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

nº 16, 1980

July

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 General Assembly

This will be held, as already announced, during the XVI International Congress of Entomology in Kyoto (3-9 August, 1980) on the 5 August 1980 at Kyoto Traditional Industry Hall, Okazaki Park, Kyoto (7.00-9.30 p.m.). The following agenda is proposed :

1. Opening - Past President
2. Report of the Secretary-General
3. Report of the Treasurer
4. Report of the Accounts Verification Panel
5. Establishment of new Sections
6. Global Working Parties
7. Elections (results of the postal ballot)
8. Addition to the IOBC rules of procedure regarding elections
9. Reports from regional Sections
10. Any other business
11. Address by the President

2. Postal Ballot for Election of Members of the IOBC Executive Committee

The following Members have been elected to the governing board of IOBC :

President

K.S. HAGEN — Division of Biological Control, University of California, 1050 San Pablo Ave., *Albany*, Calif 94706 (USA)

Vice-Presidents

G. FADEV — Ministry of Agriculture, Orlikov pereulok 1/11, *Moscow 107139 (USSR)*

H. MORI — Dep. of Applied Zoology, Hokkaido University, *060 Sapporo* (Japan)

Secretary-General

G. MATHYS — EPPO, 1 rue Le Nôtre, *FR - 75016 Paris* (France)

Treasurer

F.D. BENNETT — CIBC, Gordon Street, Curepe, *Trinidad* (West Indies)

3. IOBC - sponsored International Symposium on the Ecology of Bruchids Attacking Legumes, organized by the University François - Rabelais in Tours (FR) with the Cooperation of FAO (16-19 April, 1980).

The meeting, considering that the cultivation of legumes is the best and quickest way to increase food protein production, especially in developing countries, reviewed basic knowledge on particularly harmful bruchid species in

various parts of the world. A proposal was made to establish an IOBC - sponsored pluridisciplinary task force which should define middle and long-range programmes for the alleviation of the often disastrous crop losses. This group would be coordinated by Professor Labeyrie of the University François - Rabelais in Tours.

4. Bellagio Conference on "Future of Integrated Pest Management" (30 May-4 June, 1980)

This Conference was convened by IOBC with the support of the Rockefeller Foundation and was held at the Rockefeller Conference Center, Villa Serbelloni, Bellagio, Italy.

IOBC which is a Section of the International Union of Biological Sciences unites researchers throughout the world and has liaison status with FAO ; its aim is to promote the implementation of IPM. However, in spite of the considerable successes registered with the introduction of the technique in different countries in several crops and on extended acreages, its general acceptance in agricultural practice is slow. This situation is disquieting, especially if one considers that there are many additional benefits to be gained from the implementation of such systems, in particular in the developing world where the physical environment is generally conducive to the development of pests throughout the year. A balanced protection system could avoid disruption of the biological complex through excessive pesticide usage and accordingly prevent losses at the small-holder and subsistence farming levels.

These considerations led IOBC to call on 14 highly experienced scientists from various parts of the world to review the current situation, to identify remaining problems and to study ways of resolving them.

The following major themes were studied :

1. Achievements and promise for the future.
2. Research and development opportunities : technical, organizational, educational, industrial, economic, sociological.
3. Special problems encountered in the introduction of IPM in developing countries.
4. Conclusions.

Fifteen papers provided the background for these discussions, which led to a number of interesting conclusions regarding future developments in IPM.

The full report, including background papers, an account of the debates and the conclusions will be published before the end of 1980 ; it will be free of charge, as an IOBC service.

Please contact the IOBC Secretariat if you are interested in receiving the Report.

5. IOBC/WPRS Working Group on Integrated Control in Vineyards

Summary, by E.A.Baker, of the " Report of the Subgroup on " Grape Moths ", a meeting held in Kecskemet, Hungary, 11-13 March 1980, by R. Roehrich, mimeo., 12pp (French).

This meeting was attended by 14 participants from 7 countries. The report summarises discussion on the following topics : method for identifying eggs of *Clysia*, trapping-damage relationships and predictions, determining times of treatment (temperature sums), places for pupation and diapause, natural parasitism, *Trichogramma*, growth regulators, *Bacillus thuringiensis*, pyrethroids, sex pheromones, pest status and relationship with grey mould, treatment by helicopter, research in Bulgaria and establishment of a bibliography. The main resolutions made were the following :

1. Population estimation. Negative forecasts depend on regional conditions and it is not possible to generalise. But phases after the first flight are important and study of the different stages of development must be increased.

2. Life cycles as a function of environmental conditions, especially temperature sums. The simulation model of Touzeau should be verified elsewhere. According to the climate, other factors may be important.

3. Parasitism. A priority study of *Dibrachys affinis* and its biology. Regarding *Trichogramma*, the value of finding and studying strains while awaiting adequate production (strains should be sent to Mr Voegelé, Station de Zoologie et Lutte Biologique, 37 Bd du Cap, 06602 Antibes, France).

4. Times of treatment. Inquiry into present practices. At what time, using which criteria : vine phenology, temperature sums, flight data, hatching records, etc.

5. Control methods. For *Bacillus thuringiensis*, to concentrate efforts on determining dates of intervention. For growth regulators, to experiment with new products and application techniques, particularly timing, and isolation of experimental plots. For sex pheromones, to expand studies depending on the availability of compounds.

6. Bibliography. A complete bibliography on grape moths was proposed, with individuals collating papers published in their respective countries.

6. IOBC/WPRS Working Group on Integrated Control in Orchards

Summary of the " Report of the meeting on techniques for studying the side-effects of pesticides on beneficial arthropods in orchards " by P. Blaisinger, D. Martouret & H.G. Milaire (1979), *Note d'inf. Lutte Intégrée, Special 11, Dec. 1979, 57pp, mimeo.*

This meeting was held on 10-11 April 1979, in Colmar, France, with 23 participants from France, West Germany, Switzerland and Spain. The report, which is mainly in French, comprises an introduction by Steiner and the following seven papers :

- *Assessing the Effects of Insecticides on Beneficial Arthropods at the Tree Level in Orchards, by H. Willhelm (DE)*

Plots in a 7-year-old peach orchard were sprayed with four different insecticides and arthropod counts made 5, 24, and 48 hours after treatment. To obtain a total count of the tree fauna, dichlorvos was applied after 48 hours and a count made 1 hour later. Both parathion and decamethrin had a marked effect on beneficial insects. The advantages of the dichlorvos treatment are discussed.

- *Comparison of Two Application Techniques for Testing Products, by P. Blaisinger (FR)*

The nature and use of two types of insect trap (funnel and tray) are contrasted. In a trial to compare two application techniques of four insecticides in a plum orchard, funnel traps were used to enumerate beneficial arthropods. The effects of the products on insect counts were classified into four toxicity groups, according to Steiner. Comparable results regarding toxicity were obtained for the two spraying methods. The apparent variation found with phosalon proved not to be statistically significant.

- *Views on Methods for Assessing the Effects of Pesticides on Entomophagous Arthropods, by J.N. Reboulet (FR)*

The experiment, carried out in an apple orchard, was intended firstly to investigate the dichlorvos " cleaning " treatment recommended by the Working Group, and secondly to develop insect traps for different fruit trees and parts thereof. Results of counts made 48 hours after two

dichlorvos treatments suggested either that the trees had been recolonized in this time or that the application rate of 250 g/hl was inadequate. Diagrams are given of two plastic tray traps, for the upper and lower branches. Future research objectives are discussed.

– *Comparison of Two Experimental Methods to Test the Selectivity of Pesticides against Beneficial Insects in Orchards, by A.M. Both & B. Sechser (CH)*

Insect counts obtained using funnel and tray traps were compared in two apple orchards after application of a broad-spectrum and a selective insecticide, followed 24 hours later by a " cleaning " dichlorvos treatment. Three to four times as many arthropods were collected in the trays compared with the funnel traps. The advantages and disadvantages of the two trap types are discussed.

– *Calculation of the Effect of Different Pesticides on Beneficial Insects, by A.M. Both (CH)*

The effect of a pesticide is defined as the ratio of the number of arthropods killed to the total number counted. The paper describes the way in which the effects of different pesticides can be compared using a graphical adaptation of the Kruskal-Wallis test.

– *The " Plant Protection Service-Pesticide Industry " Working Group on the Side-effects of Insecticides, Acaricides and Fungicides Used in Agriculture, by J. Touzeau (FR).*

The composition and terms of reference of this Working Group are outlined, together with a set of guidelines for analysing data regarding the side-effects of pesticides. The author then describes how these data are summarised and filed. The different types of side-effects (e.g., effect on beneficial insects, russeting, phytotoxicity, etc.) are listed. Examples of standard recording forms are appended.

– *Information Centre, by P. Blaisinger (FR)*

The Working Group had previously decided to establish an Information Centre at the Colmar Zoology Station. To date, little progress has been made, but a possible procedure for information collection and dissemination is described.

The Report ends with a summary of discussion on the various topics and a conclusion. A broad protocol to be followed when assessing the effects of pesticides on beneficial arthropods is outlined, together with a provisional minimum list of beneficial arthropod species and stages which should be monitored. Only short-term effects (48-72 h) should be considered. It was decided that a " cleaning treatment " should be carried out at the end of the trial to enumerate the total fauna in trial plots, and that dichlorvos, at 0.1 % a.i. was suitable for this purpose.

7. Integrated Control in Brassica Crops, IOBC/WPRS Bulletin (1980) III (1)

This issue of the Bulletin, edited by T. Coaker, gives results of experiments carried out since 1972 by different members of the IOBC/WPRS Working Group on Integrated Control in Brassica Crops, and concentrates on the cabbage root fly, *Hylemyia (Delia) brassicae*, in cauliflowers. There are 16 papers in all, with contributors from 7 countries. Brief summaries of the papers (which are in English, with some French summaries) are given below.

Pp. 1-9. Pest assessment - as it relates to Hylemyia brassicae populations, by S. Finch (GB)

This paper describes the experimental designs and techniques currently available for sampling and estimating the abundance of *H. brassicae*, and emphasizes the importance of such data for determining when insecticidal treatments are needed.

Pp. 11-17. Trapping Hylemyia brassicae adults, by S. Finch, J. Freuler & E. Stadler (GB, CH)

Yellow sticky rectangular traps and water-traps fitted with an attractant (ANCS) dispenser, suitable for monitoring populations of *H. brassicae* are described. The latter type was more effective, and by placing the dispenser directly into the water of the trap, only 1/5 as much attractant was required. The efficiency of the presently used ANCS trap needs to be increased before such traps can be used economically to assist in directly controlling this pest.

Pp. 19-26. The assessment of damage caused to cruciferous crops by larvae of Hylemyia brassicae in soil, by A.R. Thompson (GB)

This paper assesses methods of classifying cabbage root fly damage, viz. Type I : death of seedlings or transplants, Type II : damage to unmarketable parts of plants, Type III : direct effect on marketable plant parts. Methods of estimating the various types of damage are then discussed.

Pp. 27-34. Using an economic threshold to reduce the amounts of insecticide applied to control H. brassicae, by G. Cruger & G. Mack (DE)

To prevent a reduction in cauliflower curd quality or more than 5 % of cabbage being destroyed by cabbage root fly, pupae should not exceed 5/plant or 10/plant, respectively. A spraying schedule is suggested, taking into account the fact that fewer eggs are laid/plant as the season progresses.

Pp. 35-41. A contribution towards the economic threshold of Hylemyia brassicae, by A. El Titi (DE)

Number of eggs, as a measure of population density, was found to be the most suitable parameter for establishing an economic threshold for *H. brassicae*. Up to 60 eggs/plant, 4 to 6 weeks after transplanting, did not reduce marketable yield. However, 10 to 20 eggs/plant within 14 days of transplanting justified chlorfenvinphos treatment.

Pp. 43-48. Crop loss assessment methods for Hylemyia brassicae on cauliflowers, by J. Freuler (CH)

Damage to plants by *H. brassicae* is greater at the edges than in the centre of fields. A visual method of estimating crop loss was less reliable than a method based on counting the numbers of marketable/non-marketable curds within a certain number of complete plant rows.

Pp. 49-62. Investigations on the biological control of the cabbage root fly (Hylemyia brassicae) with Aleochatra bilineata, by B. Bromand (DK)

In various localities in Denmark, 0-88 % of *H. brassicae* pupae were parasitised by *Aleochatra bilineata* and 0-39 % by *Trybliographa rapae*. A tray method for mass rearing *A. bilineata* on *H. antigua* pupae is described.

Pp. 63-87. Development of the sterile insect release method against the cabbage root fly, Delia brassicae, in north Belgium, by L. Hertveldt, M. Van Keymeulen & C. Pelerents (BE)

A mass rearing technique, based on rutabaga as larval food, is discussed. Determination of the timing and dosage of the irradiation treatment of pupae and adults is described, as well as the effects on fertility and longevity. Three SIR field experiments are reported and discussed, while conclusions on the applicability and feasibility of SIR against *H. brassicae* are formulated.

Pp. 89-98. Behavioural basis for the use of host plant volatiles in brassica pest control, by C. Hawkes (GB)

The potential and limitations of volatile host plant substances in monitoring and control of brassica pests are discussed. Observations using ANCS-baited traps suggest

that current trap design may not be utilising the full potential of attractants.

Pp. 99-104. Attraction of Hylemyia brassicae to the odours given off by its host plants, by S. Finch, R.A. Cole & G. Skinner (GB)

Information is urgently required on the distances over which host plant chemicals attract *Hylemyia brassicae* to crops. Without such information, traps releasing host plant chemicals could attract more insects into a crop than would arrive naturally and, hence, unwittingly increase crop damage.

Pp. 105-111. Problems in integrated control in cabbage crops in the Federal Republic of Germany, by G. Cruger (DE)

The various types and hectarage of brassica crops in Germany are enumerated. Growing practices for white cabbage are outlined, while cabbage pests, both in the nursery and field, are listed. The relative importance of these pests and means for their control are discussed.

Pp. 113-115. Some aspects of the binomics of Hylemyia brassicae in Western Switzerland, by J. Freuler (CH)

The pest incidence of *H. brassicae* is analysed in 3 regions of western Switzerland. Soil type and soil temperature are the main factors influencing the emergence of *H. brassicae* adults and the subsequent build-up of damaging pest populations.

Pp. 117-125. Insect pest management in brassica crops by inter-cropping, by T.H. Coaker (GB)

Mixed cropping brassicas can reduce insect pests in the crop. With the appropriate level of ground cover provided by an inter-crop, infestations of *H. brassicae* were reduced by over 70 % compared with brassicas in monoculture. This reduction was mostly due to a disturbance in the behaviour of the female flies on entering the mixed crop causing fewer eggs to be laid.

Pp. 127-130. Physical barriers to protect cauliflowers from Hylemyia brassicae damage, by S. Finch & G.A. Wheatley (GB)

Foam-rubber discs can be as effective as insecticides in protecting brassica plants from damage by *H. brassicae*. Such discs must be placed in position immediately after transplanting and fit closely around the plant stems. Discs are comparable in price to the standard insecticide treatments available to gardeners.

Pp. 131-136. Controlled release of naphthalene as a repellent against the cabbage root fly (Hylemyia brassicae), by H. Den Ouden (NL)

Experiments on the effect of mechanical and chemical barriers against oviposition of the cabbage root fly and larval penetration are described.

Pp. 137-144. A comparison of techniques using field plots with fixed or log-dose dilutions to evaluate the performance of single-plant drenches with chlorfenvinphos for the protection of early summer cauliflowers against Hylemyia brassicae, by A.R. Thompson, A.L. Percivall & G.H. Edmonds (GB)

The log-dose experiment provided considerably more information than the fixed-dose trial on the relationship between the dose of insecticide applied and the protection of cauliflower plants against cabbage root fly larvae. The experiments demonstrated the suitability of the log-dose principle for the primary evaluation of insecticides against cabbage root fly.

8. Review of Some Interesting Developments

8.1 Information Documents Produced by the WHO Division of Vector Biology and Control – Data Sheets on Biological Control Agents

These Data Sheets, each on a specific agent, give information on the following :

1. Identification and synonymy
2. Origin
3. Natural geographic distribution
4. Biological characteristics
5. Effectiveness against target organisms
   - Under laboratory conditions
   - Under field conditions
6. Effectiveness against non-target organisms
7. Production
8. Stability
9. Formulations and specifications
10. References, in chronological order

The following 6 Data Sheets have been issued, mimeographed, in English only :

a) Bacillus thuringiensis serotype H-14 (de Barjac 1978).

Doc. No. WHO/VBC/79.750 ; VBC/BC DS/79.01, 13pp, December 1979.

B. thuringiensis is a spore-forming bacterium that produces proteic endotoxins. In contrast to other serotypes, which show high pathogenicity for lepidopteran larvae, serotype 14 is highly pathogenic to mosquito larvae, including *Culex pipiens, Aedes detritus* and *Aedes aegypti*. Activity has also been demonstrated against blackflies (Simuliidae). A number of formulations are being developed in various countries ; 54 references are listed, 1959-1979.

b) Lagenidium giganteum (Couch 1935)

Doc. No. WHO/VBC/79.753 ; VBC/BC DS/79.02, 6pp, December 1979.

L. giganteum is a facultative parasitic fungus which can grow vegetatively either as a saprophyte in the aquatic environment or as a parasite of mosquito larvae. It kills the latter by invading the haemocoel and forming an extensive mycelium throughout the body. Several isolates have been reported and the species has been shown to infect a wide range of *Aedes* and *Culex* species with some activity against *Anopheles, Psorophora* and *Culiseta*. *L. giganteum* can be readily produced in 4th-instar mosquito larvae, but no formulations are reported to date ; 25 references are listed, 1935-1979.

c) Metarhizium anisopliae (Metschnikoff). Sorokin 1883

Doc. No. WHO/VBC/80.758 ; VBC/BC DS/80.04, 9pp, February 1980.

M. anisopliae is an imperfect fungus with a very wide insect host range, over 200 species, primarily coleopteran larvae. The fungus has a broad mosquito range, killing larvae by obstructing air passage through the two tracheal trunks. Investigation of the potential of *M. anisopliae* for control of terrestrial vectors such as *Rhodnius prolixus*, the vector of Chagas disease, continues. No formulations to date ; 49 selected references are listed, 1879-1979.

d) Culicinomyces sp.

Doc. No. WHO/VBC/80.755 ; VBV/BC DS/80.03, 4pp, February 1980.

The genus *Culicinomyces* consists of two isolates : the type species *Culicinomyces clavosporus* (from USA) and an unidentified species with similar properties (in Australia). Their mosquito host range includes larvae of all major medically important genera. *Culicinomyces* can be mass produced by fermentation in submerged cultures using

readily available media ; techniques for harvesting, short-term storage and application of conidia are reported. Field trials will be attempted in the near future, but no formulations are available to date ; 21 references are listed, 1973-1979.

e) Vavraia (Pleistophora) culicis (Weiser 1946)

Doc. No. WHO/VBC/80.759 ; VBC/BCDS/80.05, 5pp, February 1980.

V. culicis, a microsporidian, is an obligate parasite of mosquitos. Although not a good larvicide, *V. culicis* reduces the longevity of adult female anopheline mosquitos and can thus prevent transmission of malaria. Factors favouring the use of this microsporidian are spore longevity, ease of spore production in a large alternate host and safety. No formulations to date ; formulations increasing the flotation of spores must be devised to maximise the chances of contact between the parasites and mosquito larvae ; 31 references are listed, 1946-1979.

f) Octomyomermis muspratti (Obiamiwe and Macdonald 1973)

Doc. No. WHO/VBC/80.764 ; VBC/BC DS/80.07, 5pp, March 1980.

O. muspratti is a mermithid nematode which was isolated from tree-hole mosquitos. The parasitic larvae of this nematode develop inside mosquito larvae. *O. muspratti* is currently being studied because it appears tolerant to dessication, salinity and pollution and can be easily produced in the laboratory. The primary obstacle in its development is the lack of synchrony of egg hatch which hinders mass-production ; 13 references are listed, 1945-1978.

8.2 Plant Protection

– Original Paper
by courtesy Oxford group of researchers in virology.

Developments in European Pine Sawfly Control with Nuclear Polyhedrosis Virus which have Relevance to Crop Protection in General, by P.F. Entwistle, H.F. Evans, K.A. Harrap & J.S. Robertson, NERC Institute of Virology, Oxford, UK

The first successful demonstration that European Pine Sawfly, *Neodiprion sertifer*, could be controlled by spraying with a suspension of nuclear polyhedrosis virus (NPV), a baculovirus, was by Dr F.T. Bird in Canada in 1953. The NPV had been imported from Sweden where it was collected from natural disease outbreaks. Since then, a large number of research reports have confirmed the outstanding efficiency of this method of sawfly control. Currently, the Forest Pest Management Institute, Canada and the USDA Forest Service are co-sponsoring extensive safety testing of *N. sertifer* NPV, and it is likely that this virus will soon be available in North America as an officially approved control system. The requirements of registering authorities will probably be stringent. For instance in the UK, the Ministry of Agriculture, Fisheries and Food through its Pesticides Safety Precautions Scheme will require information on the methods demonstrating the identity and microbiological purity of the viral product. With the NPV's of many Lepidoptera, one approach to controlling microbiological contamination is to grow virus in host insects reared under sterile conditions on autoclaved semi-synthetic diets. This cannot yet be done with sawflies where a microbiologically defined NPV product can only be obtained through a complex purification process.

All field trials conducted on *N. sertifer* prior to 1977 have employed distinctly impure or, at best, only partially purified NPV. It is well know that host impurities confer on NPV's some protection against u.v. light – often the single most important factor in the degradation of insect viruses – so that an investigation of the performance of purified NPV becomes an essential part of a modern development programme. The staff of the UK Natural Environment Research Council's Institute of Virology conducted fully replicated field trials during 1977-78 to inspect the efficiency of highly purified NPV in conjunction with an up-to-date application system. All the work was done on infestations in lodgepole pine *(Pinus contorta)* in Scotland : as in the rest of Europe, pines in the UK are chronically subject to severe attack by *N. sertifer*. In the first years' work, a comparison was made between rates of 3×10^7, 3×10^9 and 3×10^{11} polyhedral inclusion bodies (PIB's) of the NPV/ha applied in water from the ground using a hand held controlled droplet applicator (Micron « Mini-Ulva »). The spray droplets were 50 µm in diameter and delivery was in approximately 6 litres/ha. Very good control and foliage protection were obtained with the intermediate dosage rate. In 1978, the formulation included 20 % anti-evaporant oil with emulsifiers, thus delaying droplet shrinkage by evaporation and making practicable the drifting of spray over crop swaths 4 meters wide. By this means, the total spray volume was reduced to just over one litre/ha. Five individual dosages were compared (5×10^7 - 5×10^{10} PIB's/ha) and good control was obtained with 10^{10} PIB's/ha. Similar results were obtained in 1978 by applying NPV in 11 litres of water/ha by helicopter, fitted with conventional boom and nozzle spray equipment. Controlled droplet application at ultra low volume of highly purified NPV was thus shown to be a feasible method of *N. sertifer* control. The successful association of potentially good coverage consequent on small droplet size and very low delivery volume should be of interest in the application of baculoviruses to other crops.

However, foliage protection was poorer in 1978 than in 1979. This was a result of the much higher populations of larvae in the 1978 trials and highlights an important difference between the action of chemical and microbiological pesticides. Treating an insect pest with a chemical usually gives a rapid kill and so swiftly prevents further damage to the crop. However, pathogens all undergo an incubation period during which the host may continue to feed and so to inflict damage ; the effects of this are especially noticeable when pest populations are high. Therefore, where it is necessary to obtain the best foliage protection in the season of treatment, account must be taken of pest population density and an appropriate rate of pathogen selected for application. There is, however, a limit to the degree of foliage protection that can be achieved and this is determined by the minimum time to which the incubation period can be reduced by increasing dosage. For *N. sertifer*, the limit appears to be reached at a dose of about 5×10^{10} PIB's/ha. Such limits in crop systems in general represent the logical upper level of application which it will never be profitable to exceed. An answer, therefore, to the economic question « what dose of pathogen should be applied at a given pest population density to prevent damage exceeding the economic threshold » lies in understanding the interaction of three variables : pest density, pathogen dosage and level of crop damage. Though identified in the study of *N. sertifer* control, it is a question especially germane to agricultural crops in which insect attack is of more immediate concern and tolerable thresholds of damage are lower than in forests.

– Abstracts

Studies on the Variation of Pathogenicity of Verticillium lecanii *(Zimm.) Viégas to Larvae of* Trialeurodes vaporariorum *Westw. G. Galani (1979). An. ICPP, Bucarest, vol. 15 : 244-248.*

The fungus *Verticillium lecanii* is pathogenic to larvae of the white fly *Trialeurodes vaporariorum*, which occurs on a variety of glasshouse crops. Pathogenicity was tested in

glasshouses on cucumbers heavily infested with white flies. The experimental data showed that virulence of *V. lecanii* varies according to the production system used. Thus, the conidial suspensions obtained from shaken liquid media and solid media are more virulent than those obtained from fermented cultures. It was also found that the virulence of conidia obtained in fermented culture can be enhanced by the addition of metal ions such as Mn, Mg, Fe and K. The possibility of increasing the virulence of fermented cultures with added metal ions will provide means for better standardization of the biological preparation containing *Verticillium lecanii*.

New Trends in the Integrated Control of Plant Diseases. T. Baicu (1979). An. ICPP, Bucarest, vol. 15 : 258-263.

In practice, the attacks of some diseases are often overlooked even though the economic threshold has been exceeded. Based on the principle of integrated control, it may be appropriate to use curative methods and to apply growth stimulators to secure rapid recovery of the diseased plant parts. In glasshouse experiments, tomato plants artificially infected with *Didymella lycopersici* Kleb. recovered after curative treatments with Mycodifol at 0.2 % and Fundazol at 0.1 %. New roots developed above the lesions after healing, watering and the application of 3-indole acetic acid at 3 ppm. Nitrogen fertilizers were also applied to accelerate growth.

Studies on the Entomopathogenic Fungus Beauveria bassiana *(Bals.) Vuill. and its Action on the Colorado Potato Beetle* (Leptinotarsa decemlineata *Say) and the Sugar-beet Weevil* (Bothynoderes punctiventris *Germ.). Zoe Bertatlief (1979). An. ICPP, Bucarest, vol. 15 : 233-241.*

Data are given on the mass-rearing of *Beauveria bassiana* (Bals.) Vuill. in surface and submerged cultures. Rearing on agar media yielded about 2 g of conidiospores after 10-12 days (in the form of dry matter per 100 ml of culture medium) ; the submerged cultures yielded about 3 g of blastospores per 100 ml of liquid medium. Biopreparations were formulated containing 20-25 × 10^9 and 45-50 × 10^9 conidiospores/g from surface cultures, and preparations with 20-25 × 10^9 blastospores/g. These products were tested against the Colorado beetle and the sugar-beet weevil under laboratory and field conditions. The biopreparation with a higher content of conidiospores was effective against the Colorado beetle, with 100 % mortality after 12 days ; the biopreparation containing 20-25 × 10^9 conidiospores or blastospores led to 52-56 % mortality after 12 days, and the preparation containing blastospores mixed with Wofatox 0.01 % or Ekatox 0.01 % caused mortality of 92-98 %, respectively, after 5 days.

The effects of the fungus on the sugar-beet weevil were checked using the biopreparation with a high content of conidiospores. Five preparations obtained with 5 strains of *B. bassiana* were tested and the mortality recorded under glasshouse conditions was 92-100 % after 12 days and 74 % in the field.

Taxonomy and Bionomics of the Insect Parasites of Rice Leafhoppers and Planthoppers in the Philippines and their Importance in Natural Biological Control. G. Chandra (1979). Plant Protection News VIII (2). Manila, Philippines : 4-22.

Outbreaks of rice hoppers have often threatened rice production in Asia and the fact that they transmit virus diseases has meant that even low densities of these insects constantly alarm rice growers. The natural enemy complex of these pests in the Philippines is not well understood but in view of the high biotic potential of the pests it is reasonable to assume that their population growth is at most times curtailed by natural enemies.

Trichoderma harzianum : *A Biocontrol Agent Effective against* Sclerotium rolfsii *and* Rhizoctonia solani. *Y. Elad, I. Chet & J. Katan (1980). Phytopathology 70 (2) : 119-121.*

Biological control of soilborne plant pathogens by the addition of antagonistic microorganisms to the soil is a potential non-chemical method of plant disease control. *Trichoderma* spp. capable of hyperparasitizing pathogenic fungi are highly efficient antagonists, e.g. *Trichoderma lignorum* (Tode) Harz on *Sclerotium rolfsii* Sacc. and *Rhizoctonia solani* Kühn.

This effect has also been shown, under field conditions by Wells *et al.* (H.D. Wells, D.K. Bell & C.A. Jaworski, 1972. Efficacy of *Trichoderma harzianum* as a biological control agent for *Sclerotium rolfsii*. Phytopathology 62 ; 442-447) using *T. harzianum* grown on ryegrass. Similarly, Backmann, P.A. and R. Rodriguez-Kabana (1975. A system for the growth delivery of biological control agents to the soil. Phytopathology 65 ; 819-821) controlled *S. rolfsii* in peanuts by using molasses-enriched clay granules as a food base for *T. harzianum*.

Recently, Hadar *et al.* (1979) (Hadar, Y., I. Chet & Y. Henis, 1979. Biological control of *Rhizoctonia solani* damping-off with wheat bran culture of *Trichoderma harzianum*. Phytopathology 69 ; 64-68) found that *T. harzianum* directly attacked *R. solani* mycelium (in glasshouses in beans, tomatoes and eggplants) in Elad's experiments.

In greenhouse experiments, biological control of *S. rolfsii* (up to 97 % reduction of disease incidence in bean seedlings) and *R. solani* (57 % reduction of disease incidence in bean seedlings) was achieved in soil artificially infested with both pathogens (wheat bran culture of *T. harzianum*)

Under field conditions, *T. harzianum* significantly increased yield and decreased disease incidence although less efficiently than under greenhouse conditions. Improved methods for applying *T. harzianum* in the field may produce better results.

9. Abstracts from Entomophaga

(Prepared by Courtesy of B. Hurpin, INRA)

ENTOMOPHAGA, volume 25 (1), 1980

T.L. Wagner & D.E. Leonard, Department of Entomology, University of Maine, Orono, USA. Mortality factors of satin moth, Leucoma salicis *(Lymantriidae), in aspen forests in Maine.*

Natural control agents of the satin moth, *Leucoma salicis*, were examined in 2 *Populus grandidentata* stands between fall 1974 and summer 1979. The objectives were to record the mortality factors, determine the amount of mortality caused by each and to evaluate the effectiveness of native and introduced parasites.

S. Grenier, Laboratoire de Biologie, INSA, Villeurbanne, France. Endoparasitic development and ponderal larval growth of Lixophaga diatraeae (Dip. : Tachinidae) in a substitution host : *Galleria mellonella* (Lep. : Pyralidae).

Endoparasitic development of *Lixophaga diatraeae* reared in a substitution host *Galleria mellonella* was studied by dissections of hosts containing parasitoids of known age. Larval weight increase is exponential and exhibits a doubling time of 0.65 day for the 1st and 2nd stages and around 0.8 day for the 3rd stage. Mean complete larval development time is 7.5 days.

O. Zethner, Zoological Institute, Royal Veterinary and Agricultural University, Copenhagen, Denmark. Control of Agrotis segetum *(Lep. : Noctuidae) in root crops by granulosis virus.*

Agrotis segetum granulosis virus (GV) propagated in Danish laboratory cultures was applied against field populations of *A. segetum* in experimental latin square plots planted with beetroots, carrots and potatoes. In 4 tests in which released eggs or larvae were caged over plots, cutworm numbers and damage were reduced by approximately 80 % compared with untreated plots. The comparable reductions in 3 open experiments with natural populations of cutworms were 65-75 %.

R.E. McFadyen, Commonwealth Institute of Biological Control, Tucuman, Argentina. A Cactoblastis *(Lep. : Phycitidae) for the biological control of* Eriocereus martinii *(Cactaceae) in Australia.*

A *Cactoblastis* sp. was found on Harrisia cactus *(Eriocereus martinii)* in north-eastern Argentina. Laboratory tests and field observations demonstrate that it will only damage plants in the sub-tribe Cereanae of the Cactaceae. It was approved for liberation in Queensland, Australia, for the control of *Eriocereus* spp., and field releases were made in October 1978.

J. Fargues & Dora Rodriguez-Rueda, INRA, Station de lutte biologique, La Minière, France. Susceptibility of Spodoptera littoralis *larvae (Lep. : Noctuidae) to the entomopathogenic Hyphomycetes* Nomuraea rileyi *and* Paecilomyces fumoso-roseus.

Laboratory studies were conducted to determine the susceptibility of various larval instars of the cotton leafworm, *Spodoptera littoralis*, to different spore doses of *Nomuraea rileyi* and to investigate the influence of temperature on infection by this fungus and by *Paecilomyces fumoso-roseus*. The 6th instar was more resistant than all the other instars tested. Larval mortality due to *N. rileyi* N° 5 was higher at 25°C than at 20°C. The other pathotype, *P. fumoso-roseus* N° 39, was more effective at 20°C than at 25°C and 28°C.

R.C. Hedlund & G. Mihalache, USDA European Parasite Laboratory, Sèvres, France ; Institutul de Cercetari si Amenajari Silvice, Bucuresti, Romania. Parasites recovered from pupae of Lymantria dispar *(Lep. : Lymantriidae) in Romania, 1978.*

In a survey at 5 sites in southern Romania for parasites of pupal *Lymantria dispar*, 8 species were recovered : 3 Tachinidae, 4 Ichneumonidae, 1 Chalcididae. Overall, parasitism was low.

V. Alexandrakis & P. Neuenschwander, Institut des plantes subtropicales et de l'olivier, Chania, Crète, Grèce ; Département d'entomologie, Ecole polytechnique fédérale, Zurich, Switzerland. The role of Aphytis chilensis *(Hym. : Aphelinidae), the main parasite of* Aspidiotus nerii *(Hom. : Diaspididae), on olive trees in Crete.*

The parthenogenetic strain of *Aphytis chilensis* found in Greece shows 2 maxima of abundance, one in spring and the other in autumn. This parasite is capable of maintaining a high parasitization rate over a wide range of host densities. The results show the practical importance of indigenous *A. chilensis* in the biological control of *A. nerii*.

Nicole Hawlitzky & Anne-Marie Mainguet, INRA, Station de zoologie, Versailles, France. Quantitative analysis of lipids, nitrogenous compounds and glycogen in the pupa and the young adult of an ovo-larval parasitic insect, Phanerotoma flavitestacea *(Hym. : Braconidae).*

Chemical analyses were made of *Phanerotoma flavitestacea* pupae and young adults, from larvae ectoparasitic and sarcophagous on *Anagasta kuehniella* caterpillars. The constituents were mainly proteins, as in the larvae. Body dry weight, lipids, nitrogenous compounds and glycogen decreased from the end of larval development to emergence. In adults, sexual dimorphism affected body dry weight and the constituents analysed.

P. Robert & M. Marchal, INRA, Station de lutte biologique, La Minière, France. Use of Plutella maculipennis *larvae for bioassay of entomopathogenic hyphomycetes (Fungi Imperfecti).*

Bioassays of entomopathogenic hyphomycetes were conducted with 3rd instar larvae of *Plutella maculipennis* in controlled conditons. Infections were carried out by spraying the fungal suspension onto small cabbage discs in a spray tower. The results indicated that Lepidoptera larvae are of use as test insects to measure the potency of hyphomycete biopreparations.

J.B. Beavers, S.A. Lovestrand & A.G. Selhime, USDA Horticultural Research Laboratory, Orlando, Florida, USA. Establishment of the exotic parasite Tetrastichus haitiensis *(Hym. : Eulophidae) and recovery of a new* Trichogramma *(Hym. : Trichogrammatidae) from root weevil egg masses in Florida.*

The exotic root weevil egg parasite, *Tetrastichus haitiensis*, imported from Puerto Rico and released in Florida between 1969 and 1971, was found established on citrus root weevil egg masses in 1978 near Oakhill, Florida. In addition, a new species of *Trichogramma* was discovered. In the laboratory, this species parasitized egg masses of 4 species of weevils that attack citrus in Florida.

F.D. Brewer & E.G. King, Bioenvironmental Insect Control Laboratory, USDA, Stoneville, Mississippi, USA. Consumption and utilization of a soyflour-wheat germ diet by larvae of the Tobacco budworm parasitized by the tachinid Eucelatoria *sp.*

Growth and food consumption were reduced when *Heliothis virescens* larvae were parasitized by *Eucelatoria* sp. in the 3rd- or 4th-instar, but larvae parasitized in the early 5th-instar consumed more food than comparable unparasitized larvae. Since *Eucelatoria* sp. parasitize few of the younger larvae, which would continue feeding, and older larvae that were parasitized would also continue to feed, releases of this parasite would not result in an immediate reduction in damage of *H. virescens*, but they could reduce the density of later generations.

D. Gonzalez, L. Etzel, M. Esmaili, A.H. El-Heneidy & I. Kaddou, University of California, Berkeley ; University of Tehran ; Plant Protection Institute, Cairo ; University of Baghdad. Distribution of Bathyplectes curculionis *and* Bathyplectes anurus *(Hym. : Ichneumonidae) from* Hypera *(Col. : Curculionidae) on alfalfa in Egypt, Iraq and Iran.*

A survey for *Hypera postica* and its larval parasites *Bathyplectes curculionis* and *B. anurus* was conducted from 1973 through 1975 in Egypt, Iraq and Iran. The survey had two objectives : 1) to search for parasites of larvae of *H. postica* from alfalfa in localities near the reported area of origin of alfalfa, from habitats with climatic patterns similar to those found in California ; and 2) to collect parasites from

larvae of *H. postica* from different, and geographically distant, habitats to evaluate their effectiveness as biotypes against *H. postica* in the several climatic zones where *Hypera* damages alfalfa in California.

Y. Sato, Faculty of Science, Kyoto University, Japan. Experimental studies on parasitization by Apanteles glomeratus. *V. Relationships between growth rate of parasitoid and host age at the time of oviposition.*

How does the parasitoid know the time the host reaches its maximum size ? How does *Apanteles* develop when parasitizing host larvae in older stages ? To answer these questions, this study aimed at determining the increase in volume of parasitoids as a parameter of growth.

F. Hérard & G. Mercadier, European Parasite Laboratory, USDA, Sèvres, France. Comparison of biotic characteristics of two cultures (Moroccan and American) of Ooencyrtus kuvanae *(Hym. : Encyrtidae), an egg parasite of* Lymantria dispar *(Lep. : Lymantriidae).*

Adults of *Ooencyrtus kuvanae* were recovered from eggs of *Lymantria dispar* collected in Morocco and in the USA. They were reared separately and simultaneously under identical laboratory conditions. Various biological characteristics of adults from both sources were compared. The adaptation of this parasite introduced from the USA to conditions in Morocco during the ensueing 50 years since its establishment (about 500 generations) did not appear to modify the biotic potential of this species nor was it sufficient to induce the development of a new geographic race.

J.P. Aeschlimann, Biological Control Unit, CSIRO, Montpellier, France. Sitona *species (Col. : Curculionidae) occurring on* Medicago *and their natural enemies in the Mediterranean region.*

The paper outlines the results of investigations carried out in Portugal (1973), Spain (1973), France (1973-79), Italy (1974, 1979), Greece (1974, 1977-79), Cyprus (1978), Morocco (1975-76), Algeria (1975) and Tunisia (1975). It describes the distribution of the various *Sitona* species on *Medicago* spp. and the occurrence and relative importance of their natural enemies throughout the surveyed areas. The results suggest that biological control of *S. humeralis* in Australia will be achieved only by the introduction of a series of agents, each adapted to a particular set of environmental conditions within the region infested.

R.N. Coulson, Don N. Pope, J.A. Gagne, W. Scott Fargo, P.E. Pulley, L.J. Edson & T.L. Wagner, Texas Agricultural Experiment Station, College Station, USA. Impact of foraging by Monochamus titillator *(Col. : Cerambycidae) on within-tree populations of* Dendroctonus frontalis *(Col. : Scolytidae).*

M. titillator is a member of the complex arthropod community that results from colonization of pine trees by *D. frontalis*. Competition occurs as a result of spatial and temporal coincidence in development of both species in the inner bark of the host. Foraging by *M. titillator* results in mortality to *D. frontalis*. The study aims to evaluate the impact of *M. titillator* foraging on within-tree populations of *D. fontalis* and to define and describe major sources of variation in the relationship between *M. titillator* foraging and *D. frontalis* mortality.

I. Ben-Ze'ev & R.G. Kenneth, Faculty of Agriculture, Hebrew University of Jerusalem, Rehovot, Israel. Zoophthora phytonomi *and* Conidiobolus osmodes *(Zygomycetes : Entomophthoraceae), two pathogens of* Hypera *species (Col. : Curculionidae) coincidental in time and place.*

Two entomophthoraceous species, found at different localities in Israel, caused epizootics on *Hypera variabilis* larvae during the springs of 1976 and 1977. *Zoophthora phytonomi* only produced conidia in the field, whereas *Conidiobolus osmodes* formed only dark, rough-walled resting spores that had been erroneously thought in the past to belong to *Z. phytonomi*.

Girish Chandra, the International Rice Institute, Manila, Philippines. Dryinid parasitoids of rice leafhoppers and planthoppers in the Philippines. II. Rearing techniques.

Three new techniques for rearing dryinids parasitising rice hoppers were developed, namely, a laboratory rearing technique for detailed observations, a device for transporting and rearing field-collected hoppers to estimate percentage parasitism and a breeding technique.

M.W. Johnson, E.R. Oatman & J.A. Wyman, Kansas State University, Garden City ; University of California, Riverside ; University of Wisconsin, Madison, USA. Natural control of Liriomyza sativae *(Dip. : Agromyzidae) in pole tomatoes in Southern California.*

The objective of this study was to determine the population trends of *L. sativae* and its primary parasites in fresh market tomatoes in southern California in the absence of insecticidal treatments. In that situation, *L. sativae* populations were regulated by its natural enemies : *Chrysonotomyia punctiventris* and *Chrysocharis parksi*.

S. Belloncik & N. Bellemare, Institut Armand Frappier, Quebec, University of Quebec, Canada. Polyhedra of CPV from Euxoa scandens *produced* in vivo *and* in vitro. *Comparative studies.*

Cytoplasmic polyhedra isolated from larvae of *Euxoa scandens* are heterogenous in shape. The non-occluded or occluded viruses extracted from infected midguts induce exclusively cubical polyhedra in *Lymantria dispar* cells cultivated *in vitro*. This shape is maintained after passages of the virus in these cells. Reinfection of larvae by the polyhedra produced *in vitro*, however, is characterized by reapparition of the heterogenous polyhedra shape.

B.A. Federici, University of California, Riverside, USA. Production of the mosquito-parasitic fungus, Coelomomyces dodgei, *through synchronized infection and growth of the intermediate copepod host,* Cyclops vernalis.

In the study, it was determined that yields of copepods infected with *C. dodgei* could be improved substantially over those possible with previous methods by infecting large populations of synchronously developing nauplii.

G. Croizier & Liliane Croizier, Station de Pathologie Comparée, Saint Christol, France. A study of the phenomenon of induction of a bacteriolytic factor in the Lepidoptera : inhibition of lysozyme production by Actinomycin D and Cycloheximide in Galleria mellonella *larvae (Lep. : Pyralidae).*

The effect was studied of Actinomycin D and Cycloheximide introduced into *Galleria mellonella* larvae which had been stimulated to produce lysosyme by injection of saline or live *Micrococcus luteus*. The action of these metabolic inhibitors on the quantity of lysozyme in the hemolymph, 24 h after injection of the inducers, showed that variations in the amount of enzyme are under the control of only one mechanism which is not affected by the nature of the inducers.

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