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

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

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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

1. News from the IOBC Secretariat

1.1. IOBC General Assembly in Kyoto, 5 August, 1980

The Assembly was attended by 75 participants. A review of the discussions will be given in the next Newsletter.

1.2. Meetings Planned in 1981

1.2.1. Working Party Meeting on Bruchids to be held in Paris

Convenor: Prof. V. Labeyrie, IBEAS, Université François-Rabelais, avenue Monge, Parc Grandmont, 37200 Tours, France.

1.2.2. Colloquium on Techniques for the Evaluation of Economic Thresholds and Crop Loss Assessments in Cotton

It is currently being studied if this meeting can be held on 6 and 7 July, 1981, prior to the International Colloquium on the Protection of Tropical Crops, organized by the Scientific Foundation in Lyon (8-10 July, 1981); convenor: G. Mathys, 1, rue Le Nôtre, 75016 Paris.

2. News from IOBC Sections

2.1. East Palaearctic Regional Section

Symposium on the Introduction and Acclimatization of Promising Entomophages, Acariphages and Phytophages of the Principal Pests and Weeds of IOBC/EPRS Member Countries, 20-23 November, 1979.

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

1. Main results and research prospects for the introduction and acclimatization of beneficial organisms in the IOBC/EPRS Member Countries

G.V. Gusev	Main results and research prospects for the introduction and acclimatization of beneficial organisms in the USSR, with special reference to practical plant protection.
A. Kaitazov	Introduction and acclimatization of entomophages in Bulgaria.
E. Nemczik	Principles and requirements for the introduction of entomophages for pest control in orchards in Poland.
G.A. Beglyarov	Results and prospects for the introduction and acclimatization of predatory mites of the family Phytoseiidae in the USSR.
A. Szmidt & R. Luterek	Prospects for the introduction and acclimatization of *Itoplectis conquistidor* (Say) and *Coccigomimus turionellae* (L.) (Ichneumonidae) in Poland.
V.A. Tryapitsyn	Potential for the introduction into the USSR of parasitic chalcids – natural enemies of agricultural and forest pests.
M. Tsalev & U. Pelov	Present situation and prospects for the introduction of Chalcidoidea into Bulgaria.
O.V. Kovalev	Biological control of weeds in the USSR.
D. Zil'bermints	Use of pesticide-resistant beneficial organisms in integrated plant protection systems (introduction and acclimatization of resistant acariphages).

2. Introduction and Practical Utilization of Beneficial Organisms for the Control of Quarantine Pests

T.S. Izhevskii	Introduction and practical utilization of beneficial organisms for the control of quarantine pests in the USSR.
W. Wegorek & S. Pruszynski	Research situation on the introduction of natural enemies of Colorado beetle (*Leptinotarsa decemlineata* [Say]) into Poland.
V.A. Yasnosh	Review of zoophages introduced to control fruit tree and grapevine pests in the Caucasus.

3. Situation and Prospects for the Introduction and Acclimatization of Predators and Parasites for Plant Protection under Glass

N.V. Bondarenko	Situation and prospects for the use of predators and parasites under glass.
V. Natskova	Use of *Encarsia formosa* Gah. in glasshouses in Bulgaria.
G.A. Beglyarov & V.V. Lebedev	Data on the biology of *Encarsia* - a parasite of the glasshouse whitefly.
Z.M. Mudrik & G.N. Tsybul'skaya	*Aschersonia* and its efficiency in the Kiev vegetable Works Sovkhoz.
R.I. Chizhik & T.V. Kryzhanovskaya	Results on *Encarsia formosa* Gah. and *Macrolophus* sp. under glass.
S. Pruszynski	Introduction of *Phytoseiulus persimilis* Athias-Henriot and its use in controlling spider mites in Poland.
V. Natskova	Possibilities for determining the efficiency of aphidophages under field conditions.

2.2. Western Hemisphere Regional Section

Joint US/USSR Conference on Microbial Insecticides

The second joint US/USSR Conference on Microbial Insecticides, « Characterization, Production, and Utilization of Entomopathogenic Viruses », was held in Clearwater Beach, Florida, USA from January 7 to 10, 1980. The Conference was part of the continuing activity of Project V, Microbiological Control of Insect Pests, of the US/USSR Joint Working Group on the Production of Substances by Microbiological Means, under the US/USSR Agreement on Cooperation in Science and Technology.

The objectives of the Clearwater Beach Conference were to:

1) review past work and determine the current status of the use of entomopathogenic viruses for controlling insect pests in both the USA and USSR, especially as it relates to production, selection specificity, standardization, safety and epizootiology of entomopathogenic viruses;
2) define specific research objectives for collaborative research;
3) identify interested scientists to participate in collaborative research, and;
4) develop a formal working document to assist in implementing research objectives.

The fifteen papers presented, 8 by USA scientists and 7 by Soviet scientists, covered both basic and applied research on the feasibility of developing viruses for control of insect pests. Research in both countries has concentrated on viruses associated with lepidopterans (*Apamea, Autographa, Heliothis, Lymantria, Mamestra, Orgyia*) and a hymenopteran (*Diprion*). As a consequence of this conference, scientists of the USA and USSR will exchange insect cell lines, published bioassay techniques, industrial preparations of insect viruses, a standard specification list for industrial viral preparations, and a current directory of US and USSR scientists working on entomopathogenic viruses.

The published proceedings, edited by Carlo M. Ignoffo, Mauro E. Martignoni and James L. Vaughn, are available from the National Technical Service, Springfield, Virginia 22161.

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2.3. West Palaearctic Regional Section

IOBC/WPRS Working Group on Integrated Control in Cereals « Aphid Ecology ». WPRS Bulletin (1980) III (4), 118 pp

This report of the meeting of the « Cereal aphid subgroup » (held in Colmar, France, 14-15 Nov., 1979) comprises some 13 papers, three of which are in French and the remainder in English. The meeting was attended by 24 participants from 7 countries. The subgroup was founded in 1975, with the main aim of developing prognosis based on ecological criteria. The papers are as follows:

Pp 5-9. C.A. Dedryver. Preliminary results on the role of three Entomophthora *species in limiting cereal aphid populations in the West of France*

Entomophthora aphidis is the main aphid-pathogenic agent, being present for a long period and causing epizootics. *E. obscura* is of importance mainly in limiting populations of *Sitobion avenae*. *E. planchoniana* only develops later in residual colonies.

Pp 11-17. G. Latteur & J. Destain. Effects of fungi and hymenopteran parasites on populations of Sitobion avenae (F.) and Metopolophium dirhodum (Walk.) in experimental plots at Milmort in 1978 and 1979

The results of studies on cereal aphid population dynamics in 1978 and 1979 are summarised. Levels of parasitism were also monitored. *Praon volucre* was the most common parasite recovered. Although absent at the start of observations, *Entomophthora* species were later found in up to 70% of *M. dirhodum* and 27% of *S. avenae*. However, the *Entomophthora* epizootic developed too late to prevent *M. dirhodum* populations reaching high densities. Only few coccinellids were recorded.

Pp 19-25. J.P. Latge & D.F. Perry. The utilisation of an Entomophthora obscura resting spore preparation in biological control experiments against cereal aphids

E. obscura has been chosen for use in biological control against cereal aphids due to its high pathogenicity and its convenient resting spores production and germination. The known characteristics of 5 other resting spores producing Entomophthorales are also reviewed. Industrial production of *E. obscura* resting spores, their subsequent germination, conservation and formulation is being investigated. The application of resting spores in cereal fields will be effected using 3 types of treatments based on seasonal changes and the life cycle of *E. obscura*.

Pp 27-29. B. Papierok & J.P. Latge. On the pathogenicity of Entomophthora obscura Hall & Dunn against cereal aphids

Virulence comparisons of strains of *E. obscura* against *Sitobion avenae* are possible using a method for determining LD 50' s. Varying degrees of virulence can be distinguished. The authors discuss the value of the LD 50 as a criterion for assessing the activity of a strain. The phenomenon of « multiplication ability » is introduced. Strains likely to be of most use in biological control are those possessing a low LD 50, a high multiplication ability and a short infection cycle.

Pp 30-47. G. Dean, A.M. Dewar, W. Powell & N. Wilding. Integrated control of cereal aphids

This paper is an explanation of the events that lead up to the development of « plague » aphid populations on a wheat crop at Rothamsted. It is largely an account of the results of a cooperative experiment originally designed to compare methods of biological and chemical control of cereal aphids and other pests, with a view to developing an integrated approach to the control of all components of the insect pest complex in cereals. However, since neither biological nor chemical agents prevented aphid populations reaching extremely high levels in 1979, results which help to explain these failures have been extracted from other comparable experiments at Rothamsted.

Pp 49-57. E. Bode. Aphids in winter wheat: abundance and limiting factors from 1976 to 1979

The abundance of *Metopolophium dirhodum* (Walker) and *Macrosiphum (Sitobion) avenae* (F.), the most important aphids of winter wheat in the Rhine-Main area, is described, followed by a discussion on the role of predators, parasitoids and fungal pathogens as well as weather, in limiting populations. While Chrysopidae and Coccinellidae are only important in certain years, the most reliable predators are larvae of the hover fly, *Epistrophe balteata* Deg., parasitoids, mainly *Aphidius uzbekistanicus* Luzhetzki, *A. ervi* Haliday, *Praon volucre* (Haliday), and fungal pathogens, mainly *Entomophthora aphidis* Hoffmann, *E. planchoniana* Cornu and *E. obscura* Hall & Dunn, may play an important role as antagonists when weather conditions are suitable.

Pp 59-61. S.C. Hand. Overwintering of cereal aphids

The aim of this work was to obtain information on how and where the major cereal aphid species survive the winter. Both anholocyclic and holocyclic overwintering are described.

Pp 63-66. C.T. Williams. Low temperature mortality of cereal aphids

In apterous adults exposed in a cold chamber for 3 hours, mortality of *R. padi* was much greater than that of *M. dirhodum* and *S. avenae*. Small nymphs of *S. avenae* were significantly less cold hardy than other stages. Wetting *S. avenae* nymphs so that they were exposed to sub-zero temperatures with ice crystals on the cuticle (as during a frost in the field), significantly increased mortality over « dry » controls. *S. avenae* and *M. dirhodum* nymphs survived when the leaves of summer grown winter wheat seedlings on which they were feeding were frozen.

Pp 67-84. Th. Basedow. Studies on the ecology and control of the cereal aphids in Northern Germany

R. padi first infested fields of spring oats and, from there, spread to the edges of winter wheat. This aphid is holocyclic in this area. Coccinellid larvae were not generally effective as predators until the milky ripe stage in wheat. Fields sprayed at flowering with parathion-ethyl to control *M. avenae* were soon recolonised, while an early spray of oxydemeton-methyl, although effective against *M. avenae*, did not prevent late infestation by *M. dirhodum*.

Pp 85-91. K.D. Sunderland, D.L. Stacey & C.A. Edwards. The role of polyphagous predators in limiting the increase of cereal aphids in winter wheat

In 3 out of 4 experiments, an inverse relationship between numbers of predators and aphids was found in spite of differences in the density and dominant species of aphid.

Pp 93-98. N. Carter & R. Rabbinge. Simulation models of the population development of Sitobion avenae

Two models simulating the population development of *S. avenae* are described. The output results from the models are compared with field observations from the Netherlands and England over a number of years. The agreement between the models and field results is not always good but in several years the date and size of the peak density is accurately predicted. The models are reliable enough to be used for short-term predictions.

Pp 99-106. R. Rabbinge, G.W. Ankersmit, N. Carter & W.P. Mantel. Epidemics and damage effects of cereal aphids in the Netherlands

EPIPRE aims at flexible crop protection based on detailed knowledge of crop growth and prevailing pests and diseases. By integration of this data in computers, dynamic decision rules regarding when spraying is necessary have been developed. The programme relates to *Puccinia striiformis*, *Erysiphe graminis* and *Sitobion avenae*. Monitoring and sampling of aphids and the damaging effects of cereal aphids and damage thresholds are discussed.

Pp 107-118. J. Reitzel & J. Jacobsen. The occurrence of and damage caused by aphids in cereal crops in Denmark

The following are discussed: the importance of cereal aphids in Denmark and their effect on yield, with particular reference to barley; the possibilities for aphid control with insecticides in relation to the risk of yield reduction; which factors are most important with regard to population increase in aphids and hence significant both for aphid prognosis and for the farmer deciding whether or not to treat the crop.

3. Review of Some Interesting Developments in Plant Protection

3.1. Annual Research Reports

Annual Report 1978-1979, Division of Entomology, CSIRO, Canberra, Australia, 77 pp

Part 12. Biological control of Weeds. Pp 49-53

This section includes work on control of the following exotic weeds: the woody perennial *Latana camara*, water hyacinth *Eichhornia crassipes*, alligator weed *Alternanthera philoxeroides*, the aquatic fern *Salvinia*, doublegees *Emex australis* and *E. spinosa*, skeleton weed *Chondrilla juncea*, heliotrope *Heliotropium europaeum*, St. John's wort *Hypericum perforatum*, Paterson's curse *Echium plantagineum*, ragwort *Senecio jacobaea*, blackberry *Rubus fruticosus*.

Part 13. Biological Control of Dung. Pp 54-59

Activities in South Africa, Europe and Australia are summarised. Australia has a substantial complement of native dung beetles but only few species adapted to the changed environment of cleared farmland and large dung pads dropped by cattle. The aim of the dung beetle programme is to bring selected Old World species to Australia to speed up destruction and dispersal of dung and thereby reduce the pest status of dung-breeding flies such as bushfly and buff-fly. The following work in Australia is described: breeding releases and recoveries, survey of Norfolk Island, study of bush fly control, mites associated with dung beetles (these predatory mites feed on the eggs and larvae of flies), dung destruction, synthetic dung beetle attractants (to simulate fresh dung).

3.2. Guidelines

1980 Guidelines to the use of predator Phytoseiulus persimilis for controlling red spider mite on strawberries in high polythene tunnels. J.C. Cross. In: MAFF (ADAS) South Coast Glasshouse Unit Technical Note, March 1980, No. 57: 4

This guideline has been established following two seasons of successful trials work on control of red spider mite by *Phytoseiulus persimilis*, and includes brief paragraphs on: the importance of monitoring, the use of compatible chemicals (suitable fungicides and insecticides are listed), the technique.

3.3. Symposium Proceedings

Duggan, J.J. (1979). Editor. Proceedings of a seminar on Biological Control. Royal Irish Academy, Dublin, 211 pp

Fourteen papers were presented at this seminar under the auspices of the Irish National Committee for Biology at the Royal Irish Academy, Dublin, on 17-18 Feb. 1977, including:

Robinson, D.W. Biological control of weeds, 17-31;

Kavanagh, T. Biological control of plant pathogens: 32-56;

Seaby, D.A. Possibilities of using *Trichoderma viride* for the control of *Heterobasidion annosum* on conifer stumps: 57-72;

Staunton, W.P. Biological control of virus in tomato crops using cross protection: 93-96;

Cunningham, P.C. Perspectives of biological control of some soil-borne cereal pathogens from studies of take-all decline: 170-205.

Ridgway, R.L. & Vinson, S.B. (1977). Editors. Biological control by augmentation of natural enemies. Insect and mite control with parasites and predators

Proceedings of a Symposium at the 15th International Congress of Entomology, Washington, August 19-27, 1976 and other selected papers. Volume II in Environmental Science Research. Plenum Press, New York and London 1977, 480 pp.

3.4. Recent Symposium

The Beltsville Agricultural Research Center sponsored a Symposium on « Biological Control in Crop Production », on May 19-21, 1980. Subject matter was presented as invited lectures and contributed posters, with lectures to be published in the BARC Symposium Series (5th Volume). The Sessions were as follows:

Session 1 : Relevance of ecological theories to practical biological control.

Session 2 : Concepts, principles and mechanisms of biological control of pests.

Session 3 : Recent advances in mass production of biological control agents.

Session 4 : Strategies of biological control.

Session 5 : General considerations: environmental, regulatory, safety, economic and biocontrol in integrated pest management systems.

Details from Publicity Chairman, Symposium V, Room 214, Bioscience Building OIIA, BARC-West, Beltsville, MD 20705.

3.5. Biological Effects of Bacterial-insecticidal Combinations on the Caterpillars of Biston hirtaria Cl. (Lepidoptera, Geometridae). Lecheva, I. & Kouzamanova, Y. (1980). Plant Science XVI (11): 119-126

The biological effects of combinations of bacterial preparations and synthetic insecticides on *Biston hirtaria* larvae were studied. The combined use of 1/10 of the normal concentration of dipterex and basudin and entobacterin or dipel increased the efficacy of these latter considerably. On the other hand, a mixture with zolon had an adverse effect; in this case, an inhibition of spore formation was observed whereas a series of other insecticides did not cause any change in spore and crystal formation.

3.6. Integrated Control of Rhizoctonia Fruit Rot of Cucumber. J.A. Lewis & G.C. Papavizas (1980). Phytopathology 70 (2): 85-89

Incidence and severity of *Rhizoctonia solani* Kuehn were reduced in a Beltsville field in 1977 and 1978 after application of several components in an integrated pest management system.

Major components

- Mechanical ploughing of soils to remove inoculum from the surface layers of soil.
- Application of photodegradable plastic mulch (red. of incidence by 75% in disked soils).
- Microbial antagonists: *Corticium* spp. WT-G in lab tests eliminated almost all saprophytic activity of *R. solani* after 2-4 weeks.

Trichoderma spp. were also antagonistic to *R. solani*.

Trichoderma harzianum was effective against *Sclerotium rolfsii* and *Rhizoctonia solani*.

3.7. Abstracts

Hartline, B.K. (1980). Fighting the spreading chestnut blight. Science 209: 892-893

The research workers and institutes involved in research on saving the American chestnut are mentioned, but no bibliographic references are given. Although viruslike agents which infect the chestnut blight fungus, *Endothia parasitica*, thereby rendering it hypovirulent, have been used successfully to control blight in French chestnut orchards, efforts to establish these agents in the US have so far failed. One problem appears to be that the viruslike agents do not spread to untreated cankers and other trees as they do in Europe. Incompatibility of the many (80) different strains of *E. parasitica* in the US may be an important factor. However, viruslike agents which debilitate certain American strains are now being isolated. Another problem is the extreme susceptibility of the American chestnut to *E. parasitica*: there is scant time for a hypovirulent strain to infect and debilitate the virulent strain before the tree succombs. Breeding programmes to ameliorate this situation are underway. One factor being selected against is presence of the tannin hamamelitannin which the fungus uses as a source of food.

Maksymov, J.K. (1980). Biological control of the satin moth, Stilpnotia salicis L., with Bacillus thuringiensis Berliner. Anz. Schadlingskde. Pflanzenschutz, Umweltschutz 53: 52-56

Larvae of the satin moth were successfully controlled with a *B. thuringiensis* suspension applied by means of a helicopter. The outbreak occurred over an area of 100 ha in western Switzerland. Foliage was sprayed with the spore suspension to give from 1.4×10^5 to 3.5×10^6 spores/cm². Mortality due to parasitism before treatment was 9%. It rose to 92% a week after treatment.

Maramorosch, K. (1979). Biological control of insect pests with viruses. In: Practical Tissue Culture Applications. Ed. K. Maramorosch & H. Hirumi. Academic Press. Chapter 25, pp 387-398

This article reviews previous work and the present status of biological control of insect pests with viruses. There is a step-by-step description of the procedures and practical problems associated with establishing insect cell lines and producing baculoviruses. The advantages and disadvantages of viral insecticides are discussed. Applications of the technique to specific problems as well as future applications are briefly mentioned.

Mau, R.F.L., Murai, K., Kumashiro, B. & Teramoto, K. (1980). Biological control of the banana skipper, Pelopidas thrax (L.) (Lepidoptera: Hesperiidae) in Hawaii. Proc. Hawaiian ent. Soc. 23 (2): 231-237

Although *Pelopidas thrax* was a serious threat to the local banana industry, the establishment of *A. erionotae* and *O. erionotae* greatly reduced the importance of the pest. The parasites were effective in controlling widespread, heavy infestations and were also effective in preventing serious damage from developing in situations of low host density where banana skipper infestations had just begun to be noticed. As a result there were many localities in the State where severe damage to banana was prevented through timely releases of parasites.

Eligio Bruzzese (1980). The phytophagous insect fauna of Rubus spp. (Rosaceae) in Victoria, a study on the biological control of blackberry (Rubus fruticosus L.). J. Aust. ent. Soc. 19: 1-6

In Victoria 44 species of phytophagous insects and two species of mites were found to attack endemic and introduced *Rubus* spp. Most insects were polyphagous and ectophagous and half were of some economic importance to crop plants. Only one host-specific insect was found on endemic *Rubus* spp. European blackberry appears to have been introduced into Australia free of its specific insect predators and the possible use of one of these as a biological control agent is mentioned.

P. Harris (1980). Establishment of Urophora affinis Frfld. and U. quadrifasciata (Meig.) (Diptera: Tephritidae) in Canada for the biological control of diffuse and spotted knapweed. Z. ang. Ent. 89 (5): 504-514

The European seed-head flies, *Urophora affinis* and *U. quadrifasciata*, were introduced into British Columbia for the biological control of *Centaurea diffusa* and *C. maculosa*. The fly populations were monitored over a ten-year period. Both species increased and spread rapidly to reach a combined population plateau determined by the receptacle area in the knapweed stand. Within this population plateau, the abundance of the two flies has tended do fluctuate inversely.

Liu, S. & R. Baker (1980). Mechanism of biological control in soil suppressive to Rhizoctonia solani. Phytopathology 70: 404-412

Soil suppressive to *Rhizoctonia solani* was generated by monoculture planting of successive crops of radishes at weekly intervals in soil infested with the pathogen. Numbers of *Trichoderma* spp. propagules in the soil increased as suppressiveness increased, whereas inoculum density of *R. solani* was inversely proportional to the density of these *Trichoderma* spp. following radish monoculture. Successive plantings of cucumber also generated suppressiveness which was associated with population of *Trichoderma* spp. propagules. Suppressiveness did not develop and *Trichoderma* was undetectable in sugarbeet, alfalfa, and wheat monoculture. *Trichoderma* was isolated with high frequency from mycelial mats of *R. solani* incubated in suppressive soil, but only occasionally from those incubated in conducive soil. Finally, conidia of *Trichoderma* added to conducive soil, at the same density found in suppressive soil, induced suppressiveness and the same species could be reisolated from mycelial mats of *R. solani* incubated in the soil. Among the antagonists tested, *T. harzianum*, isolated from Fort Collins clay loam, was most effective in inducing suppressiveness. Suppressiveness during radish monoculture developed more rapidly in acid soils than in alkaline soils. The suppressive effect persisted longer in soils with low negative matric potential.

Scher, F.M. & Baker, R. (1980). Mechanism of biological control in a Fusarium-suppressive soil. Phytopathology 70: 412-417

Metz fine sandy loam soil from the Salinas Valley in California was suppressive to the *Fusarium* spp. which induce wilts of flax and carnation. Suppressiveness to *Fusarium oxysporum* f. sp. *dianthi* was transferred to conducive soil when the Metz fine sandy loam was added in small amounts to steamed greenhouse soil. Aerated steam treatment of the suppressive soil at 54°C for 30 min eliminated the suppressive effect. Lowering of pH values of the Metz fine sandy loam from 8.0 to 6.0 in unit increments eliminated the suppressive effect. Bacteria were isolated from mycelial mats of *F. oxysporum* f. sp. *lini* buried in the suppressive soil and conducive soils. Two isolates from suppressive soil introduced into conducive soil at 10^5 cells per gram of soil significantly reduced disease incidence of Fusarium wilt of flax. The more effective of these isolates inducing suppressiveness was a *Pseudomonas* sp. Viability of this organism was drastically reduced when soil was treated with aerated steam at 54°C. These results suggest that suppressiveness in the Metz fine sandy loam is biological in origin and that control of Fusarium wilt diseases may be accomplished through introduction of appropriate species of bacteria into conducive soil.

4. Review of Interesting Developments in Vector Biology and Control

4.1. Information Documents/WHO Division of Vector Biology and Control

Anyone wishing to receive copies of the documents recently issued by WHO on biological control research and biological control agents should request them from the WHO Division of Vector Biology and Control, 1211 Geneva 27, Switzerland.

– *UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases, Third Annual Report, 1 July 1978 – 30 June 1979, Vector Control: Biological Control of Vectors, pp. 151-167*

Research on vector control in the Special Programme is carried out by the Scientific Working Group (SWG) on Biological Control of Vectors (BCV) and under individual disease-oriented SWGs. The objectives of the SWG on BCV are firstly to identify, evaluate and develop biological control agents for the safe and effective control of invertebrate vectors and intermediate hosts of human diseases covered by the Special Programme, with special emphasis on fungi, bacteria and nematodes, and secondly to support these objectives by identifying and satisfying institutional needs for strengthening research and educational capacity. As resources do not permit proceeding with the simultaneous evaluation of many biological control agents, it was proposed that first priority be given to the following organisms:

Bacteria	: *Bacillus sphaericus*, serotypes 2 and 5; *B. thuringiensis*, serotype H 14;
Fungi	: *Coelomomyces* spp. (indigenous species); *Culicinomyces clavosporus*;
Protozoa	: *Nosema algerae*; *Vavraia culicis*;
Nematodes	: *Romanomermis culicivorax*.

Second priority to be given to studies on:

Fungi	: *Metarhizium anisopliae*; *Lagenidium giganteum*;
Nematodes	: *Octomyomermis muspratti*.

A summary of research and development reviewing world-wide activities, both within and outside the Special Programme, is then given, and covers the afore-mentioned organisms. The plan of action for 1980 and 1981 is then outlined, taking into account the latest developments in the field of biological control and expected trends and progress of research in this field. The Steering Committee has recommended that an informal consultation on standardisation and industrial development of fungal pesticides be organised towards the end of 1981 in conjunction with the meeting of the SWG. Three publications resulting from the Special Programme support are listed at the end of the Report.

– *Third Meeting of the Scientific Working Group on Biological Control of Insect Vectors of Disease, Geneva, 19-22 November, 1979. WHO Doc. No. TDR/BCV-SWG (3)/79.3, 29 pp. English only.*

Progress made in this field since September 1978 was reviewed. Recommendations to broaden the scope of the SWG to include parasitoids, predators, competitors, biological agents for snail control and related agents were noted. The list of candidate biological control agents to be given priority in the research plan (see above) was updated and extended. The following sequence of priorities was recommended: within a priority group agents are listed alphabetically:

Priority 1: *Bacillus thuringiensis*, serotype H 14 (bacterium)

Priority 2: *Bacillus sphaericus*, strain 1593 (bacterium)
Culicinomyces sp. (fungus)
Poecilia reticulata (fish)
Romanomermis culicivorax (nematode)
Toxorhynchites (predatory mosquitos)
Zacco platypus (fish)

Priority 3: *Aphanius dispar* (fish)
Coelomomyces (fungi)
Lagenidium giganteum (fungus)
Metarhizium anisopliae (fungus)
Parasitoids in general (insects)
Romanomermis iyengari (nematode)
Stenopharyngodon idella (fish)

Priority 4: (a) *Aplocheilus* sp. (fish)
Baculoviruses (viruses)
Dimorphic Microsporidia (protozoa)
Dugesia (Planaria)
Lutzia (predatory mosquitos)
Octomyomermis muspratti (nematode)
Protozoa of snails (protozoa)
Tolypocladium cylindrosporium (fungus)
(b) Entomophthorales (fungi)
Nosema algerae (protozoan)
Vavraia culicis (protozoan)

Priority 5: Irridescent and most non-occluded viruses
Neoaplectana sp. (nematode)
Non-spore-forming bacteria

The SWG made precise recommendations concerning the action required for each promising agent or group of agents; provided specific guidelines for the intensification of the search for new biological control agents; advised the development of a network of collaborating scientists and institutions; recommended improvements in the dissemination of information; suggested methods for production and formulation of microbial pesticides; and outlined the international standardization of the bioassay procedures for *B. thuringiensis*, serotype H 14.

There were 21 participants at the meeting in addition to the Secretariat of five, with two observers, altogether representing 15 countries.

4.2. Research Documents issued by the WHO Group on Biological Control of Vectors

a) *Bacillus sphaericus*, strain 1593

- Barjac, H. de, Larget, I., Cosmao, V. *et al.* (1979). Safety of *Bacillus sphaericus*, strain 1593, for mammals. Doc. No. WHO/VBC/79.731, 20 pp, French only.

Experimental infection of various laboratory animals (mouse, rat, guinea-pig) by *B. sphaericus* strain 1593 did not cause any clinical signs or mortality. Whatever the route of administration used, there was no evidence of toxicity. Moreover, successive passages through the animal did not lead to an increase in virulence of the bacterium. No pathological symptoms were observed. Growth and behaviour of treated animals were similar to that of the controls. Attempts to reisolate the bacterium from various tissues at the end of the experiment proved unsuccessful.

- Sinegre, G., Gaven, B. & Vigo, G. (1980). Preliminary evaluation of the larvicidal activity of *B. sphaericus* strain 1593 against four species of mosquito on the French Mediterranean coast. Doc. No. WHO/VBC/80.762, 8pp, French only, English summary.

Under laboratory conditions, 2nd, 3rd and 4th instar larvae of *Culex pipiens* proved relatively susceptible when exposed to *B. sphaericus* 1593 primary powder (MV. 716, Stauffer Chemicals) for 48 hours, with LD 50's of between 0.09 and 0.12 mg/l. However, *Aedes aegypti*, *Ae. caspius* and *Anopheles atroparvus* were much more resistant, with LD 50's in excess of 64 mg/l. Equivocal results were obtained for *Ae. detritus*. In a field trial against *Ae. detritus*, concentrations equivalent to 80-160 kg/ha were needed for adequate kill; such applications would not be economically feasible in practice.

b) *Bacillus thuringiensis* serotype H 14

- Dempah, J. & Coz, J. (1979). Experiments with *Bacillus thuringiensis israelensis* against mosquitoes. Doc. No. WHO/VBC/79.719, 10 pp, French only.

The variation in susceptibility to *B.t. israelensis* toxin of about 15 strains of *Aedes aegypti* was investigated. In view of the variation both within and between species in susceptibility, it will be necessary to strictly standardise experimental parameters, and to use large numbers of larvae per concentration, when titrating the amount of active ingredient in formulations of *B.t.i.*

- Dejoux, C. (1979). Preliminary studies on the effect of *Bacillus thuringiensis israelensis* de Barjac on the invertebrate fauna of a tropical stream. Doc. No. WHO/VBC/79.721, 11 pp, French only, with English summary.

In the short-term at least, *B.t. israelensis* did not appear to have any deleterious effects on the non-target aquatic fauna, while it exerted excellent larvicidal activity against the blackfly, *Simulium damnosum*, the vector of onchocerciasis. These field tests were carried out in the Ivory Coast.

- Guillet, P. & Escaffre, H. (1979). Evaluation of *Bacillus thuringiensis israelensis* de Barjac for control of *Simulium damnosum s.l.* larvae. I. Results of initial field trials. Doc. No. WHO/VBC/79.730, 7 pp, French only, English summary.

A primary powder of *B. t. i.* experimentally produced on an industrial level was evaluated as a blackfly larvicide in a small river in the southern Ivory Coast, West Africa. Complete kill of larvae immediately downstream of the dosing point was obtained with dosages equivalent to 0.2 mg/l primary powder for 10 minutes. It is hoped that these extremely encouraging results can be improved with formulations specifically developed for blackfly control.

- Guillet, P. & Escaffre, H. (1979). Evaluation of *Bacillus thuringiensis israelensis* de Barjac for control of *Simulium damnosum s.l.* larvae. II. Comparative efficacy of three experimental formulations. Doc. No. WHO/VBC/79.735, 7 pp, French only, English summary.

A primary powder of *B.t.i.*, together with three experimental formulations derived from it (50% water dispersible powder (wdp), 10% water-based concentrate, and 5% emulsifiable concentrate) were evaluated simultaneously as blackfly larvicides. Efficacy at a given concentration was inversely proportional to the size of the particles, the water-based concentrate being ineffective and the wdp being markedly less effective than the primary powder itself. Studies are underway to determine whether the influence of particle size is related to the amount of primary powder ingested by blackfly larvae, to the differential sedimentation of inert ingredients and « spore-crystal » particles, or both.

– Barjac, H. de (1979). Note on the preparation of a reference formulation IPS 78 for the bioassay of experimental and industrial formulations of *Bacillus thuringiensis* serotype H 14. Doc. No. WHO/VBC/79.741, 6 pp. English (original: French).

The results obtained in the biological determination of the activity of *B.t.* formulations vary in relation to the origin and physiological state of the insects used as well as with the experimental conditions under which the tests are carried out. These variations can be reduced by incorporating a reference powder of the same *B.t.* serotype into trials to evaluate a new *B.t.* formulation; the biological effectiveness of novel formulations evaluated may be readily quantified by assigning an arbitrary titre to the reference powder in « International Units » of effectiveness. The paper gives details on the preparation, storage, distribution and use of the reference formulation based on serotype H 14, IPS 78 (= International Pasteur Standard 1978).

– Sinegre, G., Gaven, B. & Jullien, J.L. (1979). Safety of *Bacillus thuringiensis* serotype H 14 for non-target fauna in mosquito breeding sites on the French Mediterranean coast. Doc. No. WHO/VBC/79.742, 6 pp. French only, English summary.

Safety of the primary powder R-153.78 and two experimental formulations derived from it (25% WP & 5% EC) was evaluated using laboratory simulations. Studies were made of coleopteran larvae and adults (*Berosus* sp.), copepods (*Cyclops* sp.), Cladocera (*Daphnia magna*), dragonfly larvae (*Cordulia* sp.), shrimps (*Artemia salina* adults), chironomid larvae (*Chironomus* sp.), chaoborid larvae, fish (*Gambusia affinis*) and oysters (*Ostrea edulis*). The formulations appeared to have a very large safety margin excepting for chironomids.

– Sinegre, G., Gaven, B., Jullien, J.L. *et al.* (1979). Activity of *Bacillus thuringiensis* serotype H 14 against the main anthropophilic mosquito species on the French Mediterranean coast. Doc. No. WHO/VBC/79.743, 7 pp. French only.

In most cases, the LD 50's and LD 90's observed for late 3rd/early 4th instar larvae of wild-caught *Aedes caspius*, *Ae. detritus* and *Culex pipiens* were comparable with those obtained using conventional larvicides. Between-population variation in results warrants further in-depth studies, in order to determine the critical concentrations at which mosquitoes may develop resistance to the endotoxin, as well as to define application rates for use in the field. This variation might be of considerable significance if evaluation of the larvicidal activity of commercial preparations of *B.t.* H 14 is exclusively based on biological trials simultaneously determining the LD 50's obtained with commercial formulations and the IPS 78 reference formulation.

– Barjac, H. de & Larget, I. (1979). Proposals for the adoption of a standardised bioassay method for the evaluation of insecticidal formulations derived from serotype H 14 of *Bacillus thuringiensis*. Doc. No. WHO/VBC/79.744, 15 pp. English.

The preliminary development of a standardised bioassay method using serotype H 14 is outlined. On the basis of these findings, it may be premature to finalise a method and recommend its general use. However, a number of conclusions are listed, and these are briefly summarised below.

i) difficulties are no greater than those overcome for titration of formulations of serotypes H 1 and H 3a,b, already in use;

ii) although more delicate to handle and difficult to count than 4th instar larvae, 2nd instar larvae are easier to mass produce, and can be exposed for longer periods without any risk of their getting close to pupation;

iii) 4th instar larvae take a long time to produce, synchronous mass-production is difficult; late 3rd instar larvae may be preferable;

iv) no attempt was made to determine the influence of food addition on mortality after exposure to the delta endotoxin; if there is an effect, the technique must be modified accordingly;

v) *Ae. aegypti* should be retained as the main reference test species;

vi) alternative test species could be considered according to local needs and facilities, e.g. *Cx. pipiens*, *An. stephansi*;

vii) the bioassay methods developed by the authors had good reproducibility, especially when 2nd instar *Ae. aegypti* were used, and it is hoped that their results will help the development of an internationally agreed standardised method for evaluating commercial formulations of *B.t. israelensis*.

– Sinegre, G., Gaven, B. & Jullien, J.L. (1979). Comparative titration experiments with two experimental primary powders of *Bacillus thuringiensis* serotype H 14 and the IPS 78 reference formulation used against larvae of *Culex pipiens* and *Aedes caspius*. Doc. No. WHO/VBC/79.745, 18 pp. French only, English summary.

The reference formulation IPS 78 and the WHO bioassay method for determining the susceptibility of mosquito larvae to insecticides were used to assess the active ingredient content of the experimental primary powders R 153.78 and ABG 6108 against *Ae. caspius* and *Cx. pipiens*. Each population of each mosquito species gave a different titre:

R 153.78 – 3100 ITU* for *Cx. pipiens*, and 4200 ITU for *Ae. caspius*;
ABG 6108 – 600 ITU for *Cx. pipiens*, and 1900 ITU for *Ae. caspius*.

The need to standardise both the experimental method and the mosquito strain used is emphasised.

– Sinegre, G., Vigo, G., Gaven, B. *et al.* (1979). Initial and residual larvicidal activity of *Bacillus thuringiensis* serotype H 14 endotoxin in two mosquito biotopes on the French Mediterranean coast – comparative efficacy of seven experimental formulations derived from the same primary powder. Doc. No. WHO/VBC/79.747, 7 pp. French only, English summary.

The primary powder R 153.78 and derived formulations were evaluated in small field plots against larvae of *Ae. detritus* and *Cx. pipiens*. The effectiveness of the primary powder was not exceeded by the other formulations. The minimal concentration ensuring complete mortality was 0.1 mg/l against *Ae. detritus* and 0.4 mg/l against *Cx. pipiens*, equivalent, respectively, to 310-420 and 1240-1680 ITU/l. There was almost no residual larvicidal effect despite the chemical stability of the delta endotoxin in neutral and acid water.

* ITU: International Toxic Unit.

– Guillet, P., Dempah, J. & Coz, J. (1980). Evaluation of *Bacillus thuringiensis* serotype H 14 de Barjac for control of *Simulium damnosum s.l.* larvae. III. Preliminary results on sedimentation of the endotoxin in water and on its stability under tropical conditions. Doc. No. WHO/VBC/80.756, 9 pp, French only, English summary.

Sedimentation of the primary powder and a 50% water-dispersible powder were identical: after 4h 50-75% of the a.i. had precipitated, and virtually 100% by 24h. In contrast, no sedimentation of the water-based concentrate could be detected after 24h. There was no change in the biological activity of particles which were resuspended. Only slight toxicity loss was noted in powder left open under tropical conditions for three months. No reduction in toxicity was recorded when powders were held at 80°C for 24h.

– Barjac, H. de, Larget, I., Bénichou, L. *et al.* (1980). Safety of *Bacillus thuringiensis* serotype H 14 for mammals. Doc. No. WHO/VBC/80.761, 23 pp, French only.

Toxicological studies were carried out with serotype H 14 in various laboratory animals (mice, rats, guinea-pigs and rabbits) using different routes of administration (subcut., intraperit., oral, percutaneous, inhalation, ocular, scarification). No acute or chronic toxicity was demonstrated, using average doses of 10^7 to 10^8 bacteria/animal. Anaphylactic shock could not be induced in guinea-pigs, while successive serial passage in mice did not lead to the appearance of virulence. These results confirm the safety of *B. thuringiensis* serotype H 14 for mammals.

4.3. Biological Control and Genetics. In: Special Report on Mosquito Research. California Agriculture (March 1980) 34 (3): 17-28.

This report of progress in research by the University of California, Division of Agricultural Sciences, includes the following articles: BTI a potent new biological weapon (R. Garcia *et al.*); Notonectids (R. Garcia); Other mosquito predators (pupfish, hydra, flatworms) (C. Cress); Mosquito fish – an established predator (G.A.E. Gall *et al.*); Genetic manipulation of mosquitoes (M. Asman *et al.*); Using sterile males to reduce mosquito numbers (J.R. Anderson & M. Asman); Fungi show promise in biological control (B.A. Federici *et al.*); Nematodes as biological control agents (E.G. Platzer).

4.4. Production of a Preparation Based on Bacillus thuringiensis var. israelensis with UV-inactivated Spores for Biological Control of Mosquito Larvae. Krieg, A., Engler, S. & Rieger, M. (1980). Anz. Schädlingskde, Pflanzenschutz, Umweltschutz 53: 129-133.

Extensive studies on the potential of the new serotype (H 14) of *Bacillus thuringiensis* characterized as *B.t.* var. *israelensis* (*B.t.i.*) have been conducted by the University of Heidelberg (DE) since 1976. The present study was aimed at developing high-level UV-inactivation of *B.t.i.* spores and to evaluate its effect on mosquito larvae. Preparations of *B.t.i.* contain spores and toxic parasporal crystals. To minimize loading the surface water with active spores in connection with mosquito control, a way of reducing the germination index of the spores using UV equipment for sterilization of drinking water was investigated. With this method an inactivation rate of 99.99% could be obtained. In biotests with mosquito larvae, the irradiated preparations had the same efficacy as the non-treated one. Using *B.t.i.* in the dosage calculated in surface water will not exceed the tolerance limit for drinking water. Therefore, application of an UV-treated *B.t.i.* preparation for mosquito control should not be impaired by safety considerations.

5. Abstracts from Entomophaga

(Prepared by Courtesy of B. Hurpin, INRA)

ENTOMOPHAGA, volume 25 (3), 1980

J.M. Franz, H. Bogenschütz, S.A. Hassan, P. Huang, E. Naton, H. Suter & G. Viggiani, Institut für biologische Schädlingsbekämpfung, Darmstadt; Forstliche Versuchs- und Forschungsanstalt Baden-Württemberg, Stegen-Wittental; Niedersächsische Forstliche Versuchsanstalt, Göttingen; Bayerische Landesanstalt für Bodenkultur und Pflanzenbau, Abt. Pflanzenschutz, München; Eidg. Forschungsanstalt für landwirtschaftlichen Pflanzenbau, Zürich-Reckenholz; Istituto di Entomologia Agraria, Portici. Results of a joint pesticide test programme by the Working Group: Pesticides and Beneficial Arthropods.

The side-effects of 20 commercial pesticides (10 insecticides/acaricides, 6 fungicides, 4 herbicides) on 6 different beneficial arthropods were tested by members of the IOBC/WPRS Working Group "Pesticides and Beneficial Arthropods" in 3 countries. The tests were done according to standardized methods on *Trichogramma cacoeciae, Pales pavida, Phydageuon trichops, Leptomastix dactylopii, Coccygominus turionellae* and *Chrysopa carnea.*

F. Mansour, D. Rosen & A. Shulov, Agricultural Research Organization, Haifa; The Hebrew University of Jerusalem, Rehovot and Jerusalem, Israel. Biology of the spider Chiracanthium mildei (Arachnida: Clubionidae).

The biology of *Chiracanthium mildei* was studied under standardized laboratory conditions. Biological studies included an investigation of the rate of development, life cycle, reproductive potential and behaviour, as well as the influence of certain environmental factors on these parameters.

P.A.C. Ooi, Crop Protection Branch, Kuala Lumpur, Malaysia. Laboratory studies of Diadegma cerophagus (Hym.: Ichneumonidae), a parasite introduced to control Plutella xylostella (Lep.: Hyponomeutidae) in Malaysia.

Diadegma cerophagus was introduced into Malaysia from New Zealand and Indonesia to supplement the existing natural control of *Plutella xylostella*, an important pest of cabbage. Laboratory studies were conducted to determine some of the attributes of this parasite: longevity, life cycle, number of larvae attacked, area of host discovery.

R.A. Lautenschlager, J.D. Podgwaite & D.E. Watson, Northeastern Forest Experiment Station, Forest Service, USDA, Broomall, Pa.; Hamden, Connecticut. Natural occurrence of the nucleopolyhedrosis virus of the gypsy moth, Lymantria dispar (Lep.: Lymantriidae), in wild birds and mammals.

Three species of birds and 5 species of mammals were captured in the wild from 2 plots in which mortality occurred from naturally occurring nucleopolyhedrosis virus (NPV) among gypsy moth, *Lymantria dispar*, larvae. It is concluded that birds and mammals can passively transport infectious gypsy moth NPV in the wild.

J.P. Nénon, Laboratoire de zoologie, Faculté des sciences, Reims, France. Alteration of the development and elimination of the polyembryonic entomophage Ageniaspis fuscicollis (Hym.: Encyrtidae) by fasting of its host, Hyponomeuta malinellus (Lep.: Hyponomeutidae).

Fasting of the host may greatly affect the development of its polyembryonic parasite *Ageniaspis fuscicollis* depending on the stage reached by this entomophage at the beginning of fasting.

Y. Rössler, Citrus Marketing Board, Rehovot, Israel. "69 – Apricot". A synthetic strain of the Mediterranean fruit fly, Ceratitis capitata (Dip.: Tephritidae), with sex-limited pupal colour and eye colour marker.

This strain established in the laboratory carries a Y-chromosome translocation and produces brown pupae in the male and mutant dark pupae in the female. This sex-limited pupal colour dimorphism may be used for automated sexing of pupae prior to irradiation and release in the sterile insect technique.

Nicole Hawlitzky, Anne-Marie Mainguet & J.R. Le Berre, INRA, Station de Zoologie, Versailles; Université d'Orsay, France. Quantitative analysis of lipids, nitrogenous compounds and glycogen in the larva, nymph and young adult of an ovo-larval parasitic insect, Phanerotoma flavitestacea (Hym.: Braconidae), when the sarcophagous phase is suppressed.

The analysis made on 3rd instar larvae, the nymph and the young adult with or without the sarcophagous phase demonstrated the importance of the ectoparasitic period in the development of the last instars of *Phanerotoma*.

E. Müller-Kögler & G. Zimmermann, Institut für biologische Schädlingsbekämpfung, Darmstadt. On the preservation of cultures of entomogenous fungi.

The longevity of several entomopathogenic Entomophthoraceae and Fungi imperfecti as well as two species of Trichomycetes and the imperfect state of *Cordyceps militaris* was tested by various simple preservation methods: storage in sterile soil at 4°C, in sterile aqueous solution at 4°C, as cultures in a refrigerator at 4°C with and without a layer of mineral oil and at −18°C.

F. Mansour, D. Rosen & A. Shulov, Agricultural Research Organization, Haifa; The Hebrew University of Jerusalem, Rehovot and Jerusalem, Israel. Functional response of the spider Chiracanthium mildei (Arachnida: Clubionidae) to prey density.

Laboratory experiments demonstrated that the spider *Chiracanthium mildei* shows a functional response (a sigmoid curve) to increasing density of its prey: larvae of *Spodoptera littoralis*.

G. Riba & Annick Glandard, INRA, Station de Recherches de Lutte Biologique, La Minière, France. Establishment of a nutritive medium for the deep culture of the entomopathogenic fungus Nomuraea rileyi.

Nomuraea rileyi (Farlow) Samson blastogenesis requires specific factors which may vary with the biotype. Limiting components of the medium include Tween 80 and a high concentration of yeast extract. The blastospores obtained are not infective when applied topically.

B.A. Peleg & S. Gothilf, The Israel Institute for Biological Control, Rehovot; Agricultural Research Organization, Bet Dagan, Israel. Effect of the juvenoid Altosid on the development of three hymenopteran parasites.

The juvenoid Altosid at concentrations of up to 0.1% a.i. had no adverse effect on the various developmental stages of *Aphytis holoxanthus*, *Coccophagus pulvinariae* and *Tetrastichus ceroplastae*; mortality was only observed in pupae of *C. pulvinariae*.

6. Prizes Awarded by the Filippo Silvestri Foundation

At a simple ceremony at the Faculty of Agriculture, University of Naples-Portici, on June 2, 1980, the following prizes were awarded by the Filippo Silvestri Foundation following the international competition announced in 1979.

First prize (one million Italian lire, a gold metal and a diploma of merit) awarded jointly to Dr Paul DeBach of California, Riverside, and David Rosen, Faculty of Agriculture, Hebrew University, Rehovot, for their book « The species of *Aphytis* of the world ».

Second prize (a gold medal and a diploma of merit) awarded to Prof. G. Viggiani, Faculty of Agriculture, University of Naples-Portici, for his studies on Chalcidoidea and their utilization in biological control.

Third prize (a diploma of merit) to Dr Peter Stary, Institute of Entomology, Czechoslovak Academy of Sciences for his paper « Aphid parasites (Hymenoptera, Aphididae) of the Central Asian Area ».

Congratulations to the winners.

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