant Protection

INSECTS

D.G. Campion & B.F. Nesbitt (1981). Lepidopteran sex pheromones and pest management in developing countries. Tropical Pest Management 27 (1) : 53-61

Strategies for the use of pheromones for the control of insect pests have generally been developed in countries of advanced technologies. In this paper, the relevance of pheromones to the needs of agriculture in developing countries is discussed with particular reference to work by the Scientific Units of the British Overseas Development Administration.

K.D. Ghorpade (1981). Insect prey of Syrphidae (Diptera) from India and neighbouring countries : a review and bibliography. Tropical Pest Management 27 (1) : 62-82

A comprehensive list of the insect prey of 47 species of Syrphidae from India and neighbouring countries is

presented, including a total of 542 individual records. The introduction includes a detailed summary, with references, of different insect groups known to be preyed upon by syrphids from all over the world. Pertinent information on predacious syrphids, their role as biocontrol agents, and a short historical account of Indian work on their biology, and ecology is provided.

G. Fabres (1981). Entomophagous insects associated with the cassava mealybug in Congo. Tropical Pest Management 27 (1) : 145-146

This short communication gives preliminary information on the natural enemies of *Phenococcus manihoti*, a recent introduction in Zaire. There are few parasites, *Anagyrus* sp. being the only species found in large numbers. Predators form the majority of primary entomophagous insects and include three coccinellids : *Exochomus flaviventris*, *E. concavus* and *Hyperaspis senegalensis*. *Coccodiplosis citri* is the most abundant cecidomyiid fly. Several hymenopterous parasites develop upon the primary and secondary entomophagous insects.

R.R. Granados (1980). Infectivity and mode of action of Baculoviruses. Biotechnology and Bioengineering XXII : 1377-1405

The genus *Baculovirus* contains three subgroups of viral types : 1) nuclear polyhedrosis viruses (NPVs), 2) granulosis viruses (GVs), and 3) nonoccluded baculoviruses. Little information is available for the third group. The most common route of entry of a virus into an insect host is *per os*, and both NPVs and GVs enter midgut cells by membrane fusion. Two distinct mechanisms of virus uncoating occur among the baculoviruses : NPVs uncoat within the nucleus, while GVs uncoat at the nuclear pore complex. In addition to replicating within the nucleus, NPV inoculum virus may pass through the intestinal epithelium immediately after ingestion, thereby establishing a systemic infection of the haemocoel. In general, the developmental cycle of GVs is longer than that of NPVs. NPVs have been grown in cell culture while GVs have not.

A. Kovacs (1979). Microbial control of insects. Dif. Piante 2 (6) : 359-372

The advantages and problems of microbial control are discussed. The use of fungi, bacteria and viruses are discussed with reference to examples.

R. Charpentier (1980). Insect pathology and its applications. Entomol. Tidskr. 101 (2-3) : 49-60

Insect pathology and some recent advances in microbiological control of insects are summarised. The underdevelopment of insect pathology as a science in Sweden is discussed in terms of traditions, the insignificance of Swedish pest insects and the influence of the Swedish Products Control Board.

H.G. Miltonburger & R. Reimann (1980). Viral pesticides : biohazard evaluation on the cytogenetic level. Dev. Biol. Stand. 46 : 217-222

Experiments were carried out using mammalian cells from different species *in vivo* and *in vitro* to detect a possible effect of baculoviruses on chromosome aberration rates and sister chromatid exchanges. No cytogenetic effects were produced.

W.A. Smirnoff (1980). Deposit assessment of Bacillus thuringiensis formulations applied from an aircraft. Can. J. Microbiology 26 : 1364-1366

Deposit assessment after aerial spraying with *B. thuringiensis* formulations consists of analysing the splash of droplets on Kromekote papers and determining the number of bacterial colonies growing on agar in Petri dishes. However, neither of these methods indicates the number of spores deposited although this figure is essential to determine treatment efficacy. Both methods are evaluated with regard to this need and a new approach is suggested.

A.G. Wheeler (1981). Updated distribution of Aleuropteryx juniperi (Neuroptera : Coniopterygidae), a predator of scale insects on ornamental juniper. Proc. Entomol. Soc. Wash. 83 (1) : 173

A. juniperi continues to be the most effective natural enemy of minute cypress scale, *Carulaspis minima*, in Pennsylvania. *A. juniperi* has been recorded in England and North America (Pennsylvania, Virginia). Based on collections from scale-infested Hetz and Pfitzer junipers in landscape plantings, the known distribution is reported to have extended to U.S. Maryland, New Jersey, New York and West Virginia.

R.L. Metcalf & A. Kelman (1981). Integrated pest management in China. Environment 23 (4) : 14-25

China has had 5,000 years of recorded experience in combating insect pests ; however, little attention has been paid by the Western world to Chinese pest control methods. Now that we are beginning to recognize that pest control is a more complex matter than the routine spraying of pesticides, China, which developed some of the principles of integrated pest management more than 1,000 years ago, has much to teach us.

K.M. Atkinson (1980). Biological control of glasshouse pests. ADAS Quart. Review 39 : 285-287

In this brief review article, the author traces the development of biological control of glasshouse pests, such as aphids, whitefly and red spider mites, in the UK, using agents such as *Encarsia formosa*, *Phytoseiulus persimilis* and *Verticillium lecani*.

C.B. Hoffman, G.G. Newman & L.A. Foerster (1979). Seasonal incidence of diseases and parasites in natural populations of Anticarsia gemmatalis and Plusia spp. in soybean. An. Soc. Entomol. Bras. 8 (1) : 115-124

A. gemmatalis larvae were infected by *Nomuraea rileyi*, *Beauveria bassiana*, and *Entomophthora sphaerosperma* and by a NPV. Only *Microcharops* sp. was observed parasitising *A. gemmatalis*. *Plusia* spp. larvae were infected by *N. rileyi*, *E. gammae* and a NPV. The following insects parasitised *Plusia* spp. : *Litomastix truncatellus*, *Apanteles marginiventris*, *Nemorilla ruficornis* and *Lespesia* sp. Peak infection by *N. rileyi*, both on *A. gemmatalis* and *Plusia* spp., occurred in the vegetative stage of the crop.

C.M. Ignoffo, M.S. Zuber, C. Garcia et al (1980). Evaluation of baculovirus heliothis, Bacillus thuringiensis, Nomuraea rileyi and carbaryl against Heliothis zeae on hand-pollinated sweet corn ears. J. Kans. Entomol. Soc. 53 (3) : 485-489

The virus and carbaryl were equally effective (based on mean damage index, damage-free ears and usable ears) and

they were more effective than *B. thuringiensis*, *N. rileyi* or no treatment. A mixture of all three entomopathogens was no more effective than baculovirus alone.

O. Triggiani (1979). Preliminary tests to control larvae of Porthetria (Lymantria) dispar on Macedonian oak (Quercus trojana) with Bacillus thuringiensis and Borrelinavirus reprimens. Entomologica 15 : 103-113

Field trials were carried out in 1977 with pathogens on 2nd-3rd instars of *P. dispar*. The pathogens tested were : *B. thuringiensis* var. *kurstaki* (4×10^6 viable spores /mg c.p.) 100, 200, 400 g c.p./hl and the NPV *B. reprimens* (3×10^{12} PIB/g) 50,100 g a.i./hl. Fifty larvae of *P. dispar* were placed in polythene gauze bags on 1.5 m long branches and were sprayed with different concentrations of the pathogens. *B. thuringiensis* gave good control at the lowest dose. The residual effect lasted 6 days after application. *B. reprimens* did not give good results. A mermithid nematode, *Agamermis* sp., was found for the first time in West Europe in larvae of *P. dispar*.

E. Levine & S.L. Clement (1981). Effect of parasitism by Bonnetia comta (Diptera : Tachinidae) on larvae of Agrotis ipsilon (Lepidoptera : Noctuidae). J. Kansas Entomol. Soc. 54 (2) : 219-222

The black cutworm, *Agrotis ipsilon* (Hufnagel), when parasitized as 4th and 5th instar larvae by the tachinid *Bonnetia comta*, lived for a significantly ($P<0.01$) shorter period of time than their respective nonparasitized groups. Larvae parasitized as 4th and 5th instars cut, respectively, 53 and 32 % fewer corn seedlings than did nonparasitized larvae.

L.H. Rolston, T. Barlow, A. Jones & T. Hernandez (1981). Potential of host-plant resistance in sweet potato for control of a white grub, Phyllophaga ephilida Say (Coleoptera : Scarabaeidae)

Sweet potato cultivars with different levels of resistance to larvae of a white grub, *Phyllophaga ephilida* Say, were tested with and without a preplanting soil treatment of ethoprop. Control by host-plant resistance alone was, with one exception, as good as or better than control with ethoprop applied to a susceptible cultivar. Combining the ethoprop treatment and the highest level of host-plant resistance resulted in 95-100 % control of white grub damage to the edible roots.

A. Panis (1981). Notes on some auxiliary insects regulating populations of Pseudococcidae and Coccidae (Homoptera, Coccoidae) in citrus in eastern Provence. Fruits 36 (1) : 49-52 (in French)

The efficacy of the main indigenous or introduced entomophagous insects of the citrus scales *Pseudococcus longispinus*, *P. calceolariae* and *P. maritimus* is discussed. The role of the coccinellid *Cryptolaemus montrouzieri* in regulating scale populations is explained, while the importance of chalcidien parasites (Encyrtidae) such as *Arhopoideus peregrinus* in citrus groves is described.

M.J. Way, M.E. Cammell, L.R. Taylor & I.P. Woiwod (1981). The use of egg counts and suction trap samples to forecast the infestation of spring-sown field beans, Vicia faba, by the black bean aphid, Aphis fabae. Ann. appl. Biol. 98 : 21-34

Daily suction trap samples, winter egg and « spring » population counts on the spindle tree, *Euonymus europaeus*, and initial infestations of *A. fabae* on *V. faba* crops are available from Southern England since 1970. In different areas, estimates of the sizes of the autumn migrations, the overwintering egg populations, the spring fundatrigeniae and the spring migrations have been used to forecast field bean crop infestation levels which, in turn, project subsequent trap catches of alatae. Combined, the *E. europaeus* and aerial sampling systems provide excellent longterm forewarning of the need for chemical control and short-term warning of control timing. Forecasts have been 90 % correct in 8 out of 9 years.

L.E.M. Vet & J.C. van Lenteren (1981). The parasite-host relationship between Encarsia formosa Gah. (Hymenoptera : Aphelinidae) and Trialeurodes vaporariorum (Westw.) (Homoptera : Aleyrodidae). X. A comparison of three Encarsia spp. and one Eretmocerus sp. to estimate their potentialities in controlling whitefly on tomatoes in greenhouses with a low temperature regime. Z. ang. Ent. 91 : 327-348

A search was made in California (USA) for alternative parasites able to control the greenhouse whitefly *T. vaporariorum* (Westw.) on tomatoes in greenhouses with a low temperature regime. The preselection of candidate species for biological control by means of laboratory methods is discussed. Four aphelinid species (*Encarsia formosa* Gahan, *E. pergandiella* Howard, *E.* sp. near *meritoria* Gahan and Eretmocerus sp.) could be reared and a laboratory method was developed to test their parasitization efficiency at 17 ± 1°C constant temperature : the reproductive capacity of the four species was measured over a period of 20 days. Results showed that *E.* sp. near *meritoria* and *Eretmocerus* sp. were less promising species compared to the other two, the former because of its low fecundity and the latter because of its extremely long developmental period at 17°C. The thelytokous species *E. formosa* exhibited a high fecundity but its development was significantly slower than that of the arrhenotokous *E. pergandiella*. The possible consequences of the different reproductive strategies of these last two species for their use as biological control agents are discussed. No definite answer to the question which of these two species would be most suitable for whitefly control under low temperature conditions could be given, therefore greenhouse experiments have been initiated in the Netherlands and the UK.

R. Espinel (1981). Laboratory study on feeding behaviour of Mamestra (Barathra) brassicae L. in presence of foliage treated by Bacillus thuringiensis B. Z. ang. Ent. 91 : 383-388

The behaviour of feeding refusal has been shown with the L3 larval instars of *Mamestra brassicae* L. in the presence of food treated with a *Bacillus thuringiensis* formulation. The total consumption of dry matter for each treatment was the criterion used to estimate acceptance or refusal level of food by larvae. The possibility of a specific effect of spores, crystals or non-active ingredients on the choice of food is also discussed. This behaviour could partially be explained by the poor susceptibility of this species of Noctuidae to *Bacillus thuringiensis* B.

H.S. Salama, M.S. Foda & A.M. El-Sharaby (1981). Potency of spore-δ-endotoxin complexes of Bacillus thuringiensis against some cotton pests. Z. ang. Ent. 91 : 388-398

29 cultures of *Bacillus thuringiensis* belonging to 14 serotypes were screened with respect to their activities against the 3 lepidopterous cotton pests, *Spodoptera littoralis*, *Heliothis armigera* and *Spodoptera exigua*. Only one

culture of the variety *entomocidus* produced spore-δ-endotoxin complex with high potency against *S. littoralis* and *S. exigua*. On the other hand, several cultures belonging to varieties *kurstaki* and *aizawai* were highly effective against *Heliothis armigera*. Using a newly-devised growth medium, the LC_{50} were determined to be 30.5 and 110.5 µg/ml of the diet, in *S. littoralis* and *S. exigua*, respectively, for the endotoxin produced by *B. t.* var. *entomocidus*. In the case of *Heliothis armigera*, the LC_{50} was 79.8 µg/ml diet, for the endotoxin preparation from *B. t.* var. *aizawai* (HD-133). The sporulation yields, as indices of endotoxin formation, were studied in *B. t.* var. *entomocidus* in relation to certain parameters of the growth medium. Highest sporulation titers were obtained using media buffered at neutral pH values. Among carbon sources tested, dextrin and wheat flour supported the formation of highest yields for spores followed by maltose, glucose and sucrose. Upon the use of glucose as a carbon source, a progressive increase in the spore yield was noted by increasing glucose concentration up to 0.5 % above which significant reductions in spore yields were noted. Citrate was shown to be a poor carbon source for spore formation at all concentrations tested. The results are discussed in the light of application feasibilities.

S.A. Temerak (1981). Qualitative and quantitative survey on the oophagous wasps attacking the pink borer, Sesamia cretica Led. (Lep., Noctuidae) on 3 graminaceous crops in Upper Egypt. Z. ang. Ent. 91 : 398-402

Field studies were undertaken to recognize and evaluate the relative role of the possible egg parasitoids attacking the pink borer, *Sesamia cretica* Lederer, on 3 graminaceous (sugarcane, sorghum and corn) crops at the University farm of Assiut in 1978 and 1979. One Scelionid, *Telenomus* sp. and 2 Trichogrammatids, *Paracentrobia* sp. and *P. dimorpha* (Kryger), emerged from *S. cretica* eggs. The Trichogrammatid parasitoids were only recorded from few egg masses on sorghum and considered as first records in Egypt. The Scelionid *Telenomus* sp. was the most dominant parasitoid on the 3 crops. Parasitism (%), estimated by different routes, did not significantly differ on the 3 crops. The Scelionid was actually found in more than 65 % of the egg masses on each of the 3 crops (during May) in the 2 years. After successful host acceptance, this parasitoid mostly tends to parasitize every egg in the respective egg mass. Size of egg mass (no. of eggs/mass) was significantly larger on sugarcane than both sorghum and corn plants. *Sesamia* moths showed ovipositional preference to sorghum rather than to sugarcane and corn stalks.

K. Alrouechdi, M. Canard, R. Pralavorio & Y. Arambourg (1981). Influence of the parasitoid complex on chrysopid (Neuroptera) populations in an olive orchard in southeastern France. Z. ang. Ent. 91 : 411-417

The parasitoids were an important factor reducing the chrysopid population existing in an olive orchard in southeastern France. The recorded mortality occurring in the cocoons exceeded 80 % ; it was mainly due to *Tetrastichus principiae* and *Isodromus puncticeps* which both parasitize the predating instars, and secondarily to *Gelis ilicicolator* which parasitizes the motionless ones after spinning the cocoons. About 10 % of the egg-layings were destroyed by the egg-parasitoid *Telenomus acrobates*, and 7 % of the *Anisochrysa* and *Chrysoperla* imagos supported the adult parasitoid *Chrysopophthorus hungaricus*. All these parasitic factors had a marked effect during summer so that only the chrysopid spring broods of *Chrysoperla carnea* were expected to enjoy a high survival rate.

Y. Murakami (1981). The parasitoids of Dryocosmus kuriphilus Yasumatsu (Hymenoptera : Cynipidae) in Japan and the introduction of a promising natural enemy from China (Hymenoptera : Chalcidoidae). J. Fac. Agr. Kyushu Univ. 25 (4) : 167-174

Dryocosmus kuriphilus is one of the most serious pests of chestnut trees in Japan and entered from China about 1941. Among 15 species of native parasitoids, *Torymus (Syntomaspis) beneficus* is the most important natural enemy but it has not been recognized as an effective natural enemy capable of regulating the pest population under an acceptable economic injury level. Recently, 10 species of the parasitoids were recorded from China. Among them, a promising natural enemy *Torymus (Syntomaspis)* sp. was imported into Japan and was released for propagation. The Chinese species is very closely related to the Japanese *beneficus* but distinguishable by the length of the ovipositor. The emergence period of the Chinese species is more synchronous with the host than is *beneficus*.

S. Barbagallo, S. Longo & I. Patti (1981). Preliminary results on the biological and integrated control of Planococcus citri (Risso) and Dialeurodes citri (Ashm.) in eastern Sicily. Fruits 36 (2) : 115-121

Preliminary results are reported on the use in eastern Sicily of the Hymenopteran *Leptomastix dactylopii* (How.) against *Planococcus citri* and *Encarsia lahorensis* (How.) against *Dialeurodes citri*. *L. dactylopii* was reared in the insectarium of the Catane Institute of Agricultural Entomology. It was released in the summer of 1979 in a number of citrus plantations. Good results were obtained with *Leptomastix* against *P. citri* in an orange grove. *E. lahorensis* was released during 1978 and is now established. In February 1980, parasitism was found at a level of 25 %.

J. Brenière (1981). Integrated control of pests in tropical crops. Agronomie Tropicale 36 (1) : 78-81

The concept of integrated control is discussed and defined. The author describes a number of examples including pests of rice in the Ivory Coast and the cecidomyid of sorghum in Upper Volta.

R.V. Dowell & R.H. Cherry (1981). Survey traps for parasitoids and coccinellid predators of the citrus blackfly, Aleurocanthus woglumi. Ent. exp. appl. 29 : 356-362

The attractiveness of sticky traps of eight colours for two parasitoids *Amitus hesperidum* Silvestri and *Prospaltella opulenta* Silvestri, and seven species of coccinellid predators of the citrus blackfly, *Aleurocanthus woglumi* Ashby (Homoptera : Aleyrodidae) was evaluated in insectary and field tests. Yellow traps captured significantly more parasitoids and coccinellids than other colours tested ; captures were greatest in traps placed in the lower half of citrus trees. These traps can be used to survey for and monitor the population trends of the citrus blackfly and its natural enemies.

M.O. Odindo (1981). Time-mortality response in Spodoptera exempta (Walk.) infected with heat-treated nuclear polyhedrosis virus. Insect Sci. Application 1 (3) : 225-230

The susceptibility of third-instar *Spodoptera exempta* (Walk.) to a heat-treated nuclear polyhedrosis virus was tested in the laboratory. The polyhedral suspension was purified by differential centrifugation and heat-treated at temperatures that ranged from 20 to 90°C for 10-30 min. The LT_{50} ranged from 108.4 h for virus heated at 50°C (10 min) to 162.2 h for virus heated at 80°C (10 min).

J.S. Elkinton & R.T. Cardé (1980). Distribution, dispersal and apparent survival of male gypsy moths as determined by capture in pheromone-baited traps. Environ. Ent. 9 (6) : 729-737

An average of 3.9 % of laboratory-reared, marked male gypsy moths (*Lymantria dispar* L.) released uniformly across a 0.64 km² area were captured in pheromone-baited traps set out 800 m apart in a 64 km² grid. In contrast, an average of 0.9 % of males released simultaneously from a single point at the center of the grid (566 m from the nearest trap) were captured. The 4.0 % recapture can be used to estimate the average density and the 0.9 % recapture to estimate the maximal density of a population of feral moths, based on the numbers caught in a trapping grid of the same trap density, if we assume that the feral and laboratory-reared moths behave similarly. Approximately 97 % of the recaptured males from the uniform release and 80 % from the grid center release were captured within 800 m of the release site and no moths were recaptured beyond 1600 m. An average of 18 % of males released from the center of a smaller (0.64 km²) grid of higher trap density (80 m spacing) were recaptured. Once again, recaptures occurred predominantly in traps near the center of the grid. The proportion recaptured was highest on the warmer days. Males were released 1, 2 and 3 days after eclosion to assess the effects of adult age, and mortality plus emigration upon trap catch. A higher proportion of older moths (2- and 3-days-old) were captured than one-day-old moths. The apparent average rate of mortality plus emigration between the first and second day after release was 96 %, an estimate that may be influenced by individual differences in responsiveness of males to a pheromone source.

H.T. Bell & R.G. Clarke (1980). Larval development, adult activity and a new parasite of the obscure root weevil. Environ. Ent. 9 (6) : 826-828

Larval development and adult emergence, population levels, oviposition and parasitism of *Sciopithes obscurus* Horn were determined in western Oregon. Five larval instars developed in 239 days. At 20°C, adults began emerging 288 days after 1st instars were placed on roots of container-grown strawberry. Larvae were collected from mid-June to August. Adult emergence occurred during July. Highest numbers of adults were observed on rhododendron between August and October. Between May and November, the percentage of field-collected adults containing mature oocytes ranged from 20 to 81 % with the lowest percentages occurring in July and November. Larvae of a fly *Dolichotarsus* (sp. unknown) (Diptera : Tachinidae) parasitized 32 % of adult weevils in one rhododendron garden.

H. Barclay & M. Mackauer (1980). The sterile insect release method for pest control : a density-dependent model. Environ. Ent. 9 (6) : 810-817

A logistic model of population growth is presented which describes the effects of introducing sterile individuals into a wild population regulated by density-dependent factors. It is shown that for certain levels of sterile releases two steady states exist, of which the upper state is stable and the lower state is unstable. Once a population is driven to below the lower threshold, continued releases will cause (local) extinction. The 2 steady states exist for a wide variety of density-dependent growth functions. The release of sterile males alone is less effective than the release of sterile males and sterile females but not importantly so ; however, the release of sterile females alone is not a satisfactory strategy for eradication.

D.G. Finlayson, J.R. Mackenzie & C.J. Campbell (1980). Interactions of insecticides, a carabid predator, a staphylinid parasite and cabbage maggots in cauliflower. Environ. Ent. 9 (6) : 789-794

Plots of transplanted cauliflower were assessed over a 3-year period to determine the effects of insecticides on the cabbage maggot, *Hylemya brassicae* (Weidemann) ; the small carabid beetle, *Bembidion lampros* Herbst and the staphylinid parasite, *Aleochara bilineata* Gyllenhal. *B. lampros* was the main species taken in pit-traps, and its numbers were unaffected by applications of granular chlorfenvinphos. Untreated plants averaged 7.7, 12.2 and 12.6 puparia in 1976, 1977 and 1978 respectively, of which 30.8, 42.6 and 62.2 % were parasitized by *A. bilineata*. Treated plants had fewer puparia with lesser percentage parasitism. Bioassays with granular insecticides in soil showed that *B. lampros* was quite tolerant to chlorfenvinphos, somewhat susceptible to carbofuran and isofenphos, and very susceptible to terbufos.

P.M. Room (1979). Parasites and predators of Heliothis spp. (Lepidoptera : Noctuidae) in cotton in the Namoi Valley, New South Wales. J. Aust. ent. Soc. 18 : 223-228

Four species of Diptera and 12 species of Hymenoptera were recorded as parasites and evidence was obtained that at least 19 species of insect, five species of spider and house mice were predators of *Heliothis* spp. A further 12 species of predaceous insect and three species of spider were also common in unsprayed cotton. Data are presented on consumption of *Heliothis* eggs and small larvae by various insects and spiders in petri dishes.

D.G. Rogers (1979). Host-plant resistance to Ophiomyia phaseoli (Diptera, Agromyzidae) in Phaseolus vulgaris. J. Aust. ent. Soc. 18 : 245-250

Fifteen entries representing thirteen cultivars of *Phaseolus vulgaris* were evaluated for nonpreference and antibiosis resistance to *Ophiomyia phaseoli*. The number of viable eggs per plant exhibited significant variation amongst the cultivars studied. No significant differences were found in the developmental period of larvae and pupae or in the size of adults emerging from the cultivars studied. Significant correlations were found between the number of viable eggs per plant and leaf hairiness, stem diameter and internode length. Low egg counts were associated with high leaf hair density, thin stems and long internodes.

D.P.A. Sands & G.J. Snowball (1980). Comperiella pia (Hymenoptera : Encyrtidae), a parasitoid of the circular black scale (Chrysomphalus ficus) from Queensland. J. Aust. ent. Soc. 19 : 41-46

The specific status of *Comperiella pia* is established, the female redescribed and the species recorded parasitising *Chrysomphalus ficus* in Queensland. The adult morphology and aspects of its biology are contrasted with those of the related *Comperiella bifasciata* Howard.

M. Wysoki, E. Swirski & Y. Izhar (1981). Biological control of avocado pests in Israel. Protection Ecology 3 : 25-28

Control of mite and insect pests on avocado is achieved without recourse to synthetic biocides in Israel. Damaging outbreaks of the long-tailed mealybug : *Pseudococcus longispinus* Targioni Tozzetti (Hom. : Pseudococcidae) : of

the honeydew moth, *Cryptoblabes gnidiella* Mill. (Lep. : Phycitidae) ; and of the giant looper, *Boarmia selenaria* Schiff. (Lep. : Geometridae), have resulted in some plantations from the drift of insecticidal sprays applied in adjacent cotton fields. Infestations of the mealybug, and concomitantly of the honeydew moth, could be suppressed by reducing off-target interference from aerial sprays and releasing the parasitic wasps, *Hungariella peregrina* Compere and *Anagyrus fusciventris* Girault (Hym. : Encyrtidae). The giant looper could be controlled by applications of the microbial agent, *Bacillus thuringiensis* Berliner ; since only young larvae are susceptible to the pathogen, special monitoring procedures were devised to determine their presence and to time treatments accordingly.

S. Goodwin & E. Schicha (1979). Discovery of the predatory mite Phytoseiulus persimilis (Acarina : Phytoseiidae) in Australia. J. Aust. ent. Soc. 18 : 304

Phytoseiulus persimilis Athias-Henriot (Phytoseiidae) was discovered near Sydney in December 1978 in association with *Tetranychus urticae* (Koch) (Tetranychidae) on commercial strawberries. It is the first time that this species has been recorded in Australia.

R.P. Field (1979). Integrated pest control in Victorian peach orchards : the role of Stethorus spp. (Coleoptera : Coccinellidae). J. Aust. ent. Soc. 18 : 315-322

The importance of *Stethorus* spp. in controlling *Tetranychus urticae* Koch was studied over three seasons in peach orchards in the Goulburn Valley, Victoria. In the early maturing cultivar (Riley), *Stethorus* spp. reduced the need for acaricide applications when less insecticide was used for the control of *Cydia molesta* Busck. Three species of *Stethorus* occurred, *S. vagans* Blackburn being the most abundant. No insecticide was required for the control of *C. molesta* between mid-October and early January provided adequate spraying was carried out in early spring and just before harvest.

E.R. Sinclair (1979). Parasites of Cryptophlebia ombrodelta (Lepidoptera : Tortricidae) in southeast Queensland. J. Aust. ent. Soc. 18 : 329-335

During a life-system study of *Cryptophlebia ombrodelta* (Lower) in southeast Queensland five hymenopterous, and one dipterous, parasites were recorded. In decreasing order of occurrence they were *Apanteles briareus* Nixon, *Bracon* sp. (Braconidae), *Gotra bimaculata* Cheesman (Ichneumonidae), *Brachymeria pomonae* (Cameron) (Chalcididae), ? *Thelariosoma* sp. (Tachinidae), and *Euderus* sp. (Eulophidae). All attacked larval or pupal stages. No egg parasite was detected. One hymenopterous hyperparasite (Encyrtidae) *Eupelmus* sp. emerged from *A. briareus*.

P. Bailey (1979). An attempt to control oriental fruit moth, Cydia molesta, by mass releases of Macrocentrus ancylivorus (Hymenoptera : Braconidae). J. Aust. ent. Soc. 18 : 211-212

Macrocentrus ancylivorus, released at rates of up to 60 females per peach tree, parasitized an average of 4 % of larvae of oriental fruit moth in South Australian peach orchards. Low host numbers may have caused this low rate of parasitism.

R.P. Field, W.J. Webster & D.S. Morris (1979). Mass rearing Typhlodromus occidentalis (Acarina : Phytoseiidae) for release in orchards. J. Aust. ent. Soc. 18 : 213-215

Two methods are described for mass rearing and releasing *Typhlodromus occidentalis* into orchards. The first involves rearing the predator on mite infested apple trees and the second consists of rearing them in a field of mite infested soy-beans. In 1977-78, *T. occidentalis* was released in approximately 3000 ha of apple and peach trees in 216 orchards. Establishment was detected on 46 of the 49 orchards examined during the winter after release. The second method had logistic advantages over the first.

NEMATODES

R. Mankau (1980). Biological control of nematode pests by natural enemies. A. Rev. Phytopath. 18 : 415-440

This review deals only with the most important and promising natural enemies on which there is sufficient information to make at least preliminary interpretations of their value and potential role in biological control. Viruses, rickettsias, bacteria *(Bacillus penetrans)*, fungi (including predacious and endoparasitic fungi, parasites of nematode eggs and cysts, and fungi that produce metabolites toxic to nematodes), and predacious nematodes of the orders Mononchida and Dorylaimida are all discussed. Miscellaneous predators mentioned are Collembola and mites.

G.L. Barron (1981). Predators and parasites of microscopic animals. In : Biology of Conidial Fungi, Vol. 2, Ch. 20 : 167-200

The author considers the following topics : predators of nematodes (life cycle, adhesive knobs, nets and branches, nonconstricting and constricting rings, morphogenesis of traps, persistence of predatory Hyphomycetes, attractants) ; predators of arthropods and rhizopods ; endoparasites of nematodes (adhesive and ingestive) ; endoparasites of other microfauna.

B. Kerry (1981). Fungal parasites : a weapon against cyst nematodes. Plant Disease 65 (5) : 390-393

The life cycle of cyst nematodes is described, and their natural enemies listed. Three phycomycetous fungi, *Catenaria auxiliaris, Nematophthora gynophila* and an undescribed lagenidiaceous fungus, which parasitise and kill females and eggs of *H. avenae* are dealt with. *Verticillium chlamydosporium* is mainly an egg parasite but will attack virgin females. The effect of fungal parasitism on nematode numbers in the soil is discussed.

FUNGI

J. Allan Dodds (1980). Association of Type 1 viral-like dsRNA with club-shaped particles in hypovirulent strains of Endothia parasitica. Virology 107 : 1-12

A hypovirulent strain (H_1) of *E. parasitica* (EP 113) contained enough dsRNA to be detected in unconcentrated nucleic acid extracts. Most of the dsRNA was associated with pleiomorphic club-shaped particles up to 300 nm long with spherical heads (diameter = 50-90 nm). Similarly prepared extracts from a virulent strain lacked dsRNA, club-shaped particles, and large membrane-like bodies. All these components were also detected in extracts of a hypovirulent strain (H_2) generated by conversion of the virulent strain with strain EP 113. The appearance and properties of the club-shaped particle suggest that it is either a new and pleiomorphic type of fungal virus-like particle or a site of accumulation of a complex dsRNA.

K.F. Baker (1980). Microbial antagonism – the potential for biological control. Contemporary Microbial Ecology. 2nd Int. Symp. Microbial Ecology, Univ. Warwick, Coventry, 7-12 Sept. 1980 : pp 327-347 (ed. D.C. Ellwood et al.)

Examples of biocontrol discussed in this paper include only those that have been successfully demonstrated under field or commercial conditions, and most of which are commercially used today. The author considers biological balance and its manipulation, interactions between microorganisms and then gives examples of the biological control of soil-borne pathogens (*Fomes* spp., *Phytophthora cinnamomi*, *Fusarium* spp., *Rhizoctonia solani*, *Gaeumannomyces graminis*, *Streptomyces scabies* and others), and the biological control of pathogens of aerial parts. Bacterization, the inoculation of seeds with specific bacteria before planting in nontreated soil, is briefly mentioned.

U. Schutz (1981). Biocontrol of Cytospora species. Z. Pflanzenkr. Pflanzensch. 87 (2/3) : 132-141

The effect of several known antagonists on *Cytospora persoonii* and *C. cincta*, which causes a canker and dieback of twigs on stone fruit, was tested on different types of peach, plum and sweet cherry. Good inhibition of *Cytospora* was achieved after prophylactic treatment with *Trichoderma* spp., *Peniophora gigantea*, *Coniothyrium olivaceum* and *Epicoccum purpurascens*. Moderate effects were shown by *Trichothecium roseum*, *Leptographium lundbergii* and *Bacillus subtilis* strain I. Application of *B. subtilis* strain II and *Aureobasidium pullulans* var. *melanogenum* was unsatisfactory. Treatment of established cankers was unsuccessful. Combinations of prophylactic and therapeutic treatments did not improve the result. *T. viride* showed optimum effect 4 days after application.

E.G. Kuhlman (1981). Mycoparasitic effects of Scytalidium uredinicola on aeciospore production and germination of Cronartium quercuum f.sp. fusiforme. Phytopathology 71 : 186-188

In areas of galls parasitised by *S. uredinicola*, aeciospore production by *C. quercuum* f.sp. *fusiforme* was reduced 72 % to 31,000 spores/mm². Rapid dispersal decreased the aeciospore population on nonparasitised and parasitised gall tissues to 13 and 23 %, respectively, of the maxima after 1 wk. Germination of aeciospores from heavily parasitised gall areas was significantly reduced compared with that from nonparasitized or lightly parasitized areas.

T.H. Abd-El-Moity & M.N. Shatla (1981). Biological control of white rot disease of onion (Sclerotium cepivorum) by Trichoderma harzianum. Phytopath. Z. 100 : 29-35

S. cepivorum isolates varied in their tolerance to the mycoparasitic effect of *T. harzianum*. Application of *T. harzianum* mycelium and spores in pots in the greenhouse, and in the field, decreased white rot incidence, best control being obtained when the antagonist grown on barley grains was added at the time of planting. Complete darkness is an essential factor for mycoparasitism *in vitro*. No sclerotia were formed in mycoparasitised *S. cepivorum* mycelium. Histological studies of mycoparasitised *S. cepivorum* sclerotia showed destruction and complete replacement of sclerotia content with *Trichoderma* mycelium and spores.

K.T. Smith, R.O. Blanchard & W.C. Shortle (1981). Postulated mechanism of biological control of decay fungi in red maple wounds treated with Trichoderma harzianum. Phytopathology 71 : 496-498

T. harzianum has been used as a biocontrol agent against wood decay fungi including *Fomes connatus*, a causal organism of decay in living red maple trees. *T. harzianum* and *Phialophora melinii*, an organism that becomes established early in the decay process, were both tolerant of gallic acid, a major phenolic constituent of maple sapwood, but *T. harzianum* had less capacity to alleviate gallic acid inhibition of *F. connatus* than did *P. melinii*. When wounded red maples were treated with *T. harzianum in vivo*, soluble matter from the green-coloured boundaries separating live, healthy sap wood from dead, infected, discoloured wood had a greater phenol content than did untreated controls from which *P. melinii* was commonly isolated. It is known that pioneer fungi such as *P. melinii* help render wood susceptible to decay by reducing levels of phenols that inhibit decay fungi. Therefore, it is postulated that a mechanism of biological control of decay in red maple trees by *T. harzianum* is the replacement of pioneer fungi by *T. harzianum*.

J.B. Taylor & E.M. Guy (1981). Biological control of root-infecting basidiomycetes by species of Bacillus and Clostridium. New Phytol. 87 : 729-732

The effect of flooding was studied on eight basidiomycete fungi growing on pieces of wood which were buried and flooded for 12 weeks. None of the fungi was re-isolated from the flooded site, and the cause of the phenomenon was investigated, using a bioassay with *Peniophora sacrata* as the test fungus. When four *Bacillus* spp. and three *Clostridium* spp. from this site were added together to McCartney bottles containing soil and *P. sacrata*, and then flooded, the fungus was killed, but not when single bacterial species were used. This potential was present in 24 of 32 soils in the southwest Pacific.

B. Sneh (1981). Use of rhizosphere chitinolytic bacteria for biological control of Fusarium oxysporum f.sp. dianthi in carnation. Phytopath. Z. 100 : 251-256

Fifteen chitinolytic bacterial isolates from carnation rhizosphere were capable of lysing living mycelium of *Fusarium oxysporum* Schlecht f.sp. *dianthi* (Prill & Del.) Snyd. & Hans. Two were identified as *Arthrobacter* sp. and *Serratia liquifasciens*. Carnation seedlings, roots of which were dipped in a cell suspension of *Arthrobacter* sp. and then planted in a naturally infested soil in greenhouse conditions were significantly protected from infection as compared with untreated seedlings. The number of diseased plants determined 130 and 150 days after treatment was 62 and 96 %, respectively, in the untreated control plants as compared with 8 and 21 %, respectively, in treated ones. Under field conditions, the number of diseased plants determined after 110, 136 and 160 days was 29, 45 and 55 %, respectively, in the control plots as compared with 10, 20 and 40 %, respectively, in the treated plots.

T.E. Freeman (1981). Use of conidial fungi in biological control. In : Biology of Conidial Fungi, vol. 2, Ch. 19 : 143-165

This review article first deals with the advantages and disadvantages of conidial fungi as biological control agents and then goes on to consider recent advances in their use in

the control in particular of plant pathogens (*Trichoderma* and *Gliocladium* versus soilborne diseases) and weeds (*Colletotrichum* spp. and *Cercospora* spp. and others). On the basis of these early studies, the author concludes that the use of conidial fungi for biocontrol of pest species is in its infancy, but that the successes thus far achieved should serve as building blocks for future work.

Y. Elad, I. Chet & Y. Henis (1981). Biological control of Rhizoctonia solani in strawberry fields by Trichoderma harzianum. Plant and Soil 60 : 245-254

Trichoderma harzianum preparations were used in two successive field experiments in commercial strawberry nurseries and fruiting fields. Disease severity of *Rhizoctonia solani* in daughter plants was reduced by 18-46 % in the treated nursery plots. Infestation of nursery soil with the pathogen, as tested by planting beans in soil samples, was reduced by the *Trichoderma* treatment by up to 92 % as compared to the untreated control. A rapid decline of the disease was observed in soil from *T. harzianum* treated plots, successively planted with bean seedlings. More isolates of *Trichoderma* sp. antagonistic to *R. solani* were found in the infested field as compared to the non-infested one. *Trichoderma harzianum* treated plants, transferred to the commercial field, gave a 21-37 % increase in early yield of strawberries. A combined treatment in the nursery and in the fruiting field resulted in a 20 % yield increase as compared to control plots.

G.E. Harman, I. Chet & R. Baker (1981). Factors affecting Trichoderma hamatum applied to seeds as a biocontrol agent. Phytopathology 71 : 569-572

Trichoderma hamatum, applied as a seed treatment, controlled seed rot of pea or radish in soil infested with *Pythium* spp. or *Rhizoctonia solani*, respectively, if soil temperatures were between 17 and 34°C and seeds had been treated with a suspension of conidia with a concentration equal to or greater than 10^4/ml. Addition of chitin or cell walls of *R. solani* to seed coats increased the ability of the mycoparasite *T. hamatum* to protect seeds against *Pythium* spp. or *R. solani* and resulted in an increase in the population density of *Trichoderma* in the soil. *T. hamatum* with chitin, but not with cell walls of *R. solani*, effectively reduced damping-off resulting from *Pythium* spp. compared with a seed treatment containing only *T. hamatum*. Addition of peat to *T. hamatum* did not increase the protective ability of the agent as a seed treatment, but resulted in an increase in its population density in soil. Addition of a nonpathogenic isolate of *R. solani* had little effect either on protection of seeds or levels of *Trichoderma* in the soil, whereas addition of cellulose tended to decrease both protection and establishment of the biocontrol agent in the soil. Treatment of seeds with both *Rhizobium* and *T. hamatum* had no effect on the nodulating activity of the former or the protective ability of the latter.

G. Turhan (1981). A new race of Streptomyces ochraceiscleroticus in the biological control of some soilborne pathogens. I. Effects of the isolate C/2-9 on some of the most important soilborne fungi in vitro. Z. Pflanzenkr. Pflanzensch. 88 (6) : 373-381

The antagonistic effects of an isolate of *Streptomyces ochraceiscleroticus* (C/2-9) from soil in Izmir (Turkey) on 19 soil-borne fungi were investigated *in vitro*. Many were important root pathogens. In tests using the streak method, the inhibition zone between the antagonist and the test fungi was found to be 10.8-18.2 mm. With the agar-ring method, metabolites of C/2-9 diffused into the PDA and completely inhibited the development of the test fungi. It was also found that when culture filtrate of C/2-9 was added to PDA in the ratios of 1:4 and 1:10 no fungal colony could develop. However, with a ratio of 1:15, slowly growing colonies developed as compared with controls. It was decided that C/2-9 is a new race, different from the type-culture defined in Bergey's Manual (1974) with respect to its strong antifungal effects. The possibility of using this race in the biological control of soil-borne plant pathogens is pointed out.

J.W. Deacon & C.M. Henry (1981). Death of the root cortex of winter wheat in field conditions ; effects of break crops and possible implications for the take-all fungus and its biological control agent, Phialophora radicicola var. graminicola. J. agric. Sci. Camb. 96 : 579-585

Significantly more root cortex death was seen in first to third wheat crops after 1 or 2 years of grass than after swedes-potatoes, and in one replicate block compared with the other in the trial. But there was no significant difference in cortical death between first, second, third and 16th successive wheat crops. Root cortex death could not be attributed to infection by *Gaeumannomyces graminis*, *Phialophora radicicola* var. *graminicola* or the nematode *Rotylenchus robustus*. But its implications for root-infecting parasites are considered and, in particular, the enhanced cortical death in some crops compared with others may help to explain the reported differences in infection of wheat by *P. radicicola* var. *graminicola*, a biological control agent of take-all.

K.F. Baker (1981). Biological control. In : Fungal Wilt Diseases of Plants. Ed. M.E. Mace, A.A. Bell & C.H. Beckman. Academic Press. Ch. 14 : 523-561

The following topics are covered : biological balance ; biological control (resident and introduced antagonists) ; relevant features of pathogenic fungi (host resistance, seed transmission) ; biological control prior to infection ; suppressive soils (pathogen is unable to establish, establishes but causes no disease or establishes but disease diminishes with monoculture ; biological control after infection ; some supplemental practices in biological control (pathogen-free propagules, soil treatments, crop rotation, sanitation, flooding of soil, planting date).

D.E. Munnecke et al. (1981). Interactions involved in controlling Armillaria mellea. Plant Disease 65 (5) : 384-389

The authors briefly review work since the 1930's and then report on methyl bromide's effectiveness in soil and on agar disks, the evidence of biological activity in soil after fumigation, methyl bromide's effect on *Trichoderma* spp., responses of the pathogen and antagonists to heat, production of antibiotic substances by *A. mellea*, and the stressing effect. With the stressing effect, biocontrol mechanisms are operative, but not in its absence. The complex interactions involved explain why biological measures for practical field control of this important pathogen of crop plants remain so elusive.

J. Webber (1981). A natural biological control of Dutch elm disease. Nature 292 : 449-451

The author presents evidence that the fungus *Phomopsis oblonga* prevents successful breeding of scolytid beetles (which are the vectors of *C. ulmi*) by decreasing numbers of viable offspring in brood trees or eliminating potential breeding material and therefore intensifying competition for any uncolonised bark.

G.A. Strobel & G.N. Lanier (1981). Dutch elm disease. Scientific American 245 (2) : 40-50

The history, symptomatology, pathogenicity and biology of Dutch elm disease in the USA are reviewed. Five principal strategies for control are outlined : quarantine, eradication, control of the fungus or beetle, treatment of individual trees, replacement of susceptible trees by resistant ones. Screening of *Pseudomonas* spp. for antagonists of *C. ulmi* is described as well as the antifungal effect of *Ps. syringae* and its use in the field.

G.L. Barnes et al. (1981). Aphelenchus avenae, a potential biological control agent for root rot fungi. Plant Disease 65 (5) : 423-424

Various numbers of *Aphelenchus avenae*, a mycophagous nematode, were added to pots of soil artificially infested with virulent isolates of *Rhizoctonia solani* or *Fusarium solani*. Control of these root rot fungi was determined by bioassay with alfalfa seedlings transplanted to the pots after a 3-wk fungus-nematode interaction period. Concentrations of 250,000 to 1 million nematodes per 15.2-cm (6-in.) standard clay pot of fungus-infested soil consistently produced healthy, dark green plants. Plants that survived in pots treated only with a fungus were stunted and chlorotic and had necrotic roots.

WEEDS

S.W.T. Batra (1918). Puccinia xanthii f.sp. ambrosia-trifidae : a microcyclic rust for biological control of giant ragweed, Ambrosia trifida (Compositae). Mycopathologia 73 : 61-64

The rust *Puccinia xanthii* f. sp. *ambrosia-trifidae* attacks leaves of giant ragweed, *Ambrosia trifida* L., significantly reducing seed and pollen production, seed weight and seedling vigor. In tests, teliospores did not infect *A. artemisiifolia* L., *Xanthium strumarium* L., and cultivated varieties of chrysanthemum, safflower, sunflower, cosmos, marigold, lettuce, endive, dahlia, zinnia, gloriosa daisy, aster, scabiosa, and gallardia. This fungus commonly attacks *A. trifida* in eastern and central North America, and it should be of value for the biological control of *A. trifida* where introduced in Eurasia.

A.N. Dubey (1981). Biological control of weeds in rice fields. Tropical Pest Management 27 (1) : 143-144

Preliminary studies on the ability of the steel blue beetle, *Haltica cyanea*, to suppress weeds in the field and in cages were undertaken. It was found that the beetles completely denuded the sedge *Ludwigia parviflora* without harming the rice crop. Revival of the weeds ranged from zero to 8 % in the cages depending on the number of beetles released, while there was no revival of weeds in rice crops in the field.

H. Leventer (1981). Biological control of reservoirs by fish. Bamidgeh 33 (1) : 3-26

Biological succession and the associated detrimental effects in different types of artificial reservoirs in Israel are discussed. In order to quantitatively reduce biological activity, 9 species of fish were introduced, from 1970, each occupying a specific trophic niche, as follows : tilapia *(Sarotherodon aureus)* and grey mullet *(Liza ramada)* to reduce the amount of organic matter at the bottom of the reservoir ; grass carp *(Ctenopharyngodon idella)* to eliminate submerged plants ; black carp *(Mylopharyngodon piceus)* and common carp *(Cyprinus carpio)* to eliminate snails ; silver carp *(Hypophthalmichthys molitrix)* and *Sarotherodon galilaeus* to reduce the amount of phytoplankton ; big head carp *(Aristichthys nobilis)* to reduce the amount of zooplankton ; and sea bass *(Dicentrarchus punctatus)* to prey on fish which had penetrated the reservoir. The resulting effects of each of these species are described. Although biological control by fish is slow, good control of snails and submerged plants was obtained.

b) Public Health

M. Graber, A. Euzeby & J.P. Gevrey (1981). Biological control of the snail vectors of bilharzia. Predatory action of Tilapia rendalli Boulenger and Sarotherodon mossambica Peters towards Biomphalaria glabrata Say. Hydrobiologia 78 : 253-257

Laboratory experiments indicate that the Cichlidae *Sarotherodon mossambica* and, in particular, *Tilapia rendalli* may be promising biological control agents of schistosomiasis by acting as predators of eggs and young *Biomphalaria glabrata* less than 10 mm in diameter.

J. Hamon (1981). Control of vectors by parasites and pathogens. Report of Workshop No. 9. Third European Mutlicolloquium of Parasitology, Cambridge, September 7-13, 1980. Parasitology 82 : 117-129

Following an introduction by J. Hamon, the papers listed below are included :

- *The serotype H-14 of Bacillus thuringiensis. J. Larget & H. de Barjac, pp 117-118*

  B.t. H-14 produces a delta toxin far more toxic to mosquito and blackfly larvae than other known strains. Further results on the toxicity of this serotype are reported. A standard formulation of the delta endotoxin (IPS-78) was tested against larvae of *Aedes aegypti, Drosophila melanogaster, Musca domestica, Chironomus plumosus* and *Culicoides* sp. The delta endotoxin of *B.t.* H-14 proved to have a very narrow activity spectrum.

- *Strain 1593 of Bacillus sphaericus. C. Bourgouin, pp 118-119*

Investigations were carried out on the stability of the toxin (or toxins) associated with *B.s.* 1593. Bioassays, utilising third instar larvae of *Anopheles stephensi*, confirmed that vegetative cells contain little toxin(s) while sporulating cells are extremely toxic and older spores are slightly less toxic. Both heat and UV affect the toxin(s). Experimental primary powders were less effective than those of *B.t.* H-14 against *A. stephensi* larvae.

- *Microsporidia affecting arthropod vectors. J. Vavra, pp 119-120*

Two species of monomorphic Microsporidia which affect mosquitoes are considered ; *Nosema algerae* and *Vavraia culicis*. Difficulties in exploiting the potential of both species as biological control agents are discussed. The importance of investigating the horizontal transmission of dimorphic microsporidia is emphasized.

- *Microsporidia for trematode control. E.U. Canning, pp 120-121*

Microsporidian infections of trematode larvae are quite common and not very host specific. *Nosema eurytremae* and *N. algerae* have been studied in *Fasciola hepatica* and *Schistosoma mansoni*. The high doses of spores required and lack of pathogenicity indicate that these isolates are unlikely to be effective as biological control agents. Another microsporidian species the « Torcross isolate » is much more pathogenic but has, as yet, not been extensively investigated due to difficulties in culture.

– *Mermithids for the control of Simulium damnosum. B. Mondet, pp 121-122*

The interrelationship of *Isomermis lairdi* and *Simulium damnosum s.l.* in the Volta River basin of West Africa is considered. Although *I. lairdi* undoubtedly kills a proportion of the blackfly larvae and reduces female fertility, the host-parasite relationship is such that the author concludes that there is little hope for using this mermithid as a biological agent for controlling onchocerciasis vectors.

– *Trematodes for the control of schistosomiasis molluscan hosts. C. Combes & H. Nassi, pp 122-123*

The use of trematodes for controlling the molluscan hosts of schistosomes is discussed. Small-scale field trials on the use of *Ribeiroia marini guadeloupensis* on *Biomphalaria glabrata* in Guadeloupe showed that from a quantitative viewpoint, this parasite was only of limited effectiveness. However, better results could possibly be achieved by synchronising *R.m. guadeloupensis* egg release to the two periods during which the mollusc is very susceptible to the trematode.

– *The biological control of vectors of human disease. M.W. Service, pp 123-124*

Ecological aspects of the biological control of vectors of human disease are considered. Quantitative ecological data are required because there may be differences in the efficacy of the control agents when aimed at high and low vector population densities. Biological agents should be used along with other vector control methods, with a flexible strategy taking continuously into account new ideas and new ecological data.

– *Conclusions. J. Hamon, p 126*

Dr Hamon drew attention to the fact that the dynamics and longterm trends of each particular vector-borne disease should be investigated in order that control could be improved. Even self-perpetuating agents of modest effectiveness could contribute to the progressive reduction of disease incidence. An important conclusion was that the development and sound use of biological control agents would require a larger number of better trained vector control specialists and vector pathologists than available at present, both worldwide and in the endemic countries concerned.

V.P. Sneller & R.H. Dadd (1981). Interaction of amino acids and glucose on growth of Aedes aegypti (Diptera : Culicidae) in a synthetic rearing medium. J. Med. Entomol. 18 (3) : 235-239

A requirement for glucose by larval *Aedes aegypti* was examined in this study. Addition of glucose did not affect ultimate development to the adult stage, but greatly increased larval growth rate. In a medium containing 1.5 % amino acids, glucose concentrations greater than 3.0 % were deleterious to larvae. Increasing amino acid concentrations only partially compensated for a lack of glucose. Best growth rates were achieved with an amino acid concentration of 1.5 % and glucose concentrations of 0.5 % and 1.0 %.

Laboratory trials of Bacillus thuringiensis var. israelensis on mosquito larvae in Egypt, by S.S. Bekheit, Ministry of Health, Egypt

The development of insect resistance, particularly of mosquitos, to the organochlorines, organophosphates and carbamates is reviewed. Late 3rd stage and early 4th stage larvae of *Culex pipiens*, *Anopheles pharoensis* and *C. antennatus* were collected from the field and exposed in groups of 100 in the laboratory to 0.1 mg/l *B. thuringiensis* (emulsion containing 175 ITU *Ae ae*/mg) for 10 successive days. In another experiment, varying concentrations of the larvicide were used : 0.1, 0.08, 0.06, 0.04 and 0.02 mg/l. The residual effect (at 0.1 mg/l) lasted 10 days with a gradual reduction in effectiveness from 100 % on the first 4 days to 60 % by day 10. The respective LC50's of the larvicide againts *C. pipiens*, *G. antennatus* and *A. pharoensis* were 0.027, 0.04 and 0.05 mg/l.

c) Veterinary Entomology

G.C. LaBrecque et al. (1981). Control of the stable fly, Stomoxys calcitrans (Diptera : Muscidae), on St. Croix, U.S. Virgin Islands, using integrated pest management measures. I. Feasibility of sterile male releases. J. Med. Entomol. 18 (3) : 194-196

The feasibility of controlling the stable fly, *Stomoxys calcitrans*, on St. Croix, U.S. Virgin Islands, using sterile male releases was evaluated. With the observed rates of increase, population densities, daily emergence rate, and mass-rearing capacity, it was found that sterile male releases (SMRs) are feasible during the dry season at sterile : fertile ratios of 0.5 : 1, 1 : 1, and 2 : 1 and at a 5 : 1 ratio if only a portion of the island is to be treated. Fewer options are available during the wet season, because rates of increase are too great to use SMR alone at the 0.5 : 1 and 1 : 1 sterile : fertile ratios, and only ½ of the island can be treated at 5 : 1. It is suggested that SMRs might be integrated into a pest management program, since partial suppression is all that would be necessary to reduce fly populations to levels low enough in both wet and dry seasons so that the SMR technique could be feasible.

D.F. Williams et al. (1981). Control of the stable fly, Stomoxys calcitrans (Diptera : Muscidae), on St. Croix, U.S. Virgin Islands, using integrated pest management measures. II. Mass rearing and sterilisation. J. Med. Entomol. 18 (3) : 197-202

Stable flies, *Stomoxys calcitrans*, collected at local dairies on St. Croix, U.S. Virgin Islands, were used to establish a colony for mass production of flies for a sterile male release (SMR) program. Daily adult production ranged from 250,000 to 300,000, with ca 70,000 pupae/day needed for colony maintenance. When trays were seeded at a rate of ca. 60,000 eggs/tray, average yield was 21,400 pupae/tray, and more than 90 % eclosed. Thus rearing efficiency was ca. 30 %. The SMRs were most successful when releases consisted of 24- to 48-h-old adults exposed to 2 kR of gamma radiation (cobalt-60). This dosage sterilized 100 % of the females and 98 ± 2 % of the males, and adults were vigorous and highly competitive with the native strain.

R.S. Patterson et al. (1981). Control of the stable fly, Stomoxys calcitrans (Diptera : Muscidae), on St. Croix, U.S. Virgin Islands, using integrated pest management measures. III. Field techniques and population control. J. Med. Entomol. 18 (3) : 203-210

In July 1974 a 3-year feasibility study was initiated on St. Croix, U.S. Virgin Islands, on the use of the sterile male technique as a replacement or adjunct to insecticidal or physical measures to control or eliminate the stable fly, *Stomoxys calcitrans*. Sterile male insects, ca. 1×10^5/day (5 days/wk), were released over the 218 km² island for 18 months in 1976-1977. Because of the large wild stable fly population, some of the major breeding sites were larvicided at intervals throughout the test. For the last 6 months of the study, better than 99.9 % of the wild flies were eliminated ;

however, a few fertile flies were found throughout the study. These fertile flies either came from isolated breeding sites, had immigrated from other islands, or had been introduced with imported livestock and/or pets.

5. Books

Microbial Control of Pests and Plant Diseases 1970-1980. Edited by H.D. Burges (1981), xvi + 914 pp + index. Academic Press

Some 60 specialist authors and coauthors have contribued to this book which is a sequel and supplement to the initial work entitled « Microbial Control of Insects and Mites » (Ed. H.D. Burges & N.W. Hussey, 1971, xxii + 862 pp. Academic Press). Pathogens or groups of pathogens showing particular progress have been selected from the major taxonomic divisions, as subjects for a series of compact chapters about their identification, practical use and toxins. Other chapters investigate the potential of genetic engineering ; aspects of technology and integration such as formulation, application machinery, ecology and biostatistical modelling ; safety and the insects' defence mechanisms ; and impressions of use and research in the People's Republic of China.

Management of Insect Pests with Semiochemicals : Concepts and Practice. International Colloquium on Management of Insect Pests with Semiochemicals, Gainesville, Florida, March 23-28, 1970. Ed. by E.R. Mitchell. Plenum Press (New York), 1981, 514 pp

These proceedings are divided into the following sections : Biomonitoring, Mass trapping, Mating disruption, Formulation, toxicology and registration, Oviposition disruptants and antiaggregants. There are some forty papers.

CAB Publication. The Taxonomy, Distribution and Host Preferences of African Parasitic Wasps of the Subfamily Ophioninae (Hymenoptera : Ichneumonidae), by I.D. Gauld & P.A. Mitchell

Systematic Monograph of the Commonwealth Institute of Entomology No. 1. A4, soft covers, 287 pp, 810 figs, 102 maps, 1978. ISBN 0 85198 409 6, £20.00.

6. Abstracts from Entomophaga

(Prepared by Courtesy of B. Hurpin, INRA)

ENTOMOPHAGA, volume 26 (2), 1981

R.P. Jaques, J.E. Laing, C.R. MacLellan, M.D. Proverbs, K.H. Sanford & R. Trottier, Research Station, Agriculture Canada, Harrow, Ontario ; Department of Environmental Entomology, University of Guelph, Ontario ; Research Station, Agriculture Canada, Kentville, Nova Scotia ; Summerland, British Columbia ; Vineland Station, Ontario, Canada. Apple orchard tests on the efficacy of the granulosis virus of the codling moth, Laspeyresia pomonella (Lep. : Olethreutidae).

The protection of apples against damage by the codling moth, *Laspeyresia pomonella* by applications of the granulosis virus of *L. pomonella* was assessed in apple orchard tests at 4 locations in Canada in 1974-1978. Sprays containing 3×10^9 to 4×10^{10} granules/litre, applied 2 or 3 times per generation of codling moth larvae, reduced injury to apples by 44 to 85 % compared to reductions of 72 to 98 % by applications of azinphos-methyl or phosmet. Applications of the virus did not reduce numbers of arthropods predaceous on pest insects and mites.

K.V. Yeargan & C.I. Shuck, Department of Entomology, University of Kentucky, Lexington, USA. Longevity and reproductive rate of Patasson lameerei (Hym. : Mymaridae), a parasitoid of Sitona spp. (Col. : Curculionidae) eggs.

This paper reports the reproductive rate as a function of parasitoid age, as well as fecundity and longevity. The effects on these biological characteristics of constant and fluctuating temperature regimes are compared, using *Sitona hispidulus* as hosts.

L.C. Argyriou, Benaki Phytopathological Institute, Kiphissia-Athens, Greece. Establishment of the imported parasite Prospaltella perniciosi (Hym. : Aphelinidae) on Quadraspidiotus perniciosus (Hom. : Diaspididae).

This paper describes the work that has been done to introduce the parasite *Prospaltella perniciosi* both in orchards and in alternative host plants. This aphelinid was imported into Greece to aid in the biological control of *Quadraspidiotus perniciosus*. Two to 10 years following release in apple trees, the parasite was found well established on *Q. perniciosus* with low parasitism up to 2.5 %.

I. Ben Ze'ev & R.G. Kenneth, Faculty of Agriculture, Hebrew University of Jerusalem, Rehovot, Israel. Zoophthora radicans and Zoophthora petchi sp. nov. (Zygomycetes : Entomophthorales), two species of the « Sphaerosperma group » attacking leafhoppers and frog-hoppers (Hom.).

The authors have isolated in Israel and grown in pure culture a « *Sphaerosperma* group » fungus from *Empoasca* sp. (Hom. Cicadellidae) and have examined Petch's material (dried *P. spumarius* specimens killed by « *Entomophthora aphrophorae* », obtained from the Royal Botanical Herbarium at Kew). The affinities of the 2 related fungal species to other « *Sphaerosperma* group » fungi found elsewhere on Cicadellidae and on other close families of Homoptera are discussed with regard to general morphological characters and spore dimensions.

I. Larget & H. de Barjac, Institut Pasteur, Paris, France. Activity of 22 Bacillus thuringiensis varieties against 3 Culicidae.

We have studied the 15-H serotypes of *Bacillus thuringiensis* including 22 varieties. The larvicidal potency of whole cultures of these varieties was evaluated on 4th instar larvae of *Aedes aegypti, Culex pipiens pipiens* and *Anopheles stephensi*. The H-14 serotype, variety *israelensis*, was the only one to show a true toxicity at 10^{-5} dilution on larvae of the 3 mosquito species.

J.R. Ables, S.B. Vinson & J.S. Ellis, USDA, Cotton Insects Research, College Station ; Department of Entomology, Texas A & M University, College Station ; Department of Entomology and Economic Zoology, Clemson University, Clemson, USA. Host discrimination by Chelonus insularis (Hym. : Braconidae), Telenomus heliothidis (Hym. : Scelionidae), and Trichogramma pretiosum (Hym. : Trichogrammatidae).

The ability of female parasitoids (*Chelonus insularis, Telenomus heliothidis* and *Trichogramma pretiosum*) to

distinguish between parasitized and unparasitized tobacco budworm, *Heliothis virescens*, eggs was determined in laboratory studies. All 3 species were relatively efficient at detecting eggs that were previously parasitized by conspecific females.

G. Remaudière, J.P. Latgé & M.F. Michel. Institut Pasteur, Paris, France. Comparative ecology of Entomophthoraceae pathogenic to aphids in littoral and continental France.

The role of entomophthorosis in the dynamics of aphid populations infesting natural vegetation in northern littoral France (Basse-Normandie) and in northeastern continental France (Vosges) is compared. In Basse-Normandie, anholocyclic behaviour of numerous aphid species contributes to the permanent presence of aphid populations and, consequently, the persistence of mycosis.

B. Sneh, S. Schuster & M. Broza. Institute for Nature Conservation Research, The George S. Wise Faculty of Life Sciences, Tel-Aviv University, Israel. Insecticidal activity of Bacillus thuringiensis strains against the Egyptian cotton leaf worm Spodoptera littoralis (Lep. : Noctuidae).

Among more than 50 isolates of *Bacillus thuringiensis* tested, 7 incited 100 % mortality when 2nd instar larvae of *Spodoptera littoralis* were fed on alfalfa leaves dipped in a spore-crystal suspension. Among those isolates, B.t. 24 demonstrated the highest activity.

J.G. Morse & B.A. Croft. Pesticide Research Center & Department of Entomology, Michigan State University, USA. Developed resistance to azinphosmethyl in a predator-prey mite system in greenhouse experiments.

Susceptible predatory, *Amblyseius fallacis*, and prey mites, *Tetranychus urticae*, developed comparable levels of resistance to azinphosmethyl when provided with unlimited food and similar selection treatments over 22 generations. Susceptible populations of each when hybridized with limited numbers of resistant mites incorporated the resistance rapidly and at comparable rates when selected for 5-8 generations. Data are discussed in relation to developed resistance to azinphosmethyl observed in field populations of spider mites and predators in apple orchards.

J.F. Charles & H. de Barjac. Institut Pasteur, Paris, France. Histopathology of Bacillus thuringiensis var. israelensis δ-endotoxin on Aedes aegypti larvae (Dip. : Culicidae).

Ingestion of the *Bacillus thuringiensis* serotype H-14 δ-endotoxin by *Aedes aegypti* larvae is followed by important lesions at the midgut level. The severity and speed of injury are dependent upon the cellular types of the mesenteron, but are always expressed by cellular hypertrophy followed by epithelial lysis.

D.J. Isenhour & K.V. Yeargan. Department of Entomology, University of Kentucky, Lexington, USA. Interactive behaviour of Orius insidiosus (Hem. : Anthocoridae) and Sericothrips variabilis (Thys. : Thripidae) : predator searching strategies and prey escape tactics.

The authors report the results of a study designed to observe the searching strategies of *O. insidiosus* preying on *S. variabilis* and to determine the effects of prey density, soybean trifoliolate region, and prey avoidance reactions on the behaviour of the predator.

J. Tersac & J. Guerdoux. Centre de Génétique Moléculaire du CNRS, Gif-sur-Yvette ; Université Pierre et Marie Curie, Paris, France. In vitro rearing of Pimplia instigator (Hym. : Ichneumonidae) : I. Oviposition in a decoy.

The authors set up a decoy pierced by females of *Pimpla instigator*. When filled with an aqueous extract of pupae of *Pieris brassicae*, it receives eggs as the natural host. This decoy allows one to observe egg laying as well as venom emission simply and directly.

ENTOMOPHAGA, volume 26 (3), 1981

R.V. Dowell, D. Puckett & M. Johnson. Agricultural Research Center, University of Florida, Fort Lauderdale, USA. Searching and oviposition behaviour of Amitus hesperidum (Hym. : Platygasteridae) and Encarsia opulenta (Hym. : Aphelinidae) parasitoids of the citrus blackfly (Hom. : Aleyrodidae).

Searching behaviour of *Amitus hesperidum* and *Encarsia opulenta* for immature *Aleurocanthus woglumi* was similar. *Encarsia opulenta* females showed a significant preference for hosts previously parasitized by *A. hesperidum* but the reverse was not true.

B. Papierok & N. Wilding. Institut Pasteur, Paris, France & Rothamsted Experimental Station, Harpenden, UK. Study of the behaviour of several strains of Conidiobolus obscurus (Zygomycetes, Entomophthoraceae) on the aphids Acyrthosiphon pisum and Sitobion avenae (Hom. : Aphididae).

The 2 types of strain of *Conidiobolus obscurus*, which can be separated by differences in their growth *in vitro*, differed also in characteristics of their development *in vivo*. The 2 types of strain should be considered as biological races within the species *C. obscurus*.

D. Rosen. The Hebrew University, Faculty of Agriculture, Rehovot, Israel. A new species of Pseudaphycus (Hym. : Encyrtidae) with notes on the Angelicus group.

The genus *Pseudaphycus* Clausen and related genera are considered to belong in the subfamily *Tetracneminae*. *P. debachi*, n.sp., a parasite of the striped mealybug, *Ferrisia virgata*, from Mexico, is described and compared morphologically to several closely-related members of the angelicus group of species.

J.T. Huber, CSIRO Biological Control Unit, Montpellier, France. Observations on the heliotrope flea beetle, Longitarsus albineus (Col. : Chrysomelidae) with tests of its host specificity.

The characteristics of *L. albineus* (small size, high fecundity, high level of dispersal, very variable population density, panmixis) are well adapted to its ephemeral hosts, the summer annual *Heliotropium* species. Because of the wide climatic range of *L. albineus*, its dispersal and host finding capabilities, and its ability to build up numbers fairly rapidly in summer, there should be no difficulty in establishing it in Australia.

J.K. Waage, J.T. Smiley & L.E. Gilbert. Imperial College, Field Station, Ascot, UK ; Department of Biology, University of California, Irvine ; Department of Zoology, University of Texas, Austin, USA. The Passiflora problem in Hawaii : prospects and problems of controlling the forest weed P. mollissima (Passifloraceae) with heliconiine butterflies.

The introduced vine, *Passiflora mollissima* poses a threat to unique natural forest areas in Hawaii. While biological control is desirable, the proximity of the crop plant, *P. edulis* f. *flavicarpa*, requires control agents to be highly specific. The present study reviews *Passiflora* heliconiine associations in the New World, with reference to host specificity and agricultural importance, and presents the results of preliminary oviposition and feeding trials with 9 heliconiines on *P. mollissima* and *P. edulis* f. *flavicarpa*.

R.A. Wharton, F.E. Gilstrap, R.H. Rhode, M. Fischel-M & W.G. Hart. Department of Entomology, College Station, Texas, USA ; Citrus Insects Research Laboratory USDA, Weslaco, Texas, USA ; Laboratorio de Investigaciones Biologicas, San José, Costa Rica. Hymenopterous egg-pupal and larval-pupal parasitoids of Ceratitis capitata and Anastrepha spp. (Dip. : Tephritidae) in Costa Rica.

A cooperative research program on biological control of *C. capitata* was initiated in August, 1979, by the USDA-SEA Citrus Insects Laboratory at Weslaco, Texas, and the Texas Agricultural Experiment Station at College Station, Texas. The purpose of this program is to survey selected fruits commonly infested by *C. capitata* and determine the extent of parasitoid fauna attacking *C. capitata* in Costa Rica.

G.M. Tatchell. Glasshouse Crops Research Institute, Littlehampton, UK. The effects of a granulosis virus infection and temperature on the food consumption of Pieris rapae (Lep. : Pieridae).

The 1st part of this paper investigates the relationship between the area of cabbage leaf eaten and the development of *P. rapae* larvae. In the 2nd part, the effect of a granulosis virus infection on the amount of food eaten and the development of *P. rapae* larvae of different ages is investigated. The results are discussed in relation to the feasibility of using granulosis virus for the control of *P. rapae*.

J. Chazeau. Centre ORSTOM, Nouméa, Nouvelle Calédonie. Biology of Coelophora quadrivittata (Col. : Coccinellidae) predator of Coccus viridus (Hom. : Ciccidae) in New Caledonia.

The biology of *Coelophora quadrivittata*, reared on its prey *Coccus viridis* under controlled conditions, is studied. The place of the species among the local complex of predators of the green scale is briefly discussed.

B.M. Wilk & C.Y. Kitayama. Division of Biological Control, University of California, Albany, USA. Host stage preference for deposition of male eggs by Coccophagus cowperi (Hym. : Aphelinidae).

The study was undertaken to provide information to assist in the mass rearing and establishment of *C. cowperi* on this coccid host in California. In addition, this work will provide taxonomists with biological information of value in evaluating the status of structurally similar forms within the *lycimnia* group.

A. Amargier, S. Abol-Ela, S. Vergara, G. Meynadier, D. Martouret & G. Croizier. INRA, Station de recherches de pathologie comparée, St-Christol-les-Alès ; Station de recherches de lutte biologique, La Minière, France. Histological and ultrastructural studies on the larvae of Pandemis heparana (Lep. : Tortricidae) during the advanced stages of a baculovirosis due to a new virus inducing diapause.

A nuclear polyhedrosis virus infecting the tortricid *Pandemis heparana* collected in an apple orchard in France was isolated and studied. The baculovirus is active only in the newly hatched larvae. It induces a delayed arrest of development in the L3 larvae and subsequently the death of L5 and L6 larvae. Some aspects of the ultrastructure are discussed.

H. David, S. Easwaramoorthy, V. Nandagopal, N.K. Kurup, M. Shanmugasundaram & G. Santhalakshmi. Division of Entomology, Sugarcane Breeding Institute, Coimbatore, India. Influence of different temperatures on the tachinid parasite Sturmiopsis inferens (Dip.).

The influence of constant temperatures of 27, 29, 31 and 33°C and alternating temperature of 31/33°C (18/6 h) on *Sturmiopsis inferens* was studied during 12 successive generations. A temperature range of 27-29°C appeared to be optimum for mass rearing of the parasite in the laboratory. Under field conditions, the flies will be able to withstand a comparatively higher temperature.

Editors and organizers of this issue : G. MATHYS and Elizabeth A. BAKER.