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

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Contents

News from the Secretariat

1. IOBC - Global

1.1 IOBC General Assembly

This will be held during the XVI International Congress of Entomology in Kyoto (3-9 August, 1980). The agenda will be sent to members as soon as the date and place have been settled by Dr H. Mori (Sapporo, JP), local organizer of the meeting.

1.2 Postal Ballot for Election of Members of the IOBC Executive Committee

A second ballot has been launched and votes should reach the Secretariat by the end of March 1980. The present members of the Executive Committee have accepted to prolong their mandates up to that time.

1.3 IOBC is Sponsoring the International Symposium on the Ecology of Bruchids Attacking Legumes, Tours (FR), 16-19 April, 1980

Professor V. Labeyrie of the University François Rabelais, Avenue Monge, Parc Grandmont, 37200 Tours (FR), tel. (47) 28 12 80, and his team of experts have drawn up the programme, an outline of which is given below :

- Study of general problems concerning bruchids ;
- Relation between bruchids and their host plants ;
- Importance of polymorphism in different bruchid populations ;
- Biogeography, parasitism and distribution of bruchid attacks ;
- Establishment of short and long-term international programmes.

FAO is collaborating in this meeting which is expected to have a far-reaching impact in alleviating future crop losses through concerted action in the implementation of action programmes in the Third World.

Please contact Professor Labeyrie directly (participation fee : 1000 French Francs, including lunch, dinner and proceedings).

1.4 IOBC is Organizing a Conference on « Constraints to Implementation of Integrated Pest Control » at the Bellagio Conference Centre of the Rockefeller Foundation (30 May to 4 June, 1980)

The purpose of this meeting which is restricted to invitees is to evaluate the constraints which oppose or slow down the general introduction of IPC and to study the ways of removing them.

1.5 IOBC International Working Group on Ostrinia (IWGO : see IOBC Newsletter 13-14, 1979)

This Group is meeting in Vienna from 22 to 25 September 1980 under the chairmanship of Professor H.C. Chiang (restricted to members).

2. West Palaearctic Regional Section (WPRS)

2.1. Obituary-Charles FERRIERE 1888-1979

Dr Charles Ferrière died on 21st March in Geneva after a short illness. He was in his 91st year.

Swiss by birth, Dr Ferrière obtained a science degree in 1910. In 1911,he moved to Great Britain for a year to specialise in entomology, first at the Museum of the University of Cambridge and then at the University of Edinburgh ; he obtained diplomas, with distinction, in agricultural entomology and forest entomology. Dr Ferrière received his doctorate in Geneva in 1913 for a thesis on the tracheoparenchymatous organs of aquatic hemipterans. The time which he spent at the Entomological Station in Paris (1913-1914) greatly influenced the development of his career. With the advice of Professor Paul Marchal, Director of the Station, he decided to specialise in taxonomy of entomophagous hymenopterans, particularly the chalcids. He subsequently concentrated his scientific efforts on this research, initially at the Natural History Museum in Bern where, from 1917 to 1927, he acted as keeper of the entomological collections, and then until 1940 at the Commonwealth Institute of Entomology at the British Museum (Natural History) where he was Senior Assistant, specialist in chalcids and biological control. In 1940, because of the War and family commitments, he returned to Geneva where, in 1941/42, he was temporary assistant at the Natural History Museum.Then, for two years, he was attached to the Federal Station for seeds and field crops at Lausanne and helped in the Colorado beetle control campaign until an opening in 1944 at the Natural History Museum in Geneva allowed him to pursue his taxonomic research again.From 1958, although of retirement age, he continued, nonetheless, to work regularly at the Museum, until 1974, to finish his ongoing studies on the chalcids. It was during this period that he contributed a section on Hymenoptera: Aphelinidae to « La Faune de l'Europe et du bassin Méditerranéen, published in 1965 by Masson et Cie, Paris.

Dr Ferrière took an active part in efforts leading, in 1950, to the establishment of the International Commission of Biological Control (CILB), the forerunner of the International Organisation for Biological Control (IOBC). He was soon entrusted, from 1953 to 1958, with the directorship of the « Service d'identification des insectes entomophages » of the CILB, with headquarters in Geneva at the Natural History Museum. It is also of note that, from 1947 to 1952, our colleague was visiting professor to the Faculty of Science at the University of Geneva, for a course on insect physiology.

Dr Ferrière's 150 publications, comprising 1650 pages, bear witness to his prolific activity. Throughout his long career, he received many distinctions. He was successively elected Honorary Member of the Royal Entomological Society of London (1949), of the Entomological Societies of France (1950), Belgium (1950), the Netherlands (1951), Switzerland (1955), Bavaria (1964) and Geneva (1965), and Associate Member of the Zoological Society of London (1955). A bibliographic list of his work for the period 1912-1952 appeared in Volume XI (1948-1952, p. 345-351) of the « Catalogue des ouvrages, articles et mémoires publiés par les professeurs et privat-docents de l'Université de Genève » , and for the period 1952-1974, in Volume 51 (1978, p. 297-298) of the Bulletin of the Swiss Entomological Society.

He bequeathed his collection of entomophagous hymenopterans, his library and a large catalogue to the Natural History Museum in Geneva.

Dr Charles Ferrière will be recalled as a modest and affable scholar. IOBC pays tribute to the work which he accomplished over more than half a century, completely devoted to the study of entomophagous species and to the cause of biological control.

Paul BOVEY

2.2 International Symposium on Integrated Control in Agriculture and Forestry, Vienna, 8-12 October, 1979 (organized by the West Palaearctic Regional Section of IOBC)

The purpose of this meeting was to evaluate the present state of integrated pest management in a number of advanced European, Mediterranean and Middle Eastern Research Institutions which are cooperating in WPRS Working Parties. There are currently 23 such Working Parties, many of which are engaged in specific research likely to pave the way for the establishment of integrated pest control. Some other Groups are directly involved in the development of managerial systems at the crop level, e.g. deciduous fruit orchards, grapevine, glasshouse crops, cereals, Mediterranean pine forests, while another is tackling the problem of integrated control of soil pests. It is worth mentioning that several years ago a Group was established with the aim of securing integrated crop production in orchards.

Professor Kurt Russ of the Austrian Federal Plant Protection Institute secured the local organization at the prestigious Hofburg in an outstanding way and nearly 600 participants from 37 countries were registered. The following major topics were considered by 54 researchers and administrators :

- FAO's views on Integrated Pest Control (IPC) and its potential in protecting the world's food supply ;
- Technologies leading to IPC ;
- Status of IPC in major crops of the palaearctic region.

Connected with the Symposium were 8 workshops on the following two major themes :

- Physical, biological and biochemical technologies of integrated crop protection ;
- Integration of crop protection for various crops.

The proceedings of the Symposium are expected to be issued in spring 1980 (contact Prof. K. Russ, Bundesanstalt für Pflanzenschutz, P.B. 154, AT-1021 Vienna 2, Austria). Summaries of main lectures and discussion papers are available.

2.3. IOBC/WPRS Integrated Control of Soil Pests Working Group. Convenor : C. Edwards, Rothamsted Experimental Station, Harpenden, Herts, England. Excerpts from the Meeting Report

This Group met at the Agricultural Centre at Wageningen (Netherlands), 25-28th November, 1979.

This Group has concentrated on sugar-beet, it is divided into 3 Sub-groups :

1) Pathogens of nematodes Sub-group ;

2) Role of organic matter on soil pests and diseases Sub-group ;

3) Integrated control of seedling pests on sugar-beet Sub-group.

One of the main themes of the meeting was how the work of the Sub-groups could be coordinated as far as possible to aim at integrated control in sugar-beet.

The first 2 years of collaborative work of the Sub-group on pathogens of nematodes aimed to assess the nature and extent of fungal diseases in cyst nematodes. The beet cyst nematode, *Heterodera schachtii*, was found to be infected by *Catenaria auxiliaris* and *Nematophthora gynophilia*. This was true also for the cereal cyst nematode, *H. avenae*. Fungi attacking females limit egg production and prevent the formation of the characteristic cysts. In England, and probably elsewhere, such fungi prevent populations of *H. avenae* from increasing despite the continuous cropping of cereal hosts. *Verticillium chlamydosporium* was isolated from eggs of both nematode species at all sites. This fungus was the main egg parasite except in Germany where an undescribed « cyst forming fungus » was more prevalent. The rate of parasitism is much affected by soil moisture, dry conditions inhibiting the spread of infection.

The study of the effect of organic matter on soil pests and diseases referred to experimental work done over the previous 2-4 years, on the effects of a variety of organic materials including animal slurries, sewage sludge, sewage cake and farmyard manure on numbers and diversity of soil organisms. In general, the treatments were applied to arable, monoculture sites, and investigations were carried out on their effects on soil biotic activity and faunal populations, with particular emphasis on earthworms.

In general, organic materials in moderate doses (equivalent up to 200 kg/ha) increased biotic activity ; in particular, the rate of organic matter decomposition changed species diversity and increased populations of many different groups and species. Where very large doses were used, these results were often reversed, with populations of many species being depressed. There was also evidence of uptake of certain heavy metals, especially Cu, Cd and Pb (which may be present in slurries and sewage sludge), into tissues of the soil fauna, particularly earthworms. These long-term studies are to be continued in arable, monoculture sites and where practical, the use of sugar-beet as an example will be given particular consideration.

Experiments on integrated control of seedling pests of sugar-beet have been carried out in a collaborative way during the last 4 years. In general, it was concluded that continuous sugar-beet tended to result in a build-up of pygmy mangold beetle *(Atomaria lineatus)* populations but these could be controlled with insecticides and there was some evidence of the possible control of this pest by its natural enemies with continuous cropping.

2.4 Meeting of the IOBC/WPRS Working Party for Integrated Control in Cereal Crops of the Mediterranean Region, Montfavet (FR), 6-7 November, 1979. Convenor : Prof. M. Laraichi, Meknès, Morocco. Excerpts from the Meeting Report

A Sub-group of this body met for the first time in November 1979 to study the *Sesamia* problem.

In Morocco, where *S. nonagrioides* and *S. cretica* are present and develop 4-5 generations, mainly on wheat and maize, crop losses may reach 95-100 %. The pest also occurs on sorghum, rice, sugar-cane and wild graminaceous plants. In France, south of 44° latitude, *Sesamia* species occur on maize, sorghum and rice. Cold winters are the major regulating factor and also possibly the tachinid *Lydella thompsoni*. Collaborative studies between France, Portugal and Spain are currently being undertaken on maize cultivars resistant to *Sesamia* species. Attempts are being made to synthesize the pheromone of *S. nonagrioides*.

S. nonagrioides and *S. cretica* are also very damaging in Italy and Spain.

The Sub-group proposed to concentrate on the following research objectives :

1) Characterization of populations according to ecological conditions ;

2) Biological control by means of entomophages ;

3) Isolation and synthesis of pheromones of *S. cretica* and *S. nonagrioides* ;

4) Crop loss assessment ;

5) Resistance breeding.

2.5 Third Meeting of the IOBC/WPRS Working Group on the Use of Models in Integrated Crop Protection, Wye College (Univ. London), 13-14 December, 1979. Convenor : Prof. Kranz, Justus-Liebig University, Giessen (DE). Excerpts from the Meeting Report

The members endorsed the concept and format developed by D.J. Butt (East Malling Research Station, Maidstone) for the « Inventory of models built in the West Palaearctic Region » to be published as an IOBC/WPRS Bulletin in 1980. Dr Butt was requested to prepare the manuscript for 57 models which will include a summary of meteorological data processing established by Müller (University of Stuttgart-Hohenheim).

The Working Group decided to provide advice on modelling for any researchers in integrated pest control. It also encouraged the organization of a second training course on simulation in crop protection supported mainly by members of the WPRS-Group and conducted under the leadership on Prof. Zadoks at the Agricultural University at Wageningen (NL), possibly in 1982 and with about 20 trainees.

As a first step in the generalization of available models, it was proposed to have « EPIRE », the *Cercosporella* model, and the powdery mildew model from Giessen offered for use at the Lauterbach farm in Baden-Württemberg where an extended integrated pest management project is currently operated by Dr H. Steiner (Plant Protection Research Institute, Stuttgart).

A Sub-group consisting of G.A Norton (Imperial College, London), P. Webster (Wye College) and J.C. Zadoks (Wageningen) accepted to present a report on « Damage thresholds in relation to modelling for pest management systems ».

Another Sub-group is establishing instructions for developing models for practical use in integrated pest management, with emphasis on managerial aspects.

The Group is due to meet in France on the invitation of Dr Rapilly, INRA (Versailles).

2.6 Announcement

2nd EUCARPIA/IOBC/WPRS Meeting of the Working Group : Breeding for Resistance to Insects and Mites, to be held in Canterbury (UK) from April 9-11, 1980.

Details from Miss J.H. Parker, Conference Secretary, 2nd EUCARPIA/IOBC Meeting, East Malling Research Station, Maidstone, Kent ME19 6BJ (UK). (Restricted to members).

3. Review of Some Interesting Developments

3.1 Microbial and Integrated Control of Vectors of Medical Importance

3.1.1 Un nouveau candidat à la lutte biologique contre les moustiques Bacillus thuringiensis *var.* israelensis. *De Barjac, H. (1978). Entomophaga 23 (4) : 309-319.*

Recently, substantial advances have been made with regard to new approaches to biological control as a contribution to integrated methodologies in mosquito control. The potential of these approaches involving *Bacillus thuringiensis* var. *israelensis* is studied.

3.1.2 Field Efficacy of Bacillus thuringiensis *var.* israelensis. *Lüthy, P., G. Raboud, V. Delucchi & M. Küenzi (1980). Mitt. Schweiz. Entomol. Ges. 53 : 3-9.*

The main experiment, conducted in a wildlife reserve, resulted in total mortality of the larvae of the 3 species within 1.5 days after *BT* application. No adverse effect was observed on other aquatic invertebrates. Since the experiments were successful under difficult conditions, such as low water temperature and heavy vegetation, good results are also expected in moderate and tropical climates.

3.1.3 Mosquitoes (Dipt. Culicidae) of the Reserve of Pouta Fontana (Central Wallis, Switzerland) : Ecological Study and Control. Raboud, G. (1980). Mitt. Schweiz. Entomol. Ges. 53 : 11-125 (thesis).

The second Swiss publication refers to an exhaustive study of mosquito control under practical conditions with *BT* var. *israelensis*. The results were very promising.

3.1.4 Flatworm Control of Mosquito Larvae in Rice Fields. Case, T.J. & R.K. Washino (1979). Science 206 (4425) : 1412-1414.

We describe some flatworms (some in the genus *Mesostoma)* that kill mosquito larvae and may account for the variability in the population densities of *Culex tarsalis* and *Anopheles freeborni* in rice fields. When mosquito larvae brush against these worms, the larvae immediately become paralyzed and die. When *C. tarsalis* larvae are placed inside floating cages that exclude flatworms (50-micrometer mesh), there is a fourfold increase in their survival. Rice fields that have abundant mosquito populations lack flatworms. Most such fields have only recently been turned over to rice production, suggesting that the flatworms have difficulty dispersing to new fields but, once established, are able to overwinter and control mosquitoes for the subsequent years of rice production.

3.1.5 Propagation of Nosema eurytremae *(Microsporida : Nosematidae) from trematode larvae, in abnormal hosts and in tissue culture. Higby, G.C., Elizabeth U. Canning, Barbara M. Pilley & P.J. Bush (1979). Parasitology 78 : 155-170.*

Propagation of *Nosema eurytremae*, a microsporidian pathogen of trematode larvae, was investigated by inoculation of spores into the haemocoele of insects and by growth in tissue cultures. Locusts and the larvae of three lepidopteran species were good hosts but cockroaches were not. Low replication was obtained in one lepidopteran species after *per os* infection. All stages of the microsporidium developed in cell lines of *Xenopus laevis* and *Aedes pseudoscutellaris* when spores were induced to hatch in contact with cell monolayers : the *Aedes* culture was contaminated by yeasts. Replication during 4 passages over 53 days was only 100 to 200-fold compared with the original inoculum but spores harvested from the cultures were infective to a fresh culture and to *Pieris brassicae* by inoculation into the haemocoele.

3.2 Plant Protection

3.2.1 Biology's Contribution to the Recent Agricultural Revolution. Broadbent, L. (1980). Biologist 27 (1) : 18-21.

The author shows how breeding and plant pathology has had a tremendous impact on agriculture in recent years ; he also refers to integrated pest control in the following way :

« The integration of several methods of pest and disease control minimizing chemical and maximizing biological and agronomic methods has developed fast in recent years, particularly in fruit production and for tomatoes, cucumbers and flowers under glass. They are often complex ; for instance, the control of the glasshouse red spider mite by the Chilean predatory mite, and were not possible until the science of epidemiology had been developed »

3.2.2 Annual Report of the North American Plant Protection Organization (Third Annual Meeting, Oct. 1979). Anonymous (1979). Mimeo. Contact B.E. Hopper, Executive Secretary, NAPPO (28, Langholm Crescent, Nepean, Ontario, Canada) : 11-19 (Report of the Beneficial Biological Organism Sub-Committee.

USA (J.K. Brazzel)

Currently, biological control agents are used as major components of many pest control programmes and greater use and emphasis will be made of this strategy in the immediate future. Examples include :

1) *Grasshopper Control.* A large-scale pilot management programme with a *Nosema* sp. as its major component was started in Wyoming in 1979.

2) *Citrus Blackfly.* Two species of parasites of this pest were imported from Mexico during recent years and have dramatically reduced pest populations in Texas and Florida. In order to augment native parasite populations when depressed by control measures against other pests, a parasite production facility has been established in both Texas and Florida.

3) *Sterile Insects.*

a) *Boll Weevil.* Sterile weevils are used as a part of a management programme designed to eradicate this pest from an area in North Carolina and Virginia. Approximately 11 million sterile weevils were dropped over 22,000 acres of cotton in 1979.

b) *Pink Bollworm*. Sterile moths are used to prevent establishment of pink bollworm on cotton in the San Joaquin Valley of California. Two-3 million sterile insects are dropped daily during the growing and harvest period.

c) *Mexican Fruit Fly*. Sterile insects have been used to prevent infestations of this pest in California for many years. It is planned to extend this programme to Texas in 1980.

4) A general biological control programme will be initiated in 1980. Basically, the programme will consist of production, distribution and evaluation of effectiveness.

The two programmes planned for 1980 are Mexican bean beetle parasites in the North-east US and alfalfa parasites in the mid-west and other interested areas.

Canada (J.S. Kelleher)

This country does relatively little exchange of entomophagous insects except with the US. Most importations are done under contracts with the Commonwealth Institute of Biological Control.

Entomopathogenic microorganisms are mainly studied by the Great Lake Forest Research Centre, Sault Ste Marie.

Mexico (E. Jimenez Jimenez)

The use of entomopathogenic microorganisms in the control of agricultural pests has recently received much encouragement from the Plant Health Branch.

Among the bacteria studied were the following species; *Pseudomonas fluorescens*, isolated from fruit fly larvae, *Serratia marcescens*, isolated from locusts and corn weevil and the genus *Bacillus* isolated from the pine defoliator.

Among the fungi studied were: four *Entomophthora* species, *Metarhizium anisopliae*, *Aschersonia aleyrodis* and *Beauveria bassiana*.

The species primarily used for biological control of the fruit fly (*Anastrepha* spp.) are: *Syntomosphyrum indicum*, *Opius* spp.) (*longicaudatus* complex) which are bred in commercial quantities at the Central Laboratories of the Plant Health Branch, Ministry of Agriculture and Water Resources, from colonies originally sent from Hawaii.

Considerable efforts are being made for mass rearing and release of *Trichogramma* spp. There are 16 breeding sites which, from January to July 1979, produced 13,773 million specimens; released during that period were 9,850 million specimens on a total area of 651,000 ha (corn, cotton, sugarcane, sorghum, wheat, vegetables, etc.).

3.2.3. Production of Fungal Growth Inhibitors by Isolates of Gaeumannomyces graminis *var.* tritici. *Romanos, M.A. et al. (1980). Trans. Br. mycol. Soc. 74 (1): 79-88*

Three isolates of the take-all fungus, *Gaeumannomyces graminis* var. *tritici* (GGT), were found to produce diffusible fungal growth inhibitors when grown on potato dextrose agar. Possible circumstances where these inhibitors could play a role are: a) direct inhibition of take-all disease at the rhizosphere, b) take-all decline, a depression of disease which occurs after a peak of take-all in monoculture, c) the antagonism which develops in soil when a virulent isolate of GGT is added to the virgin soil in the absence of the host plant, d) cross-protection of wheat roots against pathogenic isolates, provided that one of the isolates (not necessarily the hypovirulent isolate) is capable of producing inhibitors and that growth of the isolates together on wheat roots causes inhibitors to be produced.

All of these possibilities can be tested by direct experimentation.

3.2.4 Isolation of Entomogenous Fungi from Elm bark and Soil with Reference to Ecology of Beauveria bassiana *and* Metarhizium anisopliae. *Doberski, J.W. & H.T. Tribe (1980). Trans. Br. Mycol. Soc. 74 (1): 95-100*

Using a selective medium, the entomogenous fungus *Beauveria bassiana* was isolated in quantity from bark of elm trees and from soil at the base of trees. Most of the trees had died of Dutch elm disease but some were healthy. It was concluded that *B. bassiana* was present as conidia which originated from infected insects on or under the bark. By contrast, *Metarhizium anisopliae* was isolated only once from a sample. Differences in the distribution of these 2 unspecialized entomogenous hyphomycetes are discussed. Knowledge of the factors underlying the ecology of entomogenous fungi is of obvious importance in the utilization of these fungi as pathogens of pest insects.

3.2.5 Two Fungi Parasitic on Females of Cyst Nematodes (Heterodera *spp.). Kerry, B.R. & D.H. Crump (1980). Trans. Br. mycol. Soc. 74 (1): 119-125*

A nematode parasitic fungus *Nematophthora gynophila* gen. et sp. nov. which attacks females of cyst nematodes (*Heterodera* spp.) is described. Parasitized female nematodes fail to form cysts as the fungus destroys the body wall and cuticle and eventually replaces the body contents with a mass of resting spores. A Lagenidiaceous fungus is reported which also kills female cyst nematodes. The release of zoospores by both fungi is described, and their significance in biological control discussed.

3.2.6 Role of Ceratocystis piceae *in Preventing Infection by* Ceratocystis fagacearum *in Minnesota. Gibbs, J.N. (1980). Trans. Br. mycol. Soc. 74 (1): 171-174*

In Minnesota, the *Pesotum* state of *Ceratocystis piceae* is found on sporulating mats of *C. fagacearum*, the cause of oak wilt. Inoculation experiments showed that if *C. piceae* was introduced with *C. fagacearum* to wounds on healthy *Quercus ellipsoidalis*, it had no influence upon development of oak wilt, but if it was introduced 24 h before *C. fagacearum*, it prevented infection.

In general, it seems that with a vascular wilt disease a competitor is only likely to prevent infection if it can become established at the infection court before the pathogen arrives. If the organisms arrive together, the superior adaptation to the host shown by the pathogen will enable it to develop more or less unhindered.

3.2.7 Investigations on the Influence of Dimilin (diflubenzuron) on Growth and Germination of Conidia of Some Insect Pathogenic Fungi. Keller, S. (1978). Anz. Schädlingskde. Pflanzenschutz, Umweltschutz 51: 81-83

The influence of Dimilin, an inhibitor of chitin synthesis, on growth of 2 Deuteromycetes (*Beauveria tenella*, *Metarhizium anisopliae*) and 4 species of *Entomophthora* (*E. aphidis*, *E. culicis*, *E. spaerosperma*, *E. thaxteriana*) and on germination of conidia of *E. aphidis* and *E. thaxteriana* was studied. It was demonstrated that concentrations proposed for practical applications slightly impaired the growth of *B. tenella* and *M. anisopliae*, but did not influence the growth of *Entomophthora* species. The same concentrations stimulated germination of conidia and formation of secondary conidia of *E. aphidis* and *E. thaxteriana*. Thus, if pathogenicity is not impaired, an aspect which could not be considered in these experiments, the use of Dimilin could even have a beneficial effect in stimulating the entomophthorosis.

3.2.8 Injurious Effect of the Blossom Oil-seed Rape Beetle Meligethes aeneus *at Different Levels of Nitrogen Fertilization. Daebeler, Fr., K. Röder, B. Hinz & W. Lucke (1980). NachrBl. Dt. Pflanzenschutz DDR 34 (1) : 13-15*

The injurious effect of *Meligethes aeneus* as influenced by population density and nitrogen fertilization (150 and 250 kg N/ha respectively) was investigated in 4-year experiments (pot experiment in 1974, field experiments in 1975, 1977 and 1978). From the results of these experiments it is concluded that under very favourable conditions of rape growth, a rape plant would not suffer economic damage when attacked by a number of beetles in the range of 8 to 10 per plant. Under less favourable conditions, however, control measures should be taken in the presence of 5 to 6 beetles. When comparing the 2 fertilization rates (150 and 250 kg N/ha), it appears that damage occurs earlier with the lower rate and also that total crop losses are higher.

3.2.9 Biological Control of Take-all of Cereals. Physiological Modifications of Inoculated Wheat with a Hypoaggressive Strain of Ophiobolus graminis. *Lemaire, J.M., F. Carpentier, J.F. Dalle & G. Doussinault (1979). Ann. Phytopathol. 11 (2) : 193-197*

Inoculation of wheat seeds with a weak strain of *Ophiobolus graminis* used to control take-all of cereals modifies the amount of chlorophyl *a* and *b* in plants and acts as an accelerator to their disappearance. Before earing, loss of chlorophyl *a* and *b* is reduced during the dark in the case of inoculated wheat.

3.2.10 Bacterial Leaf Spot of Johnson Grass Caused by Pseudomonas syringae. *Mikulas, J. & S. Süle (1979). Acta Phytopathologica Academiae Scientiarum Hungaricae 14 (1-2) : 83-87*

A bacterial leaf spot of Johnson grass, *Sorghum halepense*, one of the most serious weeds of maize in southern Hungary, was shown to be caused by the bacterium *Pseudomonas syringae*. The pathogen is probably host specific and may be considered as a useful tool for biological control of the weed.

3.2.11 Field Evaluation of (E,E)-10,12 hexadecadienal, a Component of the Female Sex Pheromone of the Spiny Bollworm, Earias insulana *(Boisd.) (Lepidoptera, Noctuidae). Kehat, M., S. Gothilf, E. Dunkelblum & S. Greenberg (1979). Phytoparasitica 7 (2) : 99-100*

The spiny bollworm, *Earias insulana*, is an important cotton pest in Africa, the Mediterranean region, and eastward to Malaysia. The sex pheromone used in Israel was an effective attractant for *E. insulana* males and its use in traps for monitoring the pest populations is recommended.

3.2.12 Introduction of Beneficial Insects into Israel by the Institute of Plant Protection Quarantine Laboratory, ARO. Wysoki, M. (1979). Phytoparasitica 7 (2) : 101-106

A list is given of the beneficial insects introduced into Israel during 1971-1978 by the above Institute. The list includes 15 species of Hymenoptera as well as four coleopterous predators.

3.2.13 Protection of Carnation against Fusarium *Stem Rot by Fungi. Baker, R., Hanchey & S.D. Dottarar (1978). Phytopathology 68 (10) : 1495-1501*

Many species of fungi protected wounded carnation stem tissue from ingress by *Fusarium roseum* « Avenaceum » when inoculation with the pathogen was made 24 h after wounding. A nonpathogenic isolate of *F. roseum* « Gibbosum » was used as the biocontrol agent. Nine cultivars were protected by the biocontrol agent.

3.2.14 Effects of Juvenile Hormone I, Methoprene and Kinoprene on Development of the Hymenopteran Parasitoid Nasonia vitripennis. *A. De Loof, J. Van Loon & F. Hadermann (1979). Ent. exp. & appl. 26 : 301-313.*

Juvenile hormone I, methoprene and kinoprene were applied to almost all developmental stages of *Nasonia vitripennis*, a hymenopteran parasitoid particularly of Diptera. JH I has ovicidal activity, and may arrest postembryonic development in the first larval instar. If applied to larvae and pupae, the three compounds may cause a wide range of effects : arrestment of development in the last larval instar, any pupal or pharate adult stage ; incomplete coloration of the adult cuticle ; and most commonly, disruption of normal eclosion. None of the compounds induced diapause in the last larval instar. Kinoprene is a very potent inhibitor of eclosion, even if applied to completely black pharate adults. Depending upon the compound used, the time lapse between the treatment of *Sarcophaga* and parasitization, and the developmental stage of *Nasonia* which is taken as a reference, the parasitoids inside a puparium of *Sarcophaga bullata* tolerate a dose which is 80 to more than 5,000 times higher than that tolerated after being removed from a fly puparium. JH I and methoprene are less toxic to *Nasonia* than to *Sarcophaga*.

3.2.15 Insect Growth Regulators : New Protectants against the Almond Moth in Stored Inshell Peanuts. Nickle, D.A. (1979). J. Econ. Entomol 72 : 816-819.

Four insect growth regulators (IGRs) were tested for efficacy in suppressing populations of *Ephestia cautella* (Walker) in inshell peanuts. In laboratory tests, peanuts were sprayed with several concentrations of either hydroprene, methoprene, diflubenzuron, or Stauffer MV-678 (1-(8-methoxy-4,8-dimethylnonyl)-4-(1-methyl-ethyl) benzene) and infested with 200 eggs of almond moths. Concentrations below 100 ppm of all IGRs except diflubenzuron (hydroprene, 5 ppm ; methoprene, 25 ppm ; MV-678, 90 ppm) completely suppressed adult emergence. These IGRs also reduced fecundity at lower concentrations. MV-678 at ca. 30 ppm completely inhibited oviposition. Residues of hydroprene, methoprene, and MV-678 were as effective as residues of malathion (35 ppm) against the almond moth after at least 8 months of storage.

3.2.16 Selective Methods for Managing Insect Pests of Cotton. Bull, D.L., V.S. House, J.R. Ables & R.K. Morrison (1979). J. Econ. Entomol. 72 : 841-846.

In replicated tests in small field plots of cotton, applications of a commercial formulation of *Bacillus thuringiensis* Berliner (BT) (1121 g/ha) did not adequately suppress heavy populations of *Heliothis* spp. larvae. When chlordimeform (140 g/ha) was applied in conjunction with this same dose, the level of control increased but did not exceed that provided by chlordimeform alone. Direct comparisons of the efficacy of the BT formulation (561 g/ha) and a commercial formulation of *Baculovirus heliothis* (BH)

(148 g/ha) against *Heliothis* spp. indicated that the materials provided comparable levels of control against moderate populations of larvae. When the BH formulation (148 g/ha) or the BT formulation (560 g/ha) was applied in conjunction with releases of *Trichogramma* (110,000/ha) in test plots oversprayed with diflubenzuron (70 g + 4.7 liter crop oil/ha) to control boll weevils, *Anthonomus grandis grandis* Boheman, the 2 microbial pesticides caused a similar and significant reduction (compared with the check) in the numbers of both small and large *Heliothis* spp. larvae. Numbers of undamaged bolls were also significantly greater in microbial-treated plots.

3.2.17 Laboratory Techniques for Rearing Blepharipa pratensis, *a Tachinid Parasite of Gypsy Moth. Odell, M. & P.A. Godwin (1979). Ann. Entomol. Soc. Am. 72 : 632-635*

Laboratory-reared 5th and 6th stage gypsy moth larvae were fed *Blepharipa pratensis* (Meigen) eggs placed on gypsy moth diet to induce parasitization. Laboratory-reared *B. pratensis* laid an avg of 900 eggs/female. Utilizing survival estimates for each life stage, the ratio of increase in egg laying females for a generation reared in the laboratory was 1 : 34. Some eggs retained viability when stored at 0°-2° C and 40% RH for up to 4 wk. Pupae stored at 0°-2° C and 100% RH were held successfully for 3 mo beyond the normal adult eclosion period. By proper timing of adult eclosion and egg feeding, the period for biological study of the parasite was extended for 3-4 mo.

3.2.18 Emergence Patterns and Dispersal in Chelonus *spp. near* curvimaculatus *and* Pristomerus hawaiiensis, *Parasitic on* Pectinophora gossypiella. *Legner, E.F. (1979). Ann. Entomol. Soc. Am. 72 : 681-686*

Two *Chelonus* spp. near *curvimaculatus* Cameron, imported from Ethiopia for biological control of pink bollworm, *Pectinophora gossypiella* (Saunders), appeared to enter diapause with their host, overwintered, and spread their adult emergence with the host into early May. Both the *Chelonus* spp. and *Pristomerus hawaiiensis* Ashmead, imported from Hawaii, were highly vagile, dispersing widely in release fields. However, *P. hawaiiensis* did not diapause and could not overwinter, which helps explain this species' absence in subsequent years. The absence of the *Chelonus* spp. in succeeding years following releases may result from the lack of suitable host stages in springtime.

3.2.19 α-Tomatine and Parasitic Wasps : Potential Incompatibility of Plant Antibiosis with Biological Control. Campbell, B.C. & S.S. Duffey. Science 205 : 700-702

α-Tomatine, an alkaloid in tomato plants, is toxic to *Hyposoter exiguae* (Viereck), an endoparasite of *Heliothis zea* (Boddie), a major lepidopterous pest of tomatoes. The parasite acquires the alkaloid from its host after the host ingests the alkaloid. Results are based on the use of artificial diets for the host containing 0.3 and 0.5 % (wet weight)α-tomatine. This form of interaction creates a potential dilemma to controlling herbivorous pests through chemical antibiosis in plants.

4. Training Course

Monitoring the Side Effects of Pesticide Use. Imperial College at Silwood Park, Ascot, Berks (UK), April 8-19, 1980.

A course sponsored by the British Council which aims to bring together experts involved in research, development, conservation and administration. The programme will consist of talks, discussion groups and visits. Participants will be invited to discuss methods and problems encountered in their own country. The Director of Studies will be Dr G.N.J. Le Patourel in association with Prof. M.J. Way, both of the Dept of Zoology and Applied Entomology at Imperial College, London.

The outline programme is as follows : hazards of pesticides to operators ; monitoring the hazards of pesticide residues to consumers ; design of monitoring programmes to assess environmental hazards on wildlife ; monitoring long-term effects of pesticide use.

Contributions are expected from such leading organisations as Rothamsted Experimental Station, Pest Infestation Control Laboratory, Weed Research Organisation, Institute of Terrestrial Ecology, ICI and the Laboratory of the Government Chemist.

This is a residential course and the fee will be £370. There are vacancies for 25 members.

5. Abstracts from Entomophaga

(Prepared by Courtesy of B. Hurpin, INRA)

ENTOMOPHAGA, volume 24 (4), 1979

J.M. Franz & J. Huber, Institut für biologische Schädlingsbekämpfung, Bundesrepublik Deutschland. Field tests using insect-pathogenic viruses in Europe.

The results of an inquiry are reported, dealing with the experimental and field use of insect-pathogenic viruses in Europe. For the 42 examples listed, details are given concerning : pest insect species, virus type, its origin, propagated on (host) in (country), investigations on safety and other side-effects, crop, size of area treated, virus dosage or concentration, amount of water, technique of application, instars treated, efficacy, remarks, cooperating researchers (name of correspondent underlined), country.

The field experiments comprise 17 species of Lepidoptera, 1 Diptera, 1 Hymenoptera, and were carried out in 13 countries.

G.L. Leibee, B.C. Pass & K.V. Yeargan, Department of Entomology, University of Kentucky, Lexington, K. Y40546, USA. Developmental rates of *Patasson lameerei* (Hym. : Mymaridae) and the effect of host egg on parasitism.

The purpose of the study was to determine the developmental rates of *P. lameerei* on *S. hispidulus* eggs and the effect of host egg age on parasitism. This information was needed to increase the efficiency of parasite production and provide better timing of parasite releases for establishment.

C. Pisica, I. Petcu & M.C. Mateias, University of Iasi & Research Institute for Cereals and Technical Plants, Fundulea, Romania. Species of Ichneumonidae (Hym.), parasites of some lepidopteran pests of lucerne in Romania.

Eleven species of Ichneumonidae were identified as parasites of lepidopteran pests of lucerne. All of the parasitized Lepidoptera are new host records for these Ichneumonidae and *Diadegma variegata* is a species of parasite new to Romania.

A. Bournier, A. Lacasa & Y. Pivot, INRA, Laboratoire de Zoologie, ENSA, Montpellier, France. Diet of a predatory thrips, *Aeolothrips intermedius* (Thys. : Aeolothripidae).

Various species of prey were given to larvae of *Aeolothrips intermedius*. Duration of larval development was used to gauge their nutritive value. *A. intermedius* is chiefly a predator of thrips but it can also prey on acari.

T.R. Ashley & D.L. Chambers, Insect Attractants, Behavior and Basic Biology Research Laboratory, USDA, Gainesville, Florida, USA. Effects of parasite density and host availability on progeny production by *Biosteres (Opius) longicaudatus* (Hym. : Braconidae), a parasite of *Anastrepha suspensa* (Dip. : Tephritidae)

Progeny production of *Biosteres (Opius) longicaudatus*, a larval-pupal parasite of the Caribbean fruit fly, *Anastrepha suspensa*, was affected by host availability, previous ovipositional experience, and parasite density and age.

The number of progeny produced per surviving female parasite was inversely proportional to the adult parasite density and relatively more female progeny were produced as the adult parasites aged.

F. Hérard, G. Mercadier & M. Abai, European Parasite Laboratory, USDA, Sèvres, France. *Lymantria dispar* (Lep. : Lymantriidae) and its parasite complex in Iran, 1976.

An inventory was made of the parasites, predators and pathogens of *L. dispar*. In general, these natural enemies are represented by species also present in Europe. However, in Iran, they are able to maintain the population of the host at a very low level and no serious outbreak has ever been recorded. The most effective insect parasites belonged to 2 groups : *Apanteles*, primarily *A. melanoscelus* and the tachinids, *Exorista larvarum*, *Carcelia separata* and *Compsilura concinnata*.

R. Cherry & R.V. Dowell, Agricultural Research Center, University of Florida, Ft. Lauderdale, USA. Predators of citrus blackfly (Hom. : Aleyrodidae).

A 2-year survey of known whitefly was conducted from winter 1976 to winter 1978 in Broward County, Florida. Their impact on citrus blackfly populations was measured under field conditions using lifetable data and predator exclusion data. Feeding experiments were conducted to determine specific predators on different citrus blackfly stages.

Bashir H. Shah, O. Zethner, H. Gul & M.I. Chaudhry, Pakistan Forest Institute, Peshawar, Pakistan ; Royal Veterinary and Agricultural University, Copenhagen, Denmark. Control experiments using *Agrotis segetum* granulosis virus against *Agrotis ipsilon* (Lep. : Noctuidae) on tobacco seedlings in Northern Pakistan.

Agrotis segetum granulosis virus propagated in Denmark was applied against released 2nd instar larvae of *Agrotis ipsilon* in tobacco plots in nurseries of Northern Pakistan.

Reduction in cutworms as well as cutworm damage varied between 72 and 100% compared with plots treated only with water.

A. Ferran & M.M. Larroque, INRA, Station de lutte biologique, Antibes, France. Influence of abiotic factors on the feeding physiology of larvae of the aphidophagous lady beetle, *Semiadalia undecimnotata* (Col. : Coccinellidae). I. Effect of temperature.

Larvae of the lady beetle, *S. undecimnotata*, were reared under various thermal conditions (constant and alternate temperatures). Duration of the stage and of the feeding period, daily or total food consumption, weight gain and maximum weight depend on temperature. But food consumption and the corresponding weight of larvae show a constant ratio.

Y. Rossler, Institute for Biological Control, Citrus Marketing Board, Rehovot, Israel. Automated sexing of *Ceratitis capitata* (Dip. : Tephritidae) : the development of strains with inherited, sex-limited pupal colour dimorphism.

The wild-type allele of a 'dark pupae' mutant of the Mediterranean fruitfly, *Ceratitis capitata*, was translocated to the male's Y-chromosome. Two lines with the male linked translocation were obtained. These lines produced continuously wild-type (brown pupae) males and mutant 'dark pupae' females. Automated sex-sorting of such lines may be feasible using pupal colour dimorphism.

Sudha Nagarkatti, Indian Station, CIBC, Bangalore, India. Experimental comparison of laboratory-reared vs. wild-type *Trichogramma chilonis* (Hym. : Trichogrammatidae). II. Tolerance of non-optimal temperatures.

A comparative study of tolerance for low (2° C) and high (35° C) temperatures showed that wild-type populations of *T. chilonis* survived better than laboratory-reared populations.

A.A. Kirk & A.J. Wapshere, CSIRO Biological Control Unit, Montpellier, France. The life history and host specificity of the *Echium* borer, *Phytoecia coerulescens* (Col. : Cerambycidae).

The life history of *P. coerulescens* was followed in the field by examining infested plants of *Echium plantagineum* and other boraginaceous hosts during the year and by confirmatory observations on caged, attacked plants in a greenhouse.

It does not attack plants of agricultural importance in the field and host restriction to a small group of boraginaceous plants was confirmed in the laboratory, with *Echium* spp. as the principal hosts. It is therefore considered that *P. coerulescens* is a safe agent to introduce into Australia for the control of *E. plantagineum*.

G. Lauenstein, Institut für Pflanzenpathologie und Pflanzenschutz der Universität, Göttingen, Bundesrepublik Deutschland. Plant-feeding by the predacious bug *Anthocoris nemorum* (Hem. : Heteroptera).

A. nemorum can actively imbibe plant sap. The substance taken out of the leaf tissue allows a longevity comparable to that allowed by water. Larvae are not able to develop into adults on plant sap alone.

C.A. Dedryver, INRA, Laboratoire de Zoologie, ENSA, Rennes, France. Initiating an epizootic in a glasshouse with *Entomophthora fresenii* on *Aphis fabae* through inoculum introduction and control of relative humidity.

Two glasshouse experiments were carried out in order to control populations of *A. fabae* on broad beans by dissemination of living infected aphids (*E. fresenii*) into the healthy colonies, and enhancement of relative humidity by means of misting.

The best results were obtained when the glasshouse was completely closed and then the inoculum (infected aphids) was applied shortly (2 days) after infestation of the beans by healthy *A. fabae*.

D.P. Peschken, Research Station, Agriculture Canada, Regina, Canada. Host specificity and suitability of *Tephritis dilacerata* (Dip. : Tephritidae), a candidate for the biological control of perennial sow-thistle (*Sonchus arvensis*) (Compositae) in Canada.

The host specificity and suitability of *Tephritis dilacerata*, a promising biocontrol agent of perennial sow-thistle (*Sonchus arvensis*) were investigated. A total of 47 plant species in 13 tribes of the family Compositae was tested. These laboratory results and European field records demonstrate that *T. dilacerata* attacks plants of the genus *Sonchus* only, with *S. arvensis* as the main host. *T. dilacerata* can be released in Canada to aid in the control of perennial sow-thistle.

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