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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NEWS FROM THE SECRETARIAT

1. IOBC General Assembly, Kyoto, 5 August, 1980

(on the occasion of the XVIth International Congress of Entomology)

Opening

The Past President, Dr Huffaker, United States, opened the meeting in the presence of 60 participants. He expressed his sadness at the loss of the two dear friends, Dr Biliotti, France, and Dr van den Bosch, United States, who both occupied leading positions within IOBC.

Dr Huffaker was confident that under the leadership of Dr Hagen, United States, new President of IOBC, the prestige of IOBC would be reinforced.

IOBC Presidential Address

By K.S. HAGEN

It is an honor to be President of IOBC at any time, but to become President during this period when IOBC is thriving and the importance of biological control of pests is becoming more widely recognized, it is indeed an honor, and I thank you for the privilege of being in this position. The only regrettable aspect at this time is not having among us our late Past President, Professor Biliotti, whom we all miss as a friend and as a dedicated scientist.

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

Biological control and host-plant resistance strategies are now receiving more attention since these alternate methods of pest control, compared to chemical control, are energy saving, non-polluting and ecologically sound. With increasing numbers of pests becoming resistant to pesticides, with rising costs of developing new pesticides and with increasing cost of petrochemicals, not to mention ecological disruptions caused by many of these pesticides, it is little wonder that we begin to see increasing interest directed toward methods of pest control other than use of chemicals.

Integrated pest management (IPM) is only beginning purposely to integrate biological control into crop protection. Today IPM is primarily based upon monitoring only the pest populations and treating when economic injury levels are approached. This approach alone is a significant step forward since it permits what natural enemies that are present to function better. Other benefits from this approach are the development of improved monitoring techniques for pests and establishment of economic injury levels. However, there are very few IPM programs today that include monitoring for natural enemies and consideration of their impact on pest populations. For IPM to be fully implemented, the biological control component in crop systems must be recognized, and more research support, particularly from governments, is necessary to enhance the three main tactics of biological control, namely, classical biological control, augmentation of natural enemies and their conservation — — that is, of parasitoids, predators and pathogens. In spite of the often relatively low priority that biological control research has been afforded compared to other aspects of IPM, there have been striking advances made in controlling insects, spider mites, weeds and pathogens through employing natural enemies. Yet I would emphasize that IPM is not of itself a specific goal of IOBC, although as I have noted, pursuit of either field is mutually beneficial to the other, and biological control has been the cornerstone of most IPM programs.

Classical Biological Control

Importation of natural enemies in the past was mainly utilized in the New World, Australia and South Africa, where many new types of crop plants were introduced by early settlers. With the increase of international traffic today, many pests are rapidly invading new localities ; consequently, many countries are for the first time initiating classical biological control programs. In the past, agricultural pests and some forest pests have been the main targets of biological control workers, but today natural enemies are being imported to control pests that attack shade trees and high-way plantings in both urban and rural areas, and as well, even cockroaches.

Biological control of weeds, particularly the weeds of ranges and waterways have been outstandingly successful utilizing imported insects. The recent use of plant pathogens in controlling weeds has added a new dimension which should increase the number of successes. Weeds in grain crops and along roadways are becoming targets of introduced biological control agents.

Biological control of plant diseases is an exciting new field. Chestnut blight, crown gall, as well as some soil-borne pathogens including root-knot nematodes can be controlled biologically. We hope that plant pathologists working in this area will join IOBC on an increased scale and become active in its affairs.

Recent cost-benefit analyses of successful classical biological control projects clearly indicate the tremendous savings involved when compared to accumulated costs of using the routine short-term chemical control approach. In the future, cost-benefit statements should be included in our reports on impact evaluations of introduced natural enemies.

An important advance in classical biological control which will increase the success rate of establishing introduced natural enemies is the paying of closer attention to geographical biotypes and seeking populations from localities that match the climatic parameters of the release sites and general target areas. In the past, populations of a natural enemy species from different localities commonly have been mixed while in quarantine and the survivors then cultured in the insectary and released. It is clear now that introduced populations coming from different climatic zones even within the same country should be kept isolated, cultured separately and released at separate places initially.

Biosystematic studies, particularly through the use of electrophoretic techniques, which depict the presence or absence of various enzymes, reveal differences between sibling species and between segrate populations of a single species. This technique not only allows monitoring genetic variability in populations, but also may aid in determining the origin of pest insects and weeds through comparative studies of populations from various geographical regions. Past classical biological control projects that have failed should be renewed keeping in mind the differences between biotypes from different geographical regions and habitats.

Certainly alpha taxonomy is important also, particularly to countries where the fauna is still not well known. Cataloguing species and host associations is extremely important to biological control workers, and support for taxonomy of groups containing natural enemies must be emphasized by all of us.

Augmentation of Natural Enemies

The tactics of augmenting natural enemies are becoming more diverse and offer much promise in the future in controlling insect and spider mite pests as well as plant pathogens. Periodically colonizing natural enemies has been limited to only a few predators and parasitoids that could be mass-cultured economically, but when economic production becomes possible for a wide range of species this tactic will become a major thrust in the biological control of arthropods, pathogens and weeds. Manipulating the environment by applying behavioral chemicals to increase the effectiveness of natural enemies is still mostly in the research stage but this approach is likely to become another major tool for biological control and IPM workers.

Even though there is much controversy concerning the value of periodically releasing *Trichogramma*, this method of controlling pests is increasing. Closer attention is being paid to the identity and quality of the *Trichogramma* being released, and there are apparently some lepidopterous pests that are consistently controlled by well-timed releases of adequate numbers of appropriate stocks. A cost-benefit analysis shows that the cost of periodic releases of *Pedobius* against the Mexican bean beetle is comparable to cost of using insecticides, yet if used this method would not entail the adverse consequences of the chemical alternative. Periodic releases of natural enemies against aphids, white flies and spider mites in northern European glasshouses is routinely utilized and is achieving good control. Presently, effective natural enemies of thrips and leaf miners are being sought to control these pests that were formerly controlled by the insecticides that were used to control the key pests. Several commercial insectaries in the USA sell various pteromalid species that successfully control filth flies associated with poultry houses, dairies and cattle feed lots.

Cabbage and onion maggots have been suppressed in the USSR by carefully timed releases of the staphylinid *Aleochara*. Today there are about a dozen other species of parasitoids and predators that are mass-cultured and released periodically against various insects and spider mites, accounting for varying degrees of control.

Exciting results are being obtained in controlling various plant pathogens by innoculating seedlings, standing trees and soil with antagonistic non-pathogenic strains of microorganisms as well as mycoparasites. Another significant development in the use of plant pathogens is culturing endemic pathogens that attack weeds in the lab and using them as mycoherbicides.

The ability to culture natural enemies either directly on artificial diets or indirectly on prey or hosts reared on artificial diets is critical to the advancement of the periodic colonization technique. Today very few natural enemies can be cultured directly on artificial diets. Although some progress is being made along these lines, more support must be directed toward research and development of the technology. Culturing certain tachinids on wax moth larvae which are reared on artificial diets has made possible inoculative releases of the tachinids annually against the sugar-cane borer in thousands of hectares in Brazil.

The role that behavioral chemicals such as kairomones play in the biology of natural enemies is just beginning to be understood. Parasitoids and predators commonly follow a series of chemical cues (kairomones), from finding the habitats of their hosts or prey to finally ovipositing into their hosts or feeding upon their prey. Kairomones can act as distant attractants, as contact chemicals that induce intensive searching, and as well in stimulating feeding. Such kairomones applied to crops individually or combined with artificial food can simulate high prey populations which not only attract certain natural enemies, but may also induce their feeding, production of eggs and oviposition. It has also been shown that parasitoids such as *Trichogramma* can be retained in release areas and their searching intensified by applying certain kairomones which were originally isolated from their host species. The effectiveness of insect pathogens has also been increased by adding phagostimulants to microbials.

To integrate augmentative techniques into IPM programs it is necessary to know the economic injury level of the target pest or pests and what predator/prey or parasitoid/host ratios are necessary to keep the pest populations from reaching damaging levels. One of the main responsibilities of IPM workers is to determine the economic injury level of pests. It is the responsibility of biological control researchers to determine effective natural enemy densities or natural enemy/prey ratios. The pest management advisers have to have this information plus knowing at what temperatures both pests and natural enemies can be active in order to make decisions as whether or not to do nothing to the crop, to treat with a pesticide or to augment the biological control agents by addition of natural enemies or stimulating them by application of behavioral chemicals.

Most IPM crop system models today embrace the growth dynamics of the crop, with a pest population superimposed, and are basically temperature driven. Very few models include the impact of natural enemies. The lack of biological control inputs into most of these models is the scarcity of critical biological data that biological control researchers must provide. The future IPM crop system models which include all three trophic levels will reveal the power of natural enemies in regulating phytophagous pest populations and will stimulate further support for biological control research. The biological control researchers that have contributed so enormously to the knowledge of population dynamics of arthropods have already demonstrated the ability of natural enemies to regulate arthropod populations but it seems that many IPM modelers are not aware of the importance of biological control.

Conservation of Natural Enemies

In any sound IPM program the natural enemies of target and nontarget pests must be considered and conserved even though the target pest has reached pesticide treatment levels. The plea for research and development of selective pesticides that spare the natural enemies has been responded to mostly by microbiologists. It has been the insect pathologists who have stimulated the commercial production of *Bacillus thuringiensis* plus a few other bacteria, viruses, protozoa and fungi which are selective microbial pesticides for use in control of certain insects. The plant pathologists have provided antibiotics, antagonists, mycoparasites and now even mycoherbicides that selectively control certain plant pathogens and weeds.

The few cases where broad spectrum insecticides are used which allow some natural enemies to function involve predators that are resistant to the insecticides used. Certain phytoseiid mites are resistant to organophosphates, chlorinated hydrocarbons and carbamates. *Chrysopa carnea* larvae are highly resistant to chlorinated hydrocarbons and pyrethroids. Certain pathogens are compatible with chemical insecticides and are applied together to give longer term control.

In the future, the chances of selecting parasitoids that are resistant to broad spectrum pesticides are rather low since parasitoids are rather food specific and their genomes do not contain complexes of enzymes for detoxification of natural chemical products occurring in plants and are sequestered in their host's tissues. On the other hand, polyphagous predators perhaps offer some opportunity to select for pesticide resistance since they may contain in their genetic make-up some detoxifying enzymes or carry symbiotic microorganisms that have the ability to break down plant produced toxins. Many groups of injurious insects contain mutualistic microorganisms. If antibiotics could be used to destroy them, this could provide a selective way of controlling the pests that harbor the microorganisms.

Recently it has been shown that plants only partially resistant to certain insect pests should not be discarded by plant breeders if natural enemies of the insect pest are present where the crop is to be grown, or could be established there. The natural enemies pressure plus the slower development of the pest population combined may give control, but in the absence of the natural enemies even though the pest population growth is slowed there is still too much damage. Therefore, biological control can be integrated with the host plant resistance strategy.

Conclusions

Although using natural enemies to regulate pest insects and spider mites is an old control strategy, biological control still remains one of the most powerful ecological methods of suppressing agricultural and urban pests and is a cornerstone of IPM. The density dependent action of natural enemies, responding to their host population's abundance, does not lead to selection of host strains resistant to their attack. Natural enemies do not contaminate the environment and can account for complete control of pests, and pests under partial biological control in time and space greatly reduce the need for pesticides.

The original approach of importing exotic natural enemies to control introduced pests, known as classical biological control, is still an important tactic and past importation attempts may have to be repeated, taking into consideration biotypes of natural enemies that better fit the environments where released. The tactic of augmenting natural enemies that are endemic or introduced holds much promise in the future. As the technology of inexpensively mass culturing a diversity of natural enemies develops, periodic colonization of natural enemies, including pathogens and antagonists, will come to compete economically with the use of synthetic pesticides, but this tactic will require the services of trained IPM field advisers to implement it. The use of behavioral chemicals, particularly kairomones incorporated in food sprays that increase the effectiveness of natural enemies, provides another tool for IPM advisers. In the area of conservation of natural enemies, the development and use of microbials will increase since they are and will also be used in the future to control pests which harbor symbiotes susceptible to these materials.

Biological control can also be integrated with the use of plant varieties only partially resistant to pests.

Report of the Secretary-General

By Dr G. MATHYS

Introduction

Professor Emile Biliotti (55), President of IOBC, died on 26th April, 1978. IOBC lost an outstanding personality and friend who conducted WPRS's affairs as Chairman for eight brilliant years. His name will remain in the hearts of his friends all around the world and they will appreciate, I am sure, that a French Research Institute near Antibes has been named the Emile Biliotti Research Centre, Valbonne.

Under these sad conditions the Executive Committee had to find an *ad interim* solution and proposed that Professor Carl Huffaker, Past President, should assume the presidency for the 2 years to run until the 1980 elections. On 8th November, 1978, Carl Huffaker agreed to take on the leadership for the fill-in period.

During the same year (19th November, 1978) we have also lost our US friend and colleague, Professor van den Bosch (56), Chairman of the WHRS. His pioneer work has largely contributed to the development of integrated pest management.

1. Meetings of Statutory Bodies

In accordance with the proposals made by the 7th General Assembly held in Washington in 1976, the IOBC Executive Committee became operational at the beginning of 1977, with the following members:

President	Biliotti
Past-President	Huffaker
Vice-Presidents	Ignoffo, Simmonds
Secretary-General	Mathys
Treasurer	Delucchi

At the beginning of his mandate, the Secretary-General wrote to several prominent IOBC members to seek their views and advice on the course which could best be followed during the 4 years ahead. Some were in favour of limiting the activities to information exchange through Newsletters, others felt that new efforts should be made to establish working groups at the global level, as done by Professor Delucchi.

1.1 First Executive Committee Meeting

The Executive Committee which met in Paris on 25th and 26th September 1978 studied these proposals and considered also the East Palaearctic Regional Section's endeavour to cooperate closely with the West Palaearctic Regional Section on topics such as IPM on vegetables, glasshouse crops, cereals (*Eurygaster* and *Aelia* spp.), *Lymantria dispar*, hops.

The Executive Committee took the view that efforts should be made to establish the following 3 global working groups: *Lymantria dispar*, trypetids in the tropics and subtropics, rice stem borers.

It felt that the East-West exchanges on the other topics should be bilateral, not involving the General Secretariat directly.

1.2 Second Executive Committee Meeting

This was held on 8th August 1979 in Washington DC. Its major concern was to identify potential members of the new Executive Committee and to submit a list of candidates for the IOBC Council.

1.3 Council Meeting

The 4 Regional Sections were represented at the meeting which took place on 9 August, 1979.

The Council adopted the Secretary-General's report, together with the accounts which on 30.6.1979 showed a positive balance of SF 131.896.15. It was decided to maintain subscriptions at the same level, i.e. 15 SF for individual membership without Entomophaga, 65 SF for individual membership with Entomophaga, 300 SF for institutional membership and 1800 SF for supporting membership.

The activities in the various sections were reviewed and it was mentioned that WHRS had difficulty in establishing working parties since there were already national IPM groups in operation. For the SEARS, lack of funds had hampered the expected developments. The WPRS continued to be very active in many fields, while the EPRS had started work in 1977, on a most promising basis.

The Council was in favour of the proposal made to sponsor two conferences, one on Bruchids at the University of Tours (FR) and the second at the Rockefeller Foundation Centre at Bellagio (IT) for a study on the Future of IPM. It also accepted the idea of sponsoring the International Working Group on *Ostrinia nubilalis* and other maize pests (IWGO). This Group was expected to become an IOBC technical body.

Finally, attention was drawn to action taken by the International Geographical Union in the perception of the environment in relation to pesticide usage. The Council considered that contact should be made with this Agency.

2. Technical Meetings

2.1 EPPO/IOBC Conference on Systems Modelling in Modern Crop Protection (Paris, 12-14 October, 1976)

The Conference attracted 108 scientists including a strong participation from the Unites States. EPPO and IOBC drew up the programme jointly but the costs were entirely born by EPPO which published the proceedings.

One of the Conference recommendations was the establishment of an international working party on mathematical modelling and the systems approach. This recommendation has been implemented by the WPRS.

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

The meeting, considering that the cultivation of legumes is the best and quickest way to increase food protein production, especially in developing countries, reviewed basic knowledge on particularly harmful bruchid species in various parts of the world. A proposal was made to establish an IOBC-sponsored pluridisciplinary task force, which should define middle and long-term programmes for the alleviation of the often disastrous crop losses. The Group has been established and is headed by Professor Labeyrie of the University François-Rabelais in Tours. A first meeting is planned in February 1981.

2.3 Bellagio Conference on « Future of Integrated Pest Management » (Bellagio, IT, 30 May-4 June 1980)

This Conference was convened by IOBC with the support of the Rockefeller Conference Centre. Fourteen highly experienced scientists from various parts of the world reviewed the current IPM situation to identify remaining problems and to study ways of resolving them. The following major themes were studied :

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

Fifteen papers provided the background material for these discussions which led to a number of interesting conclusions regarding the future of IPM. The full report, including background papers, an account of the debates and the conclusions will be published in short : it will be free of charge, as an IOBC service.

3. Newsletters

It was felt that the best way to strengthen the links among regional sections and members of IOBC was to provide regular information exchange. During the period under review, 8 Newsletters have been issued and widely distributed. More than 800 copies of each issue were dispatched and there appears to be great interest in this type of publication, covering such aspects as internal affairs, brief original papers, review articles, announcements and abstracts from selected papers which are thought to have a potential impact on future developments. Last but by far not least, the Newsletters include abstracts of all papers published in Entomophaga, by courtesy of Dr Hurpin (Chief editor). The annual subscription to the Newsletters is only 15 SF (about 9 US).

In March 1980, the first issue of « Biocontrol News and Information » was published by the Commonwealth Agricultural Bureaux. This CAB journal systematically abstracts a large number of scientific publications ; it will be issued quarterly and includes news, reviews and digests ; its price is about US $ 70 per annum. There is clearly some information overlap between these various publications, which could usefully be discussed.

4. Contribution of IOBC to the 9th International Plant Protection Congress (Washington, 5-11 August, 1979)

A poster was displayed during the Congress, explaining the structures of IOBC and drawing attention to its fields of activity. A similar poster has been displayed during the XVIth International Congress of Entomology in Kyoto.

Conclusions

The 4-year period under review has not fulfilled all our expectations. However, it appears that global activities are not just limited to information exchange. IOBC's direct involvement in meetings, as illustrated by the Modelling, Bruchid and Bellagio conferences, has generated considerable interest from FAO. Furthermore, the existence of 2 global working parties and the move towards establishing 2 more such groups (Quality Control and Vector Control) in the near future shows new potentials for IOBC.

The 4 regional sections are largely autonomous ; it is up to their governing boards to intensify their activities and the general Secretariat seeks to encourage them.

A comparison of the IOBC membership in 1978 and 1979 shows a considerable increase in individuals receiving the Newsletters and in institutional members :

	Individual members without Entomophaga	Individual members with Entomophaga	Institutional members	Supporting members
1978	153	201	50	1
1979	276	202	58	1

but even more could be hoped for ; much remains to be done to strengthen biological control and the development of IPM.

The report of the Secretary-General was adopted by the General Assembly.

Report of the Treasurer

The accounts had been established by Dr Delucchi and were audited by the Accounts Verification Panel composed of Dr Bennett, Dr Hurpin and Dr Mori. The accounts were found to be in order and appreciation was expressed for the high standard of presentation. On 30 June, 1980, the balance of availabilities amounted to SF 131,896.15 as compared to SF 125,375.55 on 31.12.1978.

The General Assembly adopted the IOBC accounts for the period 1978-1980 and agreed to keep the membership fees unchanged : 65 SF with Entomophaga and 15 SF without Entomophaga.

Elections (Results of the Postal Ballot)

In Washington in 1979, the Council had proposed a slate of candidates as members of the Executive Committee. As a result of the postal ballot (see IOBC Newsletter 16) the Executive Committee of IOBC is composed as follows :

President

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

Vice-Presidents

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

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

Secretary-General

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

Treasurer

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

The documents referring to the postal ballot were scrutinized by Dr Hurpin and found to be in order.

Reports from Regional Sections

West Hemisphere Regional Section (WHRS) Report

Current Status of WHRS

a) Membership (July 28, 1980): 233 individual (109 with Entomophaga), 4 Institutional, 1 Supporting.

b) WHRS meets annually with the Entomological Society of America (ESA).

c) A highly successful newsletter has been initiated and 3 issues have appeared (quarterly).

d) Re-organization of the Section into sub-organizations is under study. Currently it appears that the US will follow the « branch » approach of the ESA whereby the WHRS group will meet simultaneously with the ESA branches. The most promising approach for the Central and South American countries is to function as country units through the national entomological organizations. So far Brazil, Peru, Colombia and Venezuela have taken this approach with success

Proposed Activities for 1980

Annual Meeting

To accent the 10th anniversary of WHRS a « Distinguished Achievement Award in Biological Control » will be awarded to a deserving recipient. The award will include a plaque and a $ 500 check.

Subjects under Review by WHRS

a) Expansion of discipline (plant pathology, weed science, etc.) inputs other than entomology to round out the overall biological control effort.

b) Holding a national meeting for biological control independent of any other meeting (such as ESA). Such an effort might well encourage a broader base for biocontrol in WHRS. We calculate that our prospective membership in WHRS could reach 600 individuals on a broader basis.

c) Evaluation of Publication Needs

There is strong concern that the publication needs for WHRS are not being met. A Committee has been established to consider the needs of the membership, and Entomophaga. There are two reasons for this review :

a) the failure of Spanish and Portuguese scientists to publish and b) the delay of up to two years for publications to appear in Entomophaga.

After the findings of the Committee are received and considered by the WHRS Executive Committee, recommendations will be made to the membership.
It should be pointed out that the evaluation of the publication needs for WHRS members is not a reflection or criticism of Entomophaga. It does however reflect that a serious study should be made at the global level to determine current-day needs of the IOBC membership.

d) There is a need for WHRS to standardize its dues to IOBC based on the dollar rather than the Swiss franc. The ever continuing fluctuation of the dollar and the Swiss franc has for the past 4 years had a negative impact on the WHRS funding balance. We do not feel that we can, or should, go to the membership annually for increases. A standard dollar fee could greatly stabilize the WHRS situation.

West Palaearctic Regional Section (WPRS) Report

1. Membership

35 Institutions (21 countries).

2. General Assembly, Athens, Greece, 1979

Ongoing work within the Section's three commissions and 23 Working Groups was reviewed and the conveners of these technical bodies had to define future objectives. A number of important decisions were made among which the following are mentioned :

a) The Section should also be responsible for the development of practical pest management systems at the crop level.

b) A new commission should deal with the optimization of production. The interesting results obtained with total production management in deciduous fruit orchards encourage the study of the potentials of such systems in other crops.

c) Studies on safety aspects of granulosis viruses should be undertaken.

d) The Working Group on genetical control of fruit flies should be restructured and be oriented towards quality control.

e) A Working Group on mathematical modelling should be established.

The General Assembly nominated the new governing board and accepted that the forthcoming General Assembly be held in Antibes (France) in 1981.

Finally, the General Assembly agreed to establish a close cooperation with the European Economic Commission, which has started work in integrated control.

3. Symposium on Integrated Control in Agriculture and Forestry, Vienna, Austria, 8-12 October, 1979

The Symposium is to be considered as the most important meeting ever held by WPRS. It allowed the achievements of the systems developed by the Working Groups to be reviewed and their economics and practicability to be evaluated. The proceedings (647 pages) were issued in April 1980 and are a most valuable source of information.

4. 25th Anniversary of WPRS

In 1980 WPRS commemorated its 25 years of existence and the Proceedings of the Vienna Symposium were dedicated to this event.

5. Regular Publications

WPRS is in charge of editing Entomophaga, a Journal of Biological and Integrated Control. In addition, there are several annual issues of WPRS Bulletin which report on research activities within the Working Groups.

East Palaearctic Regional Section (EPRS) Report

The East Palaearctic Regional Section of the International Organization for Biological Control was set up at the first session of the IOBC General Assembly.

The session adopted the Charter and the Regulations of the Section ; elected the President, the Vice-President, the Secretary-General, the Council, the Executive Committee, the Inspection Committee ; established five Standing Committees and elected their chairmen. The session also considered « The main directions of the EPRS scientific and applied activity ». Besides, 10 research establishments and institutions from seven countries were put on the list of EPRS.

During the period under review the section held :

1. Four meetings of Standing Committees :
- the Editorial Board,
- the Committee on entomophages and phytophages of weeds,
- the Committee on microbiological methods of plant protection,
- the Committee on methods of genetic plant protection.

2. Three symposia :
- « The use of *Trichogramma* in plant protection integrated systems » (Sofia, Bulgaria, June, 1979) ;
- « Use of pheromones in biological control of codling moth (*Laspeyresia pomonella* L.), oriental fruit moth (*Grapholitha molesta* Busck), and plum moth (*Grapholitha funebrana* Tr.) » (Budapest, Hungary, 1980, October) ;
- « Introduction and acclimatization of potential entomophages, acariphages and phytophages of the main pests and weeds in Members Countries of EPRS ».

The Symposium « Elaboration of integrated plant protection systems in monocultures » is to be held in Kishinev in September, 1980. The Symposium « Insect viruses and prospects for their application in plant protection » is to be convened in Moscow, in November, 1980.

3. Two meetings of chairmen of Standing Committees :

The first meeting was held in April, 1978. The meeting discussed and ratified the programme of the Committees' activity, established the personnel of the Committees and worked out the plan of their working meetings, as well as that of symposia. The meeting also considered the question of setting up Temporary Working Parties under the Standing Committees. This question was finally resolved at the Second meeting of chairmen of Standing Committees.

Information about the meetings and symposia held was duplicated by the Secretariat of the Section and dispatched to all research establishments and Institutional Members of the Section, of the Council and of the Executive Committee. It was also sent to the chairmen of Standing Committees and to heads of Plant Protection Services of EPRS Member Countries for potential recommendations in Plant Protection.

Considerable work has been carried out in publishing a regular Bulletin of the Section – « Information Bulletin » which will be issued four times a year.

Work is now underway on collecting material for a list of entomophages of economically significant agricultural and forestry pests.

The Section has elaborated a plan on the introduction of useful organisms both from the West Palaearctic Region and from other regions.

The main principles are being worked out for the registration and evaluation of entomophages.

Finally, a programme has been started to collect available material in EPRS Member Countries on economic damage thresholds for insects.

Work is now underway on the preparation of the Second session of the EPRS General Assembly.

South and East Asian Regional Section (SEARS) Report

By Dr A.J. MOHYUDDIN

On assuming the charge of Secretary-Treasurer of the SEARS in January 1977, a circular letter was sent to the members of the Governing Board of SEARS for suggestions to improve working of IOBC in this Region and furnishing lists of people interested in biological control in their respective countries. The lists of members, possible members and people interested in biological control were received from Korea (7 people), Sri Lanka (5), Malaysia (38), Thailand (21) and India (16). From Pakistan 13 people consented to become members of IOBC in response to a circular sent locally. Forty-six people joined IOBC from Japan.

These lists were supplied to the IOBC Secretariat. The members of the Governing Board, SEARS, were requested to ask the persons interested in biological control if they would like to become members of IOBC. The response was quite encouraging and a large number of people offered to become members. About 67 people in 1978 and 56 in 1979 became members as compared with 18 in 1977. It was decided that the Treasurer of IOBC, in addition to IOBC membership, will charge one US dollar as membership fee of SEARS to cover incidental expenses of the Regional Section. However, Dr H. Mori from Japan collected membership of the SEARS directly and sent it to me.

As most of the new members in the Region were not fully aware of the functions and activities of IOBC, Dr Delucchi, Treasurer IOBC, was requested to send literature in this regard. The literature received from him was distributed among members of the Governing Board for information of the IOBC members in their respective countries.

In response to Dr Mathys' letter of July 30, 1977, regarding ways of increasing the impact of IOBC, a circular letter was sent to members of the Governing Board in which their views were invited. I sent my views to Dr Mathys in September 1977 and a summary of the views received was sent in July 1978. All had complained about lack of communication among members. They suggested that a Regional Newsletter including a list of members, and a list of readily available natural enemies should be published and circulated with a view to exchange material.

An attempt was made to organize the First Regional Meeting of the SEARS on Biological Control of Insect and Weed Pests. Dr Yasumatsu very kindly offered to arrange it in Bangkok, but unfortunately funds could not be arranged in spite of efforts on the part of a number of members of the Executive Committee. Therefore the meeting was not held.

An effort was made to organize working groups in biological control of some insect and weed pests. A notice for this appeared in the IOBC Newsletter N° 10. I got some response but this was not enough to organize working groups. Moreover, the SEARS Newsletter could not be produced and the lack of communication between the members was a major hindrance in organizing any practical biological control programme.

As regards money matters I have very little to say. The SEARS suffered mainly because of paucity of funds. Dr Mori collected membership fees from the Japanese members and sent me US $101 from 1977 to 1979. To collect membership fees for SEARS through IOBC was not successful. Most of the money received was spent on stationery, postage, etc. The balance will be sent to the newly elected President of SEARS. It is suggested that the Regional contribution should be increased to make the SEARS more effective.

The ballot papers for election of officers of the Executive Committee of SEARS were sent to the members and the following have been elected unanimously :

President	Dr. T. SANKARAN Entomologist-in-Charge, Indian Station, CIBC, c/o Post Bag 2484, Habbel Agriculture Farm P.O., Bangalore 560024 (India)
Vice-Presidents	Dr. Ahmad YUNUS Director-General of Agriculture, Ministry of Agriculture, Jalan Swettenham, Kuala Lumpur (Malaysia)
	Dr. Banpot NAPOMPETH Director of the National Biological Control Research Centre, P.O. Box 9-52, Bangkok 9 (Thailand)

Establishment of New Regional Sections

The Secretary-General reported as follows on the developments which occurred during the period under review :

During the period extending from 1971-1975, considerable efforts have been made for the establishment of new regional sections, notably in the East Palaearctic, South-Pacific and Tropical African regions. Thanks to these efforts, it proved possible to establish the East Palaearctic Regional Section in 1977. Its President is Dr Fadev from the Academy of Agricultural Sciences in Moscow, and Dr Lebedev, Ministry of Agriculture in Moscow, is Secretary-General. There are 10 institutional members representing 7 COMECON countries.

For the establishment of the two other sections, more efforts are still needed. It seems that in Tropical Africa there is some interest on the part of the Inter-African Phytosanitary Council, which has approached its members. Another possibility could be offered in East Africa with the assistance of the Commonwealth Institute for Biological Control.

IOBC Global Working Groups

Information on developments were presented by the Secretary-General.

1. Existing Groups

1.1 As mentioned in the General Report, the International Working Group on Ostrinia (IWGO) has been placed under the sponsorship of IOBC. This dynamic worldwide group which links researchers from 15 countries has the following objectives :

i) To exchange inbred maize lines to test their response to *Ostrinia nubilalis* and other maize insects (frit fly in Europe ; corn root worm in North America) and *Helminthosporium* spp.

ii) To select resistant inbreds with local adaptability and to produce hybrids and/or sychetic families which are resistant to pests and have good local adaptability.

The next meeting of the Group is to be held in Vienna from 22-25 September, 1980.

1.2 The Working Group on Bruchids mentioned earlier in the General Report is meeting in Paris from 16-17 February, 1981.

2. Planned Groups

2.1 Working Group on Integrated Control in Vector Control of Human Diseases

Contacts have been taken with WHO and the Pasteur Institute in Paris to set up this Group (convener could be Dr de Barjac, Pasteur Institute, Paris).

2.2 Working Group on Quality Control

There is considerable interest in the establishment of such a body at the global level. Contacts to this end have been taken between Dr Boller, convener of the WPRS Working Party on fruit flies, and Dr Chambers (USDA).

Proposals for IOBC Meetings in 1982

1. Antibes (France), April 1982

Dr Jourdheuil, Director of the Institute of Zoology and Biological Control, of the National Institute of Agricultural Research (Antibes) has the honour to invite researchers of different countries who are interested in the problems of *Trichogramma* to attend a meeting which will be held in spring 1982 in Antibes or in Nice. At the occasion of this meeting, a working group will be formed on these beneficial insects to increase the development and application of biological control in this field.

2. Prague (Czechoslovakia), April 1982. IOBC/FAO Second Symposium on Ecology of Aphidophagous Insects and Pathogenic Fungi

This meeting will be organized following the above Colloquium.

2. Report on the IOBC Bellagio Meeting on « Future of Integrated Pest Management » (IPM), Bellagio (IT), 30 May - 4 June, 1980

by G. MATHYS, Paris (FR)

IOBC called on 14[1] highly experienced scientists from various parts of the world to review the current situation in IPM, to identify the continuing constraints to its general acceptance in agricultural practice, and to study ways of resolving them.

Four days were devoted to these studies and each of the 14 participants was invited to prepare a paper as background material. The following subjects were covered :

- Review of the current status of IPM : in the United States, Europe and Developing Countries ;
- Current status of IPM in phytopathology ;
- Cost/benefit analyses in IPM ;
- Study of various constraints slowing down the introduction of IPM : technical, organizational, economic, social, industrial, case studies in pigeon peas and on the perception of the environment with special reference to pest control.

The Proceedings of the meeting have been published.

1. Current status of IPM

1.1. United States

Currently, IPM has been successfully tried out in cotton, alfalfa, soybean, apples, sorghum and corn. Millions of acres of cotton and sorghum are produced under some form of IPM.

1.2. Europe

Concerted studies on IPM have been promoted since 1956 by IOBC. This research has gradually expanded to include all major crops but true IPM systems are really operational in orchards and for glasshouse crops. For other crops these developments have led to a kind of supervised control with

1) See appended list of participants.

more precise and less prodigal systems of pesticide use. However, calendar spraying still tends to dominate.

1.3. Developing World

In Latin American countries such as Colombia, El Salvador, Guatemala and Nicaragua considerable successes have been obtained in cotton. IPM cotton and maize programmes are in operation in Egypt, whereas integrated control in rice has been introduced in India and Thailand. In Malaysia, rice, cocoa and oilpalm crops are considered and special mention must be made of the very extensive application of techniques of the IPM type on various crops in China.

2. Prospects

The best results have been obtained in areas where growers have organized themselves over relatively large areas for the purpose of controlling a specific pest or complex of pests. Firstly there must be a perceived need for an IPM which should provide the farmers with a more profitable or convenient alternative to their current system. This need may be created by pest-inflicted crop failure or by extension workers who can demonstrate a better system.

3. Research and Development Opportunities

3.1. Technical

Crop loss assessment as the first essential step needs to be further developed : it is a key element for the establishment of economic thresholds and accordingly for improving forecasting systems.

There is an urgent need for the development of simple, but reliable sampling techniques. Furthermore, the overall significance of natural enemies has still not been fully appreciated. Increased research efforts are needed on the ecology of pests and their natural enemies, and on the plant/pest interactions. It appears also that current application techniques of pesticides are very deficient both with regard to the unnecessarily large amounts of active ingredients used and with regard to selectivity. The development of more selective pesticides is however hampered by commercial constraints.

Cultural practices are the key components in creating overall crop conditions favourable or unfavourable to the development of pests. However, modern cropping systems often themselves create an increased need for highly effective crop protection and it will be difficult to change this trend, except through overall crop production management based on transsectorial research.

The introduction of biological control in the form of artificial dissemination of parasites, predators and entomopathogens is delayed in particular by a lack of appropriate techniques and release systems. Quality control and regulatory problems require further research developments.

3.2. Organizational

Three of the greatest constraints to agricultural research and development are :

3.2.1. Inadequate coordination between various governmental and institutional entities involved in IPM activities.

3.2.2. Scarcity of funds for IPM research and extension activities.

3.2.3. Instability in administration and lack of continuity of funding of IPM programmes at the field level.

3.3. Educational

Continuing training and development programmes at all levels are needed for the successful implementation of IPM.

Guidelines and manuals for IPM should be prepared for individual crops and cropping systems to assist agricultural research and extension services.

3.4. Industrial

IPM is not currently seen to offer sufficiently attractive investment opportunities to persuade the agrochemical industry to make major changes in its approach to crop protection. As mentioned earlier, the commercial introduction of selective chemicals for limited use is generally unprofitable owing to high development costs.

3.5. Economic

A detailed study of the impact of currently available pest control techniques is essential in order to better define the economic advantages likely to be derived from IPM. A stronger participation of agricultural economists is needed in IPM programmes.

3.6. Sociological

Even without resistant pests, it is possible that a combination of social and political circumstances acting together could greatly assist the adoption of IPM, e.g. the commitment of governmental extension agencies to the goal of supervising pesticide usage, the relaxation of cosmetic quality standards on fruit and vegetable crops.

4. Conclusions of the Conference

Sufficient progress has been made in the past 25 years towards IPM to demonstrate clearly the great potential of this approach to crop protection.

This meeting reviewed the current status of IPM, examined the obstacles impeding its progress and studied ways of removing them.

A major collaborative effort is now needed to initiate, develop and implement IPM systems for the world's crops.

Appendix : List of Participants

ADKISSON, P.L.	Texas A & M University, *College Station*, Texas 77840 (USA)
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LIM, Guan-Soon	Crop Protection Research Branch, MARDI, P.O. Box 202, Agriculture University, Post Office, *Serdang, Selangor* (Malaysia)
MATHYS, G.	Secretary-General IOBC, 1 rue Le Nôtre, *75016 Paris* (France)

REED, W.	ICRISAT, 1-11-256 Begumpet, *Hyderabad-500 016*, A.P. (India)
SMITH, F. Ray	UC/AID/PM Project Director, University of California, 2288 Fulton Street, Suite 310, *Berkeley*, Calif. 94704 (USA)
TAIT, Joyce	47, Hurst Park Avenue, Cambridge (United Kingdom)
TIETZ, H.	BAYER AG, Sparte Pflanzenschutz, Biologische Forschung, *D-5090 Leverkusen, Bayewerk* (Fed. Rep. of Germany)
WILDE, J. DE	Laboratory of Entomology, Agricultural University, P.O. Box 8031, *6700 EH Wageningen* (Netherlands)
WOOD, R.K.S.	Imperial College of Science and Technology, Department of Botany, Prince Consort Road, *London SW7 2BB* (United Kingdom).

3. IOBC Global Working Groups

International Working Group on Ostrinia nubilalis

President	: Dr H.C. Chiang, S^t Paul, Minnesota, USA
Coordinator (1980/82)	: H.K. Berger, Bundesanstalt für Pflanzenschutz, Vienna, Austria.

This Group met in Vienna from 22-26 September, 1980. Eleven Member Countries were represented: Austria, Bulgaria, Canada, France, Hungary, Italy, Poland, Romania, Spain, USA and Yugoslavia. Guest members from the People's Republic of China and Federal Republic of Germany also attended.

The *Ostrinia nubilalis* situation in individual countries and results obtained with inbred lines for corn borer resistance were reviewed and a new programme for 1981-82 established. It was decided to prepare a catalogue on all lines tested since 1969. This informative publication will be useful to maize breeders the world over.

IWGO issued its first Newsletter in December 1980; it is planned to have biannual issues.

IOBC Working Group on Bruchids; Meeting of 12.2. 1981 in Paris

by G. MATHYS, Paris (FR)

The decision to establish an IOBC Working Group on Bruchids was taken on the occasion of the IOBC-sponsored International Symposium on the Ecology of Bruchids attacking Legumes, which was organized by the University of Tours (16-19 April, 1980) with the collaboration of FAO.

The Working Group met for the first time on 12.2.81 at EPPO Headquarters in Paris. Its 9 members[1] include 3 systematicians and 1 physiologist and represent Africa, Asia, Europe and the United States. They studied the way of bridging various gaps in the knowledge of bruchids and proposed the following action programme:

1. Establishment of Distribution Map of Bruchid Species throughout the World

Entomologists and biochemists working on bruchids are to be invited to send collected species for identificatin to[2]:

- Dr C.D. Johnson, Northern Arizona University, Flagstaff, USA
  for material collected on the American continent
- Dr B.J. Southgate, Slough Laboratory, Slough, UK
  for material from Asia and Oceania
- Dr J. Decelle, Royal Museum of Central Africa, Tervuren, Belgium
  for material from Europe, the Mediterranean Basin and Africa.

Assistance is also requested from botanists working with bruchids; all requests for identification of legumes should be sent to the Royal Botanical Gardens Richmond, Kew, Surrey TW9 3AE (UK).

Dr Bell, King's College, London (UK) is preparing a list of legume species whose parts and seeds were or are eaten by man.

2. Collection of Fundamental Data on 7 Major Bruchid Pests and the Mediterranean Bruchids

Species	*Centralization of data*
Acanthoscelides obtectus Say	Dr V. Labeyrie, IBEAS, Université François-Rabelais, Tours (France)
Callosobruchus maculatus F.	Dr B.J. Southgate, Slough Laboratory, Slough (UK)
C. chinensis L.	Dr H.R. Pajni, Dept of Zoology, Panjao Univ., Chandigarh (India)
C. analis F.	Dr H.R. Pajni, Dept of Zoology, Panjao Univ., Chandigarh (India)
Caryedon serratus 0l.	Dr J. Huignard, IBEAS, Université François-Rabelais, Tours (France)
Bruchidius atrolineatus Pic	Mr I. Azouma, Biological Laboratory, University of Niger, Niamey (Niger)
Zabrotes subfasciatus	Mr M. Pimbert, IBEAS, Université François-Rabelais, Tours (France)
Mediterranean Bruchids	
Bruchus spp. and *Bruchidius* spp.	Dr P. Genduso, Istituto di Entomologia Agraria, Facoltá di Agraria, Palermo (Italy).

3. Specific Studies on Bruchids

Pests of pulses which play key roles in certain areas

Pulses concerned: *Psophocarpus* spp. (S.E. Asia), *Cajanus cajan*, *Cordeausia edulis*, *Lupinus* (Europe, S. America, in part Bolivia, Mediterranean Basin), *Leucaena* spp., *Tylosema fassoglense*.

4. Field Project on Bruchids Attacking Pulses in Morocco

Programme to be prepared by June 1981 by Dr Decelle (BE) and Prof. Labeyrie.

Working Group on Quality Control

The newly established global Working Group on Quality Control is placed under the co-direction of D.L. Chambers, USDA Agric. Research Southern Region, 1700 SW 23rd Drive, P.O.B. 14565, Gainesville, Florida 32604, USA and E.F. Boller, Federal Agricultural Research Station, Wädenswil (Switzerland); its working structures are currently set up. The fruit fly unit has initiated a survey among fruit fly

[1] Chairman: Prof. V. Labeyrie, IBEAS, Université François-Rabelais, Tours (France).

[2] Information to be supplied by collectors can be obtained from Prof. Labeyrie.

specialists throughout the world in order to identify priorities and research needs. A concrete action programme based on qualified research laboratories and cooperative agreements between the research leaders concerned will be established in short.

In the meantime, quality profiling on *Ceratitis capitata* is carried out at Wädenswil (Switzerland), Madrid, Izmir, Mexico and Hawaii. The selection of high performance strains of *Ceratitis capitata* and *Anastrepha suspensa* has been continued and has reached an advanced stage at Wädenswil and Gainesville (Florida), respectively.

With respect to lepidopteran parasites and predators, D.L. Chambers and E.F. Boller are preparing a survey of researchers likely to contribute in this field. Any interested researcher should contact one of the Working Group leaders. The objective is to find suitable research coordinators to initiate future programmes that should evolve from existing working bodies and lead to worldwide collaborative action. As soon as good working relations between the scientists concerned have been established, it is planned to incorporate these specialized units into the global Working Group. An example of that nature is a working unit in Europe handling urgent *Trichogramma* problems. F. Bigler of the Swiss Federal Research Station, Reckenholz/Zürich coordinates the work on quality control of *Trichogramma* in Switzerland, Germany and France. He is in charge of compiling existing literature and establishing research projects in close cooperation with E.F. Boller. Similar approaches are envisaged in the United States on predatory mites and lepidopteran pests.

4. IOBC/WPRS Activities

IOBC/WPRS Working Group on Integrated Control in Orchards; Third Meeting of the Commission for Evaluation of Integrated Production, Aix-en-Provence, 23-24 August, 1979. Methods for assessing the intrinsic quality of fruits. IOBC/WPRS Bulletin (1980) III (2), 99pp (in French)

This meeting was attended by 28 participants from France, Switzerland, Italy and the Federal Republic of Germany. The minutes of the meeting are given on pages 9-31, and are summarised below:

1. Objective methods for assessing intrinsic quality: summary of studies in different countries

1.1. France: S. Aubert (INRA), p 10
1.2. France: C. Fady (CTGREF), p 12
1.3. Italy: F. Gorini (IVTPA), p 12
1.4. Switzerland: J. Aerny & A. Schwarz, J.P. Ryser (SFRA, Changins), p 14
1.5. Switzerland: K. Stoll (SFRA, Wädenswil), p 14
1.6. Conclusions and discussion: J. Thiault (CTGREF), pp 17-18.

Assessment of fruit quality should be made in three stages:

a) Inspection of the Orchard

Two things in particular should be noted.

- *The distribution and yield of the crop* which should be evenly distributed throughout the tree and in balance with the foliage surface area.
- *The length of the shoots* may indicate too much vegetative growth, with insufficient yield which leads to a potassium/calcium imbalance and subsequent storage problems.

b) Inspection of the Fruits

Visual external criteria such as colour, diameter, shape, state of lenticel development, may be used only to compare fruit from the same orchard and thus to assess homogeneity of the crop.

c) Checking Quality by Objective Tests

Sugar content, measured by refractometry, is a simple and reliable parameter for assessing the quality of a homogeneous sample of fruit. This may be complemented by assessing *acidity* which gives information not only on flavour but also on storage properties.

2. Methods of tasting, pp 18-24

2.1. Tasting sessions are of two types: either for research purposes to study correlations with measurable criteria, or simply to confirm that the flavour is acceptable to the consumer. Problems may arise in choosing the tasters, whether to ask them questions on specific characteristics or only their general comments, and in selecting the sample for tasting as well as the method of statistical evaluation to use when analysing the results. For research purposes, the tasting panel should be experienced and well informed of the problems studied and should be checked to ensure that they can clearly distinguish the basic flavours. On the other hand, for consumer tests, the tasters should be randomly selected and asked only for their general opinion. No more than 6 to 7 batches of fruit should be offered at each tasting session. Tasters are asked to rank samples or to classify them according to criteria laid down beforehand. Friedman's test is used to statistically evaluate the results.

2.2. Problems of sampling. The value of any tests for flavour and quality depends on obtaining a representative sample. The various approaches to sampling used in France, Switzerland and Italy are described and discussed.

3. Arrangements for the use in practice of the label of the International Committee (in France and French part of Switzerland), pp 25-29

The label is intended as a double guarantee to the consumer: firstly that the fruit has been produced according to certain environmental and ecological criteria and secondly that it has a satisfactory flavour and nutritional value, without being a *de luxe* product.

4. Miscellaneous

4.1. Experiments and research in the application of integrated techniques, p 29

W. Pfammater gave a brief account of the « Domaines techniques intégrés » (DTI) in Switzerland. A long-term collaborative study had been initiated by a number of Swiss research stations in 1976 to determine the best combination of cultural techniques, fertilisation and crop protection to optimise yield quantity and quality. Nineteen plots of different varieties, etc., were being assessed three times annually, and the results are appended to the report.

4.2. Definition of integrated production, p 31

Two definitions, one a shortened version, are given.

4.3. Meetings in 1980, p 31

Three are listed: a meeting of the International Committee in February, a Colloquium on Integrated Production in May-June, and a meeting on « Nutrition of Fruit Trees and Integrated Production » in September.

Appendices

The following papers are appended to the meeting minutes :

1. Rules of the International Committee on the use of an information label « Integrated production in arboriculture », pp 33-39.
2. Improvement and certification of quality (Table 1), p 40.
3. Integrated fruit production (Table 3), p 41.
4. Studies on the flavour of different varieties of peaches in France, pp 42-47.
5. Chemical analysis and taste of Golden Delicious apples, pp 48-56.
6. Mineral analyses of soil, leaves and fruits, pp 57-59.
7. Principles of tasting and classification of samples, pp 60-62.
8. Protocol for fruit and vegetable tasting, pp 63-69.
9. Three forms for recording the results of tasting (CTGREF), pp 70-72.
10. Technique for organoleptic tests, pp 73-75.
11. Sampling and methods of inspection, pp 76-79.
12. Sampling in the fields of integrated techniques, pp 80-81.
13. IOBC/GALTI form on inspection of quality in the orchard, pp 82-83.
14. French National Committee form to assess integrated production, p 84.
15. Pesticides recommended in directed control, p 85.
16. Organisation of inspections for the IOBC label, p 86.
17. Conditions to be fulfilled for use of the IOBC label, pp 87-93.
18. GALTI model labels, p 94.
19. Organisation of the « Domaines Techniques Intégrés » (DTI), « Arboriculture », p 95.

20.}
21.} Graphical representation of DTI results, pp 96-98.
22.}

23. Some bibliographic references, p 99.

IOBC/WPRS Working Group on Integrated Control in Glasshouses. Report of the fourth meeting held from 12-15 June, 1979, at the Agricultural Research Centre, Vantaa, Finland. IOBC/WPRS Bulletin (1980) III (3), 257 pp (in English unless otherwise indicated)

Following an introduction by M. Markkula, there are some 35 papers relating mainly to biological control. Brief summaries are given below :

O. Berendt (SE) : Trend of biological control in glasshouses in Sweden and Denmark, pp 11-16

The history of biological control in Sweden and Denmark is described, with emphasis on *Phytoseiulus persimilis* to control two-spotted spider mite in cucumbers and *Encarsia formosa* for whitefly control in tomato crops. The factors limiting biological control are discussed.

M.J. Berlinger (IS) : Resistance in tomato to the greenhouse whitefly in relation to integrated control in glasshouses, pp 17-24

The problems inherent in identifying and breeding for resistance to insects and mites are discussed. The variety need not be immune, but should prevent the insect population from reaching the economic threshold. *Lycopersicon hirsutum glabratum* and *Solanum pennellii* were shown to be promising sources of resistance to *Trialeurodes vaporariorum*.

B.S. Ekbom (SE) : Some aspects of the population dynamics of Trialeurodes vaporariorum and Encarsia formosa and their importance for biological control, pp 25-34

The spatial distribution of the whitefly and its parasite is such that a different approach to monitoring is needed ; the use of a trap is suggested. Because of problems associated with the use of *E. formosa*, alternative or complementary agents are proposed, including *Verticillium lecanii* and *Anthocoris* spp.

A. Forsberg (FI) : Possibilities of using the diapause of Aphidoletes aphidimyza (Diptera : Cecidomyiidae) in its mass production, pp 35-40

The predatory mite *A. aphidimyza* has proved to be efficient in biological control of aphids in glasshouse vegetable crops. The purpose of the preliminary studies was to find a means of causing the midge to enter diapause irrespective of the time of year, to maintain diapause and to terminate it : a short photoperiod and low temperature favour diapause. Further studies are needed on the conditions in which diapausing larvae can be stored.

G.N. Foster (GB) : Biological control of whitefly - initial pest density as the most important factor governing success, pp 41-44

Analysis of data from 33 tomato crops in Scotland showed that introduction of *Encarsia formosa* at 30,000 parasitised scales per hectare was successful in controlling greenhouse whitefly when the initial density of the pest did not exceed 0.1 adults per upper leaf, but such introductions had a high risk of failure at higher pest densities.

G.N. Foster (GB) : Possibilities for the control of tomato moth (Lacanobia oleracea), pp 45-52

Tomato moth is now the second commonest pest of glasshouse tomatoes in Scotland. The main possibilities for integrating the control of this pest with biological control of other pests are reviewed.

H.J. Gould (GB) : The development of biological control of whitefly and red spider mite on tomatoes and cucumbers in England and Wales, pp 53-58

During 1978, it was estimated that biological control of *Tetranychus urticae* was in use on 72 % of the cucumber crop while biological control of whitefly was being used on more than 30 % of the tomato crop. In all years, results were generally considered to be satisfactory, but complete failures sometimes occurred, thus necessitating selective spraying.

M. Hamalainen (FI) : Evaluation of two native coccinellids for aphid control in glasshouses, pp 59-64

Adalia bipunctata larvae were more effective than *Coccinella septempunctata* in controlling *Myzus persicae* on green peppers ; the converse was found on chrysanthemum. Neither coccinellid species was effective in controlling *Macrosiphum rosae* on roses. Mass production and handling of *A. bipunctata* are easier but neither of the two species can be recommended for use in practice because large numbers would have to be introduced at short intervals - an uneconomic proposition.

R.A. Hamlen (USA) : Report of Phytoseiulus macropilis management of Tetranychus urticae on greenhouse grown dieffenbachia, pp 65-74

These studies clearly demonstrate the potential of *P. macropilis* in preventing economic damage caused by *T. urticae* to dieffenbachia, an ornamental tropical foliage plant. Results indicated the importance of having effective numbers of *P. macropilis* present at relatively low densities of *T. urticae* in order to achieve population suppression before loss of aesthetic or marketable value.

J. Havelka (CZ) : Some aspects of photoperiodism of the aphidophagous gallmidge Aphidoletes aphidimyza, pp 75-82

Photoperiod (short day, 6 h ; low temperature, 15°C) is a major factor in induction of diapause in the larvae of this gallmidge. There is evidence that photoperiod, as well as low temperature, plays a role in reactivation of diapausing larvae. Short- and long-term storage of the latter were investigated.

A. Hendrikse, R. Zucchi, J.C. van Lenteren & J. Woets (NL) : Dacnusa sibirica and Opius pallipes (Hym., Braconidae) in the control of the tomato leafminer, Liriomyza bryoniae, pp 83-98

O. pallipes and *D. sibirica* are promising candidates for biological control of *L. bryoniae* in Dutch glasshouses. *O. pallipes* seems to be more efficient in finding plants with hosts. Both species are equally efficient in locating a host in a leaf and both are able to distinguish between parasitised and unparasitised hosts and avoid laying eggs in parasitised larvae. They do not select larvae of a special stage for oviposition, but *O. pallipes* is less efficient in parasitising medium- to large sized larvae. *D. sibirica* would appear to offer better prospects.

K. Kariluoto (FI) : Developing artificial diets for Adalia bipunctata and Coccinella septempunctata, pp 99-100

An artificial diet (Ad) containing 1250 ppm sorbic acid and 750 ppm nipagin was compared with the natural prey, *Myzus persicae*. Although development, mortality, fecundity and survival were poorer on Ad, it was possible to rear *A. bipunctata* for 3 to 4 generations on this diet.

T. Kowalska, K. Szczepanska & A. Bartkowiak (PL) : Studies on pesticides effect on Trialeurodes vaporariorum and its parasite Encarsia formosa, pp 101-112

Although none of the 15 insecticides tested from 1976-77 was completely selective, isathrine (bioresmethrin) offered the best possibility for integrated control. But because of its relative toxicity to *E. formosa*, this insecticide should only be applied before parasite introductions are made.

M. Ledieu (GB) : Problems of controlling minor pests in integrated control programmes, pp 113-118

The problems associated with incorporating biological control into fully integrated pest and disease programmes can be separated into several categories and stem mainly from a lack of communication between scientists, advisers and growers. The main problems are posed by the changing pesticide situation, ignorance of detailed biology of both pests and natural enemies, and changes in methods of crop culture.

R.K. Lindquist, C. Frost & M. Wolgamott (USA) : Integrated control of insects and mites on Ohio greenhouse crops, pp 119-126

Results are summarised of a program to develop integrated management procedures for *Trialeurodes vaporariorum*, *Tetranychus urticae* and *Liriomyza* spp. in tomato, cucumber, poinsettia, carnation, rose and various foliage plants. Efforts are underway to collect parasite species that may be useful in managing leafminer populations.

M. Markkula & K. Tiittanen (FI) : Biological control of pests in glasshouses in Finland - the situation today and in the future, pp 127-134

Biological control of whitefly, two-spotted spider mite and aphids by *E. formosa*, *Phytoseiulus* spp. and *Aphidoletes aphidimyza* in Finland is reviewed and future prospects are considered. The main emphasis of research at present is on mass production and use of *A. aphidimyza*.

R.J. McClanahan (CA) : Biological control of Liriomyza sativae on greenhouse tomatoes, pp 135-140

Ongoing work on the biology of the vegetable leafminer, *L. sativae*, and of 5 leafminer parasites is described. Preliminary glasshouse biological control tests with *Opius dimidiatus* and *Diglyphus begini* resulted in low levels of parasitism. Commercial glasshouse trials have not been very satisfactory to date.

R.J. McClanahan (CA) : Why has integrated control practice in the greenhouse levelled off in Canada ? pp 141-144

This presentation discusses the Canadian situation, with particular emphasis on the Essex County (southwestern Ontario) greenhouse crops of cucumber, tomato and chrysanthemums, and covers *Encarsia formosa*, *Phytoseiulus persimilis* and leafminer parasites.

B. Nedstam (SE) : Control of whitefly (Trialeurodes vaporariorum) in cucumber with the parasite Encarsia formosa. Experiences from some glasshouses in Sweden, pp 145-154

A modified method of introducing biological control is described : introductions are made at fortnightly intervals, there is one site of introduction per 250 m^2 glasshouse area (300-400 plants). *Nicotiana* leaves are used, the numbers of black and unparasitised scales per m^2 being 1 and 0.05 respectively each time, and introductions are continued for 4 to 5 months (about 10 introductions). Using this method, it seems possible to suppress whitefly on cucumber by *E. formosa* for several months.

J. C. Onillon, J. Onillon, J.P. di Pietro & E. Franco (FR) : On the biological control of glasshouse whitefly (Trialeurodes vaporariorum) by Encarsia formosa in aubergine glasshouse crops, pp 155-156 (in French)

Young aubergine plants were artificially infested with 16, 8, 4 or 1 whitefly adults per plant. With 16 adults/plant and a release 3-4 weeks later of an equivalent ratio of *E. formosa* adults, control of whitefly was obtained for the duration of the crop. At the lower infestation rates, control was obtained with parasite releases in the ratio 3:1 - the rate of parasitism was about 85 % and no damage was observed.

M. Pralavorio & L. Almaguel-Rojas (FR): Effect of temperature and relative humidity on development and reproduction of Phytoseiulus persimilis, pp 157-162 (in French)

At 93 % RH, hatching was around 90 % at temperatures between 10-30°C ; at 5°C, hatching did not occur. At 75 % RH, a large number of individuals stopped developing at the protonymph stage, while at 50 % RH, there was no development. The mean number of eggs laid per female, and adult longevity were reduced by more than half when, at constant temperature, the humidity was dropped from 93 % to 50 %.

S. Pruszynski (PL): Influence of some factors on the fecundity of Phytoseiulus persimilis females, pp 163-174

The following factors were shown to promote high fecundity in *P. persimilis* females : temperature range 25-30°C, RH over 70 %, excess of food and the presence of all developmental stages of spider mite, presence of males, and hybridisation occasionally of reared populations with wild-caught individuals or other colonies.

J.M. Rabasse (FR): Settling of Aphidius matricariae in populations of Myzus persicae in glasshouse grown aubergines, pp 175-186 (in French with English summary)

A. matricariae was shown to be an effective biocontrol agent but its use in practice is limited by the fact that it only parasitises one *(M. persicae)* of the four aphids attacking glasshouse aubergines. Studies on the population of the parasite and its host are reported.

J.M. Rabasse (FR): Aphid population dynamics on glasshouse grown aubergines. 1. General observations on the colonisation and population growth of 4 species in the South of France, pp 187-198 (in French with English summary)

A detailed two-year study of the spatial and temporal changes in populations of *Myzus persicae, Macrosiphum euphorbiae, Aulacorthum solani* and *Aphis gossypii* on aubergine is described. Aphid populations developed from one focus, leading to a clustered distribution. Population growth was exponential for a long period, and could be forecasted.

P. Raiskinmaki (FI): Practical experiences of biological control in commercial glasshouse cultures, pp 199-202

Glasshouse crops in southern Ostrobothnia cover some 100 ha, and produce about 58 % of the tomato and 42 % of the cucumber crops in the country. Since biological control of whitefly and two-spotted spider mite was begun, thrips, noctuids and woodlice have become more abundant : these latter are difficult to control chemically if biological control is being used. Poor light conditions are a limiting factor for biocontrol in the area.

P.M.J. Ramakers (NL): Biological control of Thrips tabaci (Thysanoptera : Thripidae) with Amblyseius spp. (Acari : Phytoseiidae), pp. 203-208

More than 50 % of the cucumber growers and about 20 % of the sweet pepper growers in the Netherlands use *Phytoseiulus persimilis* to control *Tetranychus urticae*. Chemical control of *Thrips tabaci* often disturbs the balance between phytophagous and predatory mites. A study of the natural enemies of *T. tabaci* was started in 1975 ; this paper deals with the first trial to use native Phytoseiids (*Amblyseius* spp.) for the control of this pest.

M. Rimpilainen (FI): Developing a mass-production method of Aphidoletes aphidimyza suitable for commercial production, pp 209-212

A plan for mass production in glasshouses is outlined : *Capsicum* peppers are grown in the first glasshouse, *Myzus persicae* fed on these plants in a second, and *A. aphidimyza* reared in a third on aphid-infested plants planted at 6 per m². These plants are changed every 3-4 weeks (generation time of the midge). The glasshouse should be shaded, the RH high, the temperature of the air about 20°C and that of the pupating substrate (fine peat) above 10°C. With this method, an area of 5-10 m² yields thousands of pupae per day.

F. Rodolphe, J.C. Onillon, El Shishiny, C. Milier & Hennequin (FR): Intervention strategy in integrated control of glasshouse whitefly : development of a decision model, pp 213-214 (in French)

A simulation model of whitefly populations incorporating data from the field on development of *T. vaporariorum* and data on insecticide usage is described. It facilitates optimising the dose rate and timing of pesticide treatment to minimise appearance of last stage larvae with the consequence that *E. formosa* biocontrol can subsequently be used.

Z. Ruzicka (CZ): Regulation of the reproductive activity after hibernation in Coccinella septempunctata by photoperiod, pp 215-220

Observations were made on the effects of long and short days on oviposition pattern, fecundity, egg hatching and longevity of females. Under both conditions, the population may be arbitrarily split into two groups : those more or less continuously ovipositing and those showing an arrest of oviposition for 42-50 days, effectively a second diapause.

C. Stenseth (NO): Methods for using Phytoseiulus persimilis for control of Tetranychus urticae on cucumber, pp 221-224

The safest practical way of using *P. persimilis* is by uniform introduction, but a successful interaction of prey and predator can be obtained with « pest in first » (predator introduced 9 days later) or with simultaneous introduction of prey and predator.

C. Stenseth (NO): Some aspects of the use of Phytoseiulus persimilis, pp 225-226

The results in practice of using *P. persimilis* to control *Tetranychus urticae* in Norway in 1976 are tabulated. Good to satisfactory control was obtained in most cases. Previous use of chemical control and adverse climatic factors help explain why control had failed in certain glasshouses ; early introduction of the predator is the key factor in good biocontrol.

U. Tulisalo (FI): Rearing Chrysopa carnea in mixed population with Sitotroga cerealella, pp 227-230

Sitotroga adults were introduced into a rearing cabinet containing 10 kg barley ; when the population had increased sufficiently, *Chrysopa* eggs were added (25,000). After about 16 days, the first *Chrysopa* adults hatch and can be collected : about 3700 adults are produced in one rearing cycle (i.e. about 10 % of the adults' total egg production had to be used to reproduce the new generation). A new batch of *Chrysopa* eggs can be introduced into the cabinet within 3-6 days.

J. Uoti (FI): The role of pesticide producer in biological control, pp 231-234

Because adverse climatic conditions reduce insect and disease problems in Finland, pesticide usage is limited, and there is only one pesticide firm, Kemira. This firm now produces the following biocontrol products: *Phytoseiulus persimilis, Encarsia formosa, Aphidoletes aphidimyza*, a polyhedrosis virus to control pine sawfly and, more recently, *Phlebia gigantea* for control of *Fomes annosus* in spruce forests. Production costs for these products are barely covered by sales.

R.E. Webb & F.F. Smith (USA): Greenhouse whitefly control of an integrated regimen based on adult trapping and nymphal parasitism, pp 235-246

Sticky yellow boards were used in trapping tests against greenhouse whitefly adults. In one test, it took only 10 days to trap out a newly established infestation, although continual reinfestation from outside prevented complete elimination. Meanwhile, *Encarsia formosa* populations built up on the progeny of the trapped out whitefly adults despite the presence of the yellow board traps. Such trapping is therefore compatible with the use of this parasite in an integrated control regimen.

J. Woets, P.M.J. Ramakers & J.C. van Lenteren (NL): Press report on development and application of integrated pest control in glasshouses in the Netherlands with an indication about limiting factors, pp 247-257

Progress on the following projects is reported:

1. *Trialeurodes vaporariorum*
1.1 Development of biological control in cucumber
1.2 Development of biological control in gerbera
1.3 Searching for new parasites or other *Encarsia* strains that might effectively parasitise at low glasshouse temperatures.
2. *Liriomyza bryoniae*
3. *Myzus persicae*
4. *Thrips tabaci*

(2–4: Development of biological control)

The future outlook is discussed.

5. Proceedings Available

Proceedings of the IOBC/WPRS Symposium on Integrated Control in Agriculture and Forestry, Vienna, 8-12 October, 1979, 647 pp (issued in 1980). Unique source of information in all disciplines of IPC research and implementation in Europe and the Mediterranean Basin.

To be ordered at Bundesanstalt für Pflanzenschutz, Trunnerstrasse 5, Postfach 154, AT-1021 Vienna 2, Austria (Prof. K. Russ). Price: US $ 50 or 80 Swiss francs.

6. Announcement

Joint IOBC/IRCT Colloquium with the Collaboration of FAO on Crop-loss Asessment, Economic Thresholds and Forecasting in Cotton, Rice and Maize, FAO Headquarters, 15-18 December, 1981

Purpose of the meeting:

1. Comparison of methods used for:
   - crop loss assessment due to pests *s.l.* in cotton, rice and maize;
   - establishment of economic thresholds;
   - forecasting.
2. Standardization of methods.

7. WHO Activities

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.

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

- *Hertlein, B.C., Hornby, J., Levy, R. & Miller, T.W., Jr (1980). Shelf-life of larvicidal preparations based on the strain 1593 of Bacillus sphaericus.* Doc. No. WHO/VBC/80.790, 3 pp, English only.

Data from bioassays on reconstituted *B. sphaericus* 1593 preparations (an industrial experimental water-dispersible powder and a concentrated fermenter culture) stored over prolonged periods of time indicated that the aqueous suspension of 1593 is relatively stable and suggested that preparations could be formulated several days or possibly even weeks before use.

- *Bourgouin, C. & Barjac, H. de (1980). Evaluation of the mosquito larvicidal potential of Bacillus sphaericus.* Doc. No. WHO/VBC/80.792, 24pp, French only.

A bioassay using *Anopheles stephensi* to assess preparations of *B. sphaericus* is described. In a series of tests to compare the larvicidal activity of 21 strains of *B. sphaericus* against *Aedes aegypti* and of 9 strains against *An. stephensi*, strains 1593, 1881 and MR4 appeared the most active. The toxin is contained in the spores and not released into the culture medium. The relationship between the stage of growth and pathogenicity of 1593 is reported. The toxin is thermostable at 80°C for 12 minutes, but pathogenicity is reduced; similarly following UV irradiation at 24 ergs/mm^2/sec. Concentrated liquid suspensions of 1593 retain pathogenicity when stored at 4°C or −20°C. A comparative study of three *B. sphaericus*-based powder preparations (strains 1593 & 1881 laboratory cultures, and P-B 20-21 an industrial preparation of 1593) is then described.

- *Subramanian, J.K. & Jayaraman, K. (1980). Some preliminary observations on the formation of larvicidal factor(s) by Bacillus sphaericus strains active against the mosquitos of South India.* Doc. No. WHO/VBC/80.794, 6pp, English only.

Toxin(s) levels in cell-free extracts of *B. sphaericus* were maximal at the onset of the stationary phase of growth in culture. Toxin formation by strains 1593 and 1593M was reduced at growth temperatures over 30°C, but the toxin(s) was heat stable up to 80°C. The toxin(s) was (were) present in the insoluble fraction of cell extracts. In bioassays, activity was markedly increased at higher protein concentrations of the cell-free extract.

Data Sheets on Biological Control Agents issued by the WHO Division of Vector Biology and Control

The Data Sheets, each on a specific agent, give details under the following headings:

1. Identification and synonymy
2. Origin
3. Natural geographical distribution
4. Biological characteristics
5. Effectiveness against target organisms
6. Effectiveness against non-target organisms
7. Production and stability
8. Formulation and specifications
9. Bibliographic references.

a) Isomermis lairdi

Doc. No. WHO/VBC/80.785 ; VBC/BCDS/80.11, 5 pp, English only, July 1980

Isomermis lairdi is a nematode endoparasite of larval, pupal and adult stages of blackflies, especially *Simulium damnosum*. *In vivo* production is not yet possible as a host-rearing system has yet to be developed. It is feasible to rear *S. damnosum* from eggs to adults but it has not proved possible to complete the remaining part of the life cycle (mating, blood-sucking, oviposition) under laboratory conditions. At present, collection, maintenance and storage of free-living and egg stages of the nematode is the only method by which the nematodes can be accrued for use in field trials ; 13 references are listed, 1976-1980.

b) Romanomermis sp. (probably R. iyengari)

Doc. No. WHO/VBC/80.765 ; VBC/BCDS/80.08, 4 pp, English only, April 1980

Romanomermis iyengari is a mermithid nematode which was first isolated from *Anopheles subpictus* in Bangalore, India, and which appears to have a potential in tropical countries similar to that of *R. culicivorax* in temperate areas. Some vertebrate safety and host-range studies have been completed with encouraging results. *R. iyengari* can be mass produced easily under laboratory conditions ; it was possible to obtain 700,000 to 800,000 postparasitic female nemas per 10^6 *Cx. quinquefasciatus* larvae when using host densities of $2.8/cm^2$ surface area and preparasitic nemas at a parasite/host ratio of 10:1. No formulations to date ; 8 references, 1964-1979.

c) Romanomermis culicivorax

Doc. No. WHO/VBC/80.766 ; VBC/BCDS/80.09, 21 pp, English only, May 1980

Romanomermis culicivorax is an obligate endoparasitic nematode which parasitises mosquito larvae ; a total of 87 species have been infected with this nematode. It can be easily mass produced, is safe to non-target organisms, and its environmental limitations are well documented. This nematode should now be evaluated in large-scale field trials. There are no formulations to date ; 107 references are listed, 1967-1980.

d) Bacillus sphaericus, strain 1593

Doc. No. WHO/VBC/80.777 ; VBC/BCDS/80.10, 16 pp, English only, June 1980

Bacillus sphaericus is an ubiquitous aerobic spore-forming bacterium, pathogenic to mosquito larvae. *Culex* spp. are particularly susceptible, but there is great variation in species and genus susceptibility ; moreover, toxin production varies according to the fermentation media and conditions. The data sheet includes tabulated bibliographic summaries of reports on the laboratory and field evaluation of *B. sphaericus* 1593 cultures and primary powders. Although not commercially available yet, a number of small-scale formulations are currently under test ; 49 references are listed, 1963-1980.

List of other Documents on Biological Control Recently issued by WHO/VBC

- WHO/VBC/79.719. J. Dempah & J. Coz. Trials with *Bacillus thuringiensis israelensis* against mosquitos (in French).
- WHO/VBC/79.721. C. Dejoux. Preliminary results on the effects of *Bacillus thuringiensis israelensis* de Barjac on the invertebrate fauna of a river in the tropics (in French).
- Evaluation of *Bacillus thuringiensis israelensis* de Barjac for control of *Simulium damnosum s.l.* larvae (in French).
  - I) WHO/VBC/79.730. P. Guillet & H. Escaffre. I. Results of preliminary field trials.
  - II) WHO/VBC/79.735. P. Guillet & H. Escaffre. II. Comparative efficacy of three experimental formulations.
  - III) WHO/VBC/80.756. P. Guillet, J. Dempah & J. Coz. III. Preliminary data on sedimentation of the endotoxin in water and on its stability in tropical areas.
- WHO/VBC/79.731. H. de Barjac, I. Larget, V. Cosmao, L. Benichou & G. Viviani. Safety of *Bacillus sphaericus*, strain 1593, for mammals (in French).
- WHO/VBC/79.741. H. de Barjac. Note on the preparation of a reference formulation, IPS.78, for the bioassay of experimental and industrial formulations of *Bacillus thuringiensis* serotype H-14 (in French).
- WHO/VBC/79.742. G. Sinegre, B. Gaven & J.L. Jullien. Safety of *Bacillus thuringiensis* serotype H-14 for non-target fauna in mosquito breeding areas on the French Mediterranean coast (in French).
- WHO/VBC/79.743. G. Sinegre, B. Gaven, J.L. Jullien & O. Crespo. Activity of *Bacillus thuringiensis* serotype H-14 against the main anthropophilic mosquitos of the French Mediterranean coast (in French).
- WHO/VBC/79.744. H. de Barjac & I. Larget. Proposals for the adoption of a standardised bioassay method for the evaluation of insecticidal formulations derived from serotype H-14 of *Bacillus thuringiensis* (in English).
- WHO/VBC/79.745. G. Sinegre, B. Gaven & J.L. Jullien. Comparative bioassay of two experimental primary powders of *Bacillus thuringiensis* serotype H-14 and the reference formulation IPS.78 using larvae of *Cx. pipiens* and *Ae. caspius* (in French).
- WHO/VBC/79.747. G. Sinegre, G. Vigo, B. Gaven & J.L. Jullien. Immediate and residual larvicidal activity of the endotoxin of *Bacillus thuringiensis* serotype H-14 in two mosquito biotopes on the French Mediterranean coast - comparative efficacy of seven experimental formulations derived from the same primary powder (in French).
- WHO/VBC/80.761. H. de Barjac, I. Larget, L. Benichou, V. Cosmao, G. Viviani, H. Ripouteau & S. Papion. Safety tests on mammals with *Bacillus thuringiensis* serotype H-14 (in French).
- WHO/VBC/80.762. G. Sinegre, B. Gaven & G. Vigo. Preliminary evaluation of the larvicidal activity of *Bacillus sphaericus* strain 1593 against four mosquito species on the French Mediterranean coast (in French).

- WHO/VBC/80.763. J.A. Shadduck. *Bacillus thuringiensis* serotype H-14. Maximum challenge and eye irritation safety in mammals (in English).
- WHO/VBC/80.767. J. Dempah & J. Coz. Study on the stability of a primary powder of *Bacillus thuringiensis* R 153-78 in tropical areas (Cayenne - South America ; Bouake - Ivory Coast) (in French).
- Standardisation of laboratory tests on experimental and commercial formulations of *Bacillus thuringiensis* serotype H-14 (in French).
  - I) WHO/VBC/80.769. G. Sinegre. I. Stability of test suspensions and detection of possible chemical contaminants toxic to mosquito larvae.
  - II) WHO/VBC/80.770. G. Sinegre. B. Gaven & G. Vigo. II. Effect of temperature, residual chlorine, pH and depth of water on the biological activity of a primary powder.
  - III) WHO/VBC/80.772. G. Sinegre, B. Gaven & J.L. Jullien. III. The effect alone or together of larval density, volume or depth of water and the presence of earth on the efficacy and residual larvicidal activity of a primary powder.
- WHO/VBC/80.778. N.E. Alger, J.V. Maddox & J.A. Shadduck. *Nosema algerae* : infectivity and immune response in normal and nude mice (in English).

8. Forthcoming Meetings

1) International Symposium on the Sterile Insect Technique and the Use of Radiation in Genetic Insect Control, 29 June-3 July 1981, Neuherberg, Federal Republic of Germany

Contact Robert Najar, Conferences Service Section, International Atomic Energy Agency, P.O. Box 100, A-1400 Vienna, Austria.

2) International Colloquium on the Protection of Tropical Crops, 9-11 July 1981, Lyon, France

Contact Professor Chevaugeon, PROMOLYON, Quai Achille Lignon, 69459 Lyon Cedex 3, France (Tel. 893.51.27).

The following main topics will be discussed : protection of food crops, protection of industrial crops, protection of harvested crops, and future prospects for plant protection in a tropical climate. Emphasis will be on integrated methods to control fungi, bacteria, viruses, insects, nematodes and weeds. Congress languages will be French, English and Spanish ; simultaneous interpretation will be provided for all three languages.

3) Autumn Meeting of the British Society of Parasitology : Parasites as Biocontrol Agents, 30 October 1981, London, England

Contact Dr R.M. Anderson, Department of Zoology, Imperial College, University of London, SW7 2BB, England, or Dr E.U. Canning, Ashurst Lodge, Imperial College at Silwood Park, Ascot, Berkshire, England. The meeting to be held in the Meetings Room of the Zoological Society of London, Regents Park, London.

9. List of Invertebrate Pathologists (Australia and New Zealand)

Insect pathologists attending the Australian Applied Entomology Research Conference at Lawes, Queensland, decided to form a Working Group in Invertebrate Pathology and Microbial Control ; the main purpose of the Group will be to foster research and cooperation in the fields of invertebrate pathology and microbial control. Following the Lawes Conference, a circular was sent to many institutions where an interest in this area might exist, and the responses received form much of the Working Group's first Newsletter (Australian Invertebrate Pathology Working Group, Newsletter 1, March 1980 ; 51 pp. mimeo ; edited by Dudley E. Pinnock, Reader in Insect Pathology, The University of Adelaide, Waite Agricultural Research Institute, Glen Osmond, South Australia, 5064). The Newsletter also contains three articles entitled : 1) Insect pathology in New Zealand ; 2) Assay of *Oryctes rhinoceros* baculovirus ; and 3) Insect pathology and microbial control of insect pests in the People's Republic of China.

10. ABSTRACTS

a. Plant Protection

INSECTS

Hall, R.W. & Ehler, L.E. (1979). Rate of establishment of natural enemies in classical biological control. Bull. ent. Soc. America 25 (4) : 280-282

The authors present an analysis of the rate of establishment of natural enemies in classical biological control based on data collated by C.P. Clausen and coworkers for the period *ca.* 1890-1968. The rate varies according to a number of factors but no particular habitat or host species should necessarily be regarded as inherently unsuitable for the establishment of natural enemies.

Hall, R.W., Ehler, L.E. & Bisabri-Ershadi, B. (1980). Rate of success in classical biological control of arthropods. Bull. ent. Soc. America 26 (2) : 111-114

There were no significant differences between the rates of success within the following categories : predators vs. parasites, islands vs. non-islands, and exotic natural enemies of native vs. exotic pest species. There was no increase in the rate of success over time and there was no significant relationship between the rates of success and the rate of establishment over time. Natural enemies introduced against Homoptera had the highest rate of success, and the highest rate of success was obtained in habitats with an intermediate amount of disruption. Vedalia beetle, *R. cardinalis*, was responsible for an inordinate number of the complete successes ; thus, one must be cautious when making generalizations about rates of success without considering the impact of *R. cardinalis* on such rates.

Finally, the results presented here are *rates* of success, not *probabilities* of success. Thus care should be exercised in using these data to make generalizations about the probability of success of biological control for a given habitat, order of host, etc.

Burger, T.L. (1980). Status of a biological control program against the cereal leaf beetle, Oulema melanopus (L.). J. New York ent. Soc. LXXXVIII (1) : 39

The cereal leaf beetle, *Oulema melanopus* (L.), an Eurasian pest of small grains, was first observed in the United States in 1959 in Berrien County, MI. Aided by the prevailing winds, its range has expanded primarily to the East to include 20 states and one Canadian province. Through a cooperative Federal and State program five hymenopterous parasites : *Tetrastichus julis* (Walker) ; *Diaparsis carinifer* (Thomson) ; *Diaparsis* n.sp. ; *Lemophagus curtus* (Townes) ; and *Anaphes flavipes* (Foerster) have been introduced as an attempt at multiple species biological control of this pest. To date one or more of these parasites have been released and/ or recovered in 18 states and one Canadian province.

Results obtained from monitoring sites in states where the program was first initiated, revealed high rates of parasitization of eggs and/or larvae of the pest. Overall seasonal egg and larvae parasitization rates of 70 and 90 percent respectively were recorded from low, medium, and high host densities. States, such as MI, IN, OH, PA, and NY, which experienced economic damage over moderately large areas in the past, no longer have significant pest populations where high parasitization rates had been encountered for one to two years. To date no single species of the introduced parasites has exhibited dominance throughout its established range in the United States. States are now in the process of assuming total responsibility for the program.

Nechols, J.R. (1980). Biological control of the greenhouse whitefly, Trialeurodes vaporariorum (Westw.) by Encarsia formosa Gahan. J. New York ent. Soc. LXXXVIII (1): 63-64

The greenhouse whitefly, *Trialeurodes vaporariorum* (Westw.), is a serious pest of many commercially-grown greenhouse crops. Control of this pest by conventional chemical methods is difficult for a number of reasons. Biological control by its parasite, *Encarsia formosa* Gahan, on the other hand, is a practical method for controlling the whitefly – both on short- as well as long-term crops. However, to use this natural enemy effectively, growers and extension agents need to know: (1) what greenhouse temperatures to maintain; (2) how many adult parasites to release (in relation to a given host density); and (3) when these parasites should be released. From previous studies, both the optimal temperatures for the parasite (21-27°C), and the parasite : host release ratio (about 1:30) have been established. However, the problem of *when* to release adult parasites had not been well established. Therefore, I exposed each nymphal whitefly stage to *E. formosa* females. The results showed that both 3rd and 4th instar whiteflies are: (a) the most highly accepted stages by ovipositing *Encarsia* females, and (b) the most suitable stages for the parasite's development and survival. Thus, timing the release of *E. formosa* adults to coincide with these host stages results in efficient mass-rearing and successful colonization of the parasite. The application of this information to biological control trials on poinsettia and Clematis has contributed to the successful suppression of whitefly populations on these crops in commercial greenhouses.

Odhiambo, T.R. (1980). Linking basic research to crop-improvement programs for the less-developed countries – Biological control of insects. In: Linking Research to Crop Production. Ed. R.C. Staples & R.J. Kuhr, Plenum Press (New York), 235 pp. 153-172

A comparison is made of the relative distribution of the production of major staples in developing market economy countries and of the mean growth rates of population and food production. Mixed cropping entomology is then discussed, followed by a section on the conventional attitude to crop resistance. Examples are given of the biochemical nature of resistance of host plants to pests. Allelochemic factors in plants and their impact on the corresponding behaviour and physiological responses of attendant insects are listed.

Huffaker, C.B. (1980). Use of predators and parasitoids in biological control. In: Linking Research to Crop Production. Ed. R.C. Staples & R.J. Kuhr, Plenum Press (New York), 235 pp. 173-198

The basic concepts involving the roles of parasites and predators in controlling and regulating their hosts' populations, the theoretical implications of their complex characters, adaptations and behaviours in these roles and the empirical record itself are dealt with in brief summary. The important role of pathogens is not within the assigned scope of the paper. Examples are given of integrated pest managment of glasshouse pests, of pests of oil palms in southwest Asia, of cotton pests in Texas and Arkansas, and of sugarcane pests in Brazil.

Hall, R.A. & Burges, H.D. (1979). Control of aphids in glasshouses with the fungus Verticillium lecanii. Ann. appl. Biol. 93: 235-246

In small glasshouses, aqueous sprays of spores of the entomopathogenic fungus, *Verticillium lecanii*, eliminated small populations of the aphid *Brachycaudus helichrysi* in the vegetative tips of chrysanthemum plants but not when they were in an exposed position on mature flower buds. Control of the chrysanthemum aphid, *Macrosiphoniella sanborni*, was however variable and usually commercially unsatisfactory. In contrast, in both small and large glasshouses, sparse populations of the major aphid pest *Myzus persicae* were successfully and consistently controlled, sometimes spectacularly. The inherent susceptibilities of these aphid species, measured by laboratory bioassay, did not account for the differences in control observed in the glasshouse. It is thought that a combination of species-characteristic feeding site preferences on the exposed parts of plants, where microclimate humidity was probably low, and relative immobility of *M. sanborni* and *B. helichrysi* explain why these aphids were less well-controlled than *My. persicae*. However, it should be possible to control satisfactorily all aphid species in large commercial glasshouses where humidity might be higher than in the small experimental glasshouses. A single spray was sufficient to introduce infection that controlled aphids for the duration of the crop.

Mansour, F., Rosen, D., Shulov, A. & Plaut, H.N. (1980). Evaluation of spiders as biological control agents of Spodoptera littoralis larvae on apple in Israel. Acta Ecol. Applic. 1 (3): 225-232

Egg masses of the Egyptian cotton leafworm, *Spodoptera littoralis* (Boisd.), were attached to the foliage of untreated apple trees in the orchard of the Newe Ya'ar Experiment Station. Daily observation indicated that exposed young larvae of *S. littoralis* did not cause any significant damage, and spiders were seen preying upon them. These observations led to the hypothesis that spiders are predators of some practical value. A field experiment was carried out to evaluate the effectiveness of spiders in the biological control of *Spodoptera* larvae in the apple orchard ecosystem. Six apple trees in the untreated orchard were infested with laboratory-reared egg masses of *S. littoralis*. Spiders were carefully eliminated from three of them, whereas on the other three they were left undisturbed. The fate of the egg masses on the two groups of trees was compared, and it was found that larval populations of *Spodoptera* did not develop to damaging proportions on the trees on which spiders were permitted to act freely. On those trees from which the spiders were removed, damage was significant.

Latgé, J.P. (1980). Sporulation of Entomophthora obscura Hall & *Dunn in liquid culture. Can. J. Microbiol. 26: 1038-1048*

Growth and production of azygospores of *Entomophthora obscura* were studied through batch cultures in media containing glucose, or vegetable oil, and yeast extract. In media containing 3 % glucose and 1 % yeast extract, an 8-h lag phase occurred and sporulation began only at the 40th hour of culture ; spore maturation lasted 4 days on average. Young mycelial stages were characterized by high nucleic acid and protein but low lipid concentrations. During sporogenesis stages, the quantity of lipids and chitin increased and the concentration of total polyosides (chitin excluded) was lower in comparison with the mycelial stages. Sporulation was induced by means of medium starvation in carbon and (or) nitrogen. The only sporulation inhibitor which allowed considerable growth was sodium fluoroacetate.

Vet, L.E.M., Lenteren, J.C. van & Woets, J. (1980). The parasite-host relationship between Encarsia formosa (Hymenoptera : Aphelinidae) and Trialeurodes vaporariorum (Homoptera : Aleyrodidae). IX. A review of the biological control of the greenhouse whitefly with suggestions for future research. Z. ang. Ent. 90 : 26-51

The parasitic wasp *Encarsia formosa* is used in many countries to control an important glasshouse pest, *Trialeurodes vaporariorum*. Increasing energy costs initiated research about breeding tomato varieties that can be grown at lower glasshouse temperatures than usual. *Encarsia formosa* is, however, not sufficiently efficient in controlling whitefly at these low temperatures. The great success of this biocontrol method forces us to search for a solution either by selecting cold-resistant *E. formosa* strains, or by screening of other parasites and predators. In this paper, the current situation with regard to control of whitefly is evaluated, the knowledge about factors influencing the relationship between host and parasite is reviewed, data about other parasites and predators are given, and evaluation procedures of natural enemies are discussed.

Webster, J.M. (1980). Biocontrol : the potential of entomophilic nematodes in insect management. J. Nematology 12 (4) : 270-278

A review of the development of entomophilic nematology and a commentary on the potential of entomophilic nematodes in controlling insect pests is given. The paper considers some of the major contributions to our knowledge of entomophilic nematology ; factors involved in insect pest management and how they are applicable to the use of nematodes ; nematodes which are most promising as biological control agents ; and problems to be solved to facilitate the use of entomophilic nematodes in insect management.

– NEMATODES

Mankau, R. (1980). Biocontrol : fungi as nematode control agents. J. Nematology 12 (4) : 244-252

The fungal antagonists of nematodes consist of a great variety of organisms belonging to widely divergent orders and families of fungi. They include the nematode-trapping fungi, endoparasitic fungi, parasites of nematode eggs and cysts, and fungi which produce metabolites toxic to nematodes. The diversity, adaptations, and distribution of nematode-destroying fungi and taxonomic problems encountered in their study are reviewed. The importance of nematophagous fungi in soil biology, with special emphasis on their relationship to populations of plant-parasitic nematodes, is considered. While predacious fungi have long been investigated as possible biocontrol agents and have often exhibited spectacular results *in vitro*, their performance in field studies has generated little enthusiasm among nematologists. To date no species has demonstrated control of any plant pest to a degree achieved with nematicides, but recent studies have provided a much clearer concept of possibilities and problems in the applied use of fungal antagonists. The discovery of new species, which appear to control certain pests effectively under specific conditions, holds out some promise that fungi may be utilized as alternatives to chemical control after a more thorough and expanded study of their biology and ecology.

Kerry, B. (1980). Biocontrol : fungal parasites of female cyst nematodes. J. Nematology 12 (4) : 253-259

Three species of fungi, *Catenaria auxiliaris* (Kühn) Tribe, *Nematophthora gynophila* Kerry and Crump, and a Lagenidiaceous fungus have been found attacking female cyst nematodes. All are zoosporic fungi which parasitize females on the root surface, cause the breakdown of the nematode cuticle, and prevent cyst formation. Their identification and some aspects of their biology are reviewed. *N. gynophila* is widespread in Britain and reduces populations of the cereal cyst nematode, *Heterodera avenae* Woll., to nondamaging levels. The potential of these nematophagous fungi as biocontrol agents is discussed.

Sayre, R.M. (1980). Biocontrol : Bacillus penetrans and related parasites of nematodes. J. Nematology 12 (4) : 260-270

Bacillus penetrans Mankau, 1975, previously described as *Duboscqia penetrans* Thorne 1940, is a candidate agent for biocontrol of nematodes. This review considers the life stages of this bacterium : vegetative growth phase, colony fragmentation, sporogenesis, soil phase, spore attachment, and penetration into larvae of root-knot nematodes. The morphology of the microthallus colonies and the unusual external features of the spore are discussed. Taxonomic affinities with the actinomycetes, particularly with the genus *Pasteuria*, are considered. Also discussed are other soil bacterial species that are potential biocontrol agents. Products of their bacterial fermentation in soil are toxic to nematodes, making them effective biocontrol agents.

– FUNGI

Burdsall, H.H. Jr, Hoch, H.C., Boosalis, M.G. & Setliff, E.C. (1980). Laetisaria arvalis (Aphyllophorales, Corticiaceae) : a possible biological control agent for Rhizoctonia solani and Pythium species. Mycologia 72 (4) : 728-736

Laetisaria arvalis, a soil-inhabiting basidiomycete, is described from culture as a new species. Descriptions and illustrations of the basidiocarps and cultures are provided and the relationship of *L. arvalis* to *Phanerochaete* as well as its potential importance as a biological control agent are discussed.

Odvody, G.N., Boosalis, M.G. & Kerr, E.D. (1980). Biological control of Rhizoctonia solani with a soil-inhabiting basidiomycete. Phytopathology 70 (7) : 655-658

An isolate of a soil-inhabiting unidentified *Corticium* sp. which was parasitic to *Rhizoctonia solani* in culture, also was an effective biological control agent of this pathogen of sugar beets in greenhouse studies. Seed coated with mycelia and sclerotia of *Corticium* and planted in nonsterilized soil artificially infested with *R. solani*, produced significantly greater seedling stands than did nontreated seeds in the same soil. In a field study, *Corticium*-coated seeds of sugar beet planted in soil naturally infested with *R. solani* produced seedling stands more than 100 % greater than untreated seeds. Nontreated sugar beet seed produced significantly greater seedling stands in soil simultaneously infested with *R. solani* and *Corticium* than in soil with *R. solani* only, if planted 2-15 wk after infestation. In greenhouse studies, high percentages of seedling establishment and low soil propagule densities of *R. solani* were correlated with high soil densities of *Corticium*. In the greenhouse and field, more consistent establishment of high soil populations of *Corticium* occurred if dry sugar beet pulp was mixed with *Corticium* prior to soil incorporation than if *Corticium* was incorporated alone. *Corticium* exhibits morphological and physiological stability in culture and longevity (> 3 yr) when stored as an air-dry preparation of mycelia and sclerotia under nonsterile conditions.

– WEEDS

Trumble, L.J.T. & Kok, L.T. (1980). Integration of Rhinocyllus conicus Froel. larvae and 2,4-D for control of Carduus nutans. J. New York ent. Soc. LXXXVIII (1).

Herbicidal effect on *Rhinocyllus conicus* Froel., a thistle head weevil, was studied by examining the mortality, emergence rates and weights of weevils developing from plants treated with 2,4-D (LVA). Infested heads, obtained by caging ovipositing *R. conicus* on primary heads of musk thistle *(Carduus nutans* L.), were treated with 2,4-D at 1.68 kg/ha 0 to 3 weeks after oviposition. Mortalities of larvae developing from untreated plants and those plants sprayed 1 to 3 weeks were significantly lower than mortality from plants sprayed within 48 hr of oviposition. The latter failed to support larval development beyond the second instar. Developmental times and weights of weevils that emerged from blooms sprayed at 1, 2, and 3 weeks were not significantly different from controls. Plants sprayed up to 2 weeks after oviposition (late-bud to early-bloom) did not produce viable seeds, but treatments at 3 weeks after oviposition (full-bloom) allowed 10 % germination of seeds not damaged by *R. conicus* in primary heads, and plants survived to produce additional heads. Treatment of musk thistles with 2,4-D at late bud to early bloom stage of the primary heads prevented formation of viable seeds without adversely affecting *R. conicus* development.

Baloch, G.M., Sana-Ullah & Ghani, M.A. (1980). Some promising insects for the biological control of Hydrilla verticillata in Pakistan. Tropical Pest Management (PANS) 26 (2) : 194-200

A leaf-mining fly, *Hydrellia pakistanae* Deonier ; a stem-boring weevil, *Bagous* sp. and a tuber-boring weevil, *Bagous* sp. nr. *limosus* (Gyll.) are stenophagous insects associated with *Hydrilla verticillata* in Pakistan. Under field conditions and in the presence of its host, *H. pakistanae* does not infest any other plant. In the absence of the host and under confinement it does feed on leaves of *Potamogeton* spp. It is widespread, fairly destructive, breeds frequently and is heavily parasitised. *Bagous* sp. is apparently specific but it attacks host tubers only when the water dries up. Adults and larvae of *Bagous* sp. nr. *limosus* damage stems in water but usually remain restricted to the edges of a water-body because they need to pupate in moist soil on the bank.

Walker, H.L. (1980). Production of spores for field studies. Alternaria macrospora as a potential biocontrol agent for spurred anoda. USDA Advances in Agricultural Technology, Southern Series Nº 12, April 1980, 5 pp

The method described produces sufficient *Alternaria macrospora* Zimm. spores to permit field evaluation of this fungus as a biocontrol agent for spurred anoda (*Anoda cristata* (L.) Schlecht.). Mycelia grown in liquid culture are blended, poured into pans, and incubated under a specific light-dark regime. Dried spores are harvested with cyclone spore collectors and stored under refrigeration at 4°C or frozen at -10°C. Spore preparations produced by this method contain $2\text{-}4 \times 10^8$ spores per gram and can be stored for as long as 12 months and still maintain over 90 % viability. The method has been shown to be applicable for the production of spores for several other fungi.

Maw, M.G. & Steinhausen, W.R. (1980). Cassida azurea (Coleoptera : Chrysomelidae) - not C. hemisphaerica - as a possible biological control agent of bladder campion, Silene cucubalus (Caryophyllaceae) in Canada. Z. ang. Ent. 90 (4) : 420-422

A tortoise beetle, which was introduced from Europe to Canada as a possible biological control agent of bladder campion, *Silene cucubalus*, was redetermined by the second author as *Cassida azurea* Fab. and not *C. hemisphaerica* Hbst., as erroneously published. A comparative description is given of the two ecologically allied species.

Scheibelreiter, G.K. (1980). Biological control of Lantana camara L. (Verbenaceae) in Ghana. Z. ang. Ent. 90 (1) : 99-103

Lantana camara L. has been controlled in restricted areas of the forest zone of Ghana by some of its insect natural enemies introduced from Trinidad, India and Australia in 1971-1973. The Tingid *Teleonemia scrupulosa* Stål and the two Hispids *Octotoma scabripennis* Guérin and *Uroplata girardi* Pic were successfully established, the Tingid *Leptobyrsa decora* Drake and the Noctuid *Diastema tigris* Guenée were released but not recovered. Indigenous species associated with *L. camara* were recorded.

b. Integrated Pest Management
BIOSCIENCE, October 1980, Vol. 30 (10). Special Issue

The following seven articles are included :

– *Allen, G.E. & Bath, J.E. The conceptual and institutional aspects of integrated pest management. pp 656-665*

Integrated pest management is an alternative to simple chemical control. It embodies a transitional philosophy that accommodates the horizontal and vertical integration of disciplines and institutions. The long-term goal of IPM is not to refine existing agricultural production systems, but to modify extensively the basic design so that less energy-intensive, more environmentally compatible methods can be used.

– *Fry, W.E. & Thurston, H.D. The relationship of plant pathology to integrated pest management. pp 665-670*

The influence of plant disease on human welfare ranges from minor annoyance to catastrophe. There have been four conventional approaches to disease control : 'prevention of entry of a pathogen into a crop, elimination of pathogens from crops, protective activities, and development of plant resistance to disease. In contrast, IPM emphasizes the entire ecosystem. Its holistic approach has stimulated efforts to combine methods which alone are insufficient for adequate disease suppression but which together are effective.

— *Bird, G.W. & Thomason, I.J. Integrated pest management : the role of nematology, pp 670-675*

Numerous characteristics of plant-parasitic nematodes contribute to their status as pests. A broadened interest in nematodes is part of the recent effort to include all plant protection disciplines in a systems approach to integrated pest management . Additional nematology research, academic instruction, extension, and interaction with all aspects of IPM are essential to result in favorable socioeconomic and environmental consequences.

— *Baldwin, F.L. & Santelmann, P.W. Weed science in integrated pest management, pp 675-683*

Agricultural losses due to weeds cost about $16.1 billion per year. Current weed control practices include using organic herbicides and improved management and cultural procedures in modern cropping systems. However, to integrate total pest management programs, comparable base population data and personnel resources must be available for each crop protection discipline.

— *Barfield, C.S. & Stimac, J.L. Pest management : an entomological perspective, pp 683-690*

Man has viewed insects from many perspectives, one of which has been as major sources of damage to agricultural crops. Currently, the most advocated philosophy of dealing with insect pests is integrated pest management. However, IPM is still far from realizing its full potential as a combat strategy against insects.

— *Haynes, D.L., Tummala, R.L. & Ellis, T.L. Ecosystem management for pest control, pp 690-697*

Research associated with modern agricultural production assumes a reasonably stable system structure. Because the design becomes a constant (not a variable), the results from experiments have value for only that particular design. In contrast, management determines a set of imput levels that will cause a given system to produce a desired output. This paper discusses design and management of a single pest crop ecosystem to demonstrate a specific experimental approach to measure the interrelationships between the natural environment and the man-made production system.

— *Edens, T.C. & Koenig, H.E. Agroecosystem management in a resource-limited world, pp 697-702*

Current western agricultural technology is based on an uninterrupted availability of fossil fuels such as natural gas and oil. However, in the decades ahead, necessary adaptations must take place because of our limited energy sources. Integrated pest management and agroecosystem integrated management strategies are viable alternatives to present, energy-dependent practices. Adaptations in agricultural technology will provide a new context for IPM in which the structure of regional food/energy systems can become a major component of pest control strategy.

c. Public Health

Slater, A.J., Hurlbert, M.J. & Lewis, V.R. (1980). Biological control of brownbanded cockroaches. California Agriculture 34 (8/9) : 16-18

In spite of the economic impact of cockroach populations, virtually no serious consideration had been given to the use of natural enemies to control them in an operational structural pest management program. Since January 1978, *Comperia merceti*, an encyrtid parasite of cockroach eggs, has been reared and released as the principal measure employed for suppressing brownbanded cockroaches, *Supella longipalpa*, in research facilities at the University of California, Berkeley. This natural enemy of brownbanded cockroaches shows promise as the most effective and efficient approach for controlling this pest in large buildings.

Glaser, A.E. (1980). Use of aggregation pheromones in the control of the German cockroach (Blattella germanica). Int. Pest Control 22 (1) : 7-8,21

Crude pheromone was extracted from faeces and tested in combination with various concentrations of fenitrothion wettable powder. The addition of pheromone considerably increases the effectiveness of this insecticide but the difficulty of obtaining it currently renders its use on a large scale uneconomical.

Sandhu, G.S. & Varma, G.C. (1980). Control of an infestation by the German cockroach, Blatella germanica (L.), in a parasite rearing laboratory. Int. Pest Control 22 (3) : 58-60, 65

This experiment was planned to test safe insecticides, including *Bacillus thuringiensis*, in bait formulations for the control of cockroaches in the laboratory. Depil (*B. thuringiensis* 16000 IU/mg) at 10 % in bait was not better than the control in one experiment but gave 23.8 % mortality in another.

Nogge, G. & Giannetti, M. (1980). Specific antibodies : a potential insecticide. Science 209 : 1028-1029

When tsetse flies are fed on human blood, the hemolymph of the flies contains human albumin. If the flies then ingest antibodies to human albumin, they die within a short time. The albumin fraction in their hemolymph disappears and osmoregulation is severely disturbed.

d. Veterinary Entomology

Bezuidenhout, J.D. & Stutterheim, C.J. (1980). A critical evaluation of the role played by the red-billed oxpecker Buphagus erythrorhynchus in the biological control of ticks. Onderstepoort Journal of Veterinary Research 47 : 51-75 (1980)

Buphagus erythrorhynchus uses 4 feeding methods – scissoring, plucking, pecking and insect catching. During the day the birds spend 68 % of their time feeding, with peaks of activity during the early morning and late afternoon. A total of 21,641 ixodid ticks were found in 53 stomachs examined with a range of between 16 and 1,665 per stomach. *Boophilus* and *Rhipicephalus* were the most important genera eaten. Thirty Diptera, also found in the stomachs, accounted for 0.4 % of the diet by mass. The food of the nestlings consisted of 45.6 % ticks, 19.4 % Diptera and 35.0 % hair and tissues.

When kept in captivity, *Buphagus* was able to account for an appreciable reduction in the numbers of *Boophilus* on cattle, reaching a figure of 95.7 % reduction for adult ticks. In controlled experiments *Buphagus* showed the highest preference for *Boophilus decoloratus*, *Rhipicephalus appendiculatus* and *Hyalomma truncatum*. The daily food intake of a captive bird was 14.7 g, which is equivalent to 7,195 engorged *Amblyomma hebraeum* larvae. Three acaricides, namely, amitraz, chloromethiuron and DDT, did not cause any clinically detectable toxicity in captive birds during a 5-day period.

Laird, M. (1980). Biocontrol in veterinary entomology. Advances in Veterinary Science and Comparative Medicine 24 : 145-177

Following an introduction and discussion on the ecological background, the author considers the viral, bacterial, fungal, protozoal and other candidate agents for control of mosquitos, blackfly and tsetse fly. There follow brief sections on the microbial control prospects for some other vectors (various Diptera, reduviid bugs and tick vectors of arboviruses), and trematodes and their snail hosts. Mass production and commercialisation is then dealt with, together with health and environmental safety aspects and there is a conclusion on future integrated control methodologies.

11. Abstracts from Entomophaga

(Prepared by Courtesy of B. Hurpin, INRA)

ENTOMOPHAGA, volume 25 (4), 1980

H.D. Burges, G. Croizier & J. Huber. Glasshouse Crops Research Institute, Littlehampton, Great Britain ; INRA, Station de recherches de Pathologie Comparée, S^t-Christol-les-Alès, France ; Institut für biologische Schädlingsbekämpfung, Darmstadt, Deutschland. A review of safety tests on baculoviruses.

In the late 1960's, the nuclearpolyhedrosis virus of *Heliothis zea* underwent a series of tests as thorough as those required for chemicals, including long-term carcinogenicity and teratogenicity tests, tests on primates and on man. Six other NPV from Lepidoptera have proved harmless in extensive tests. A number of other NPV have been partially tested and limited tests have been made on 2 granulosis viruses (GV). The data show that these baculoviruses are very specific. This suggests that new NPVs and GVs of Lepidoptera and Hymenoptera need to be subjected only to a reduced range of the more challenging tests.

H.D. Burges, J. Huber & G. Croizier. Glasshouse Crops Research Institute, Littlehampton, Great Britain ; Institut für biologische Schädlingsbekämpfung, Darmstadt, Deutschland ; INRA, Station de recherches de Pathologie comparée, S^t-Christol-les-Alès, France. Guidelines for safety tests on insect viruses.

Guidelines for testing the safety of insect viruses have been formulated in the light of present knowledge. In the family Baculoviridae, the nuclearpolyhedrosis and granulosis viruses of Lepidoptera and sawflies (Hymenoptera) are a particularly homogenous group which have been tested very extensively, without any evidence of hazard to man and vertebrates. It is considered, therefore, that data for viruses already tested can be used as evidence for the safety of a new virus in this group, so that only a limited series of mandatory tests are necessary on the new virus product itself. Other viruses may require the full range of tests.

D.H. Simser & H.C Coppel. Dept of Entomology, University of Wisconsin, Madison, Wisconsin, USA. Courtship and mating behaviour of Brachymeria lasus, an important gypsy moth parasitoid.

The courtship behaviour of *Brachymeria lasus*, which consists of a sequence of stereotypic behavioural components culminating in copulation, is compared to that of *B. intermedia*.

S.B. Vinson & J.R. Ables. Dept of Entomology, College Station, TX, USA ; USDA-SEA-FR Cotton Insects Laboratory College Station, TX, USA. Interspecific competition among endoparasitoids of tobacco budworm larvae (Lep. : Noctuidae).

The ability of 3 female larvae endoparasitoids to distinguish between unparasitized tobacco budworm, *Heliothis virescens*, larvae and *H. virescens* larvae parasitized by the egg-larval parasitoid *Chelonus insularis*, was determined in laboratory studies.

F.J. Simmonds. CIBC, Curepe, Trinidad, W.I. Biological control of Cordia curassavica (Boraginaceae) in Malaysia.

Metrogaleruca obscura (Galerucidae) from Trinidad and *Eurytoma attiva* (Eurytomidae) from Mauritius, which were introduced into Malaysia in 1977 for the control of the introduced neotropical weed *Cordia curassavica* are now established.

R. Cherry & S. Pastor, Jr. 3994 S.W. 12 Terrace, Fort Lauderdale, Florida, USA. Variations in population levels of citrus blackfly, Aleurocanthus woglumi (Hom. : Aleyrodidae) and parasites during an eradication program in Florida.

From November 1976 until October 1979, citrus blackfly, *Aleurocanthus woglumi*, and its parasite populations were sampled monthly in urban areas of Broward County, Florida. During this period, the parasites *Amitus hesperidum* and *Prospaltella opulenta* became established and exerted control on *A. woglumi* populations.

B.A. Franzmann. Dept of Primary Industries, Toowoomba, Queensland, Australia. Parasitism of Phthorimaea operculella (Lep. : Gelechiidae) larvae in Queensland.

This report provides data on the composition and relative abundance of the parasite complex from *P. operculella* larvae mining potato foliage in the Lockyer Valley, Queensland and records of parasites from sporadic collections in other Queensland areas and crops.

D.H. Simser & H.C. Coppel. Dept of Entomology, University of Wisconsin, Madison, Wisconsin, USA. Female-produced sex pheromone in Brachymeria lasus and B. intermedia (Hym. : Chalcididae).

This report confirms the existence of a female-produced sex pheromone in *B. intermedia* and *B. lasus*, and demonstrates the functional distance and pheromonal role in promoting male matesearching and recognition behaviour.

Sara S. Rosenthal & N. Hostettler. Div. of Biological Control, University of California, Berkeley, USA. Galeruca rufa (Col. : Chrysomelidae) seasonal life history and the effect of its defoliation on its host plant, Convolvulus arvensis (Convolvulaceae).

Because of the interest in the USA in *Galeruca rufa* as a biological control agent for field bindweed, *Convolvulus arvensis*, its ability to damage this plant was studied in field cages in Rome, Italy. *G. rufa* appears to be well synchronized with its host plant and able to naturally increase to a population size large enough to defoliate *C. arvensis*.

J. Guerdoux & M. Masselot. Centre de Génétique Moléculaire, CNRS, Gif-sur-Yvette, France ; Faculté Pierre et Marie Curie, Paris VI, Paris, France. Experimental conditions of mutagenesis in females on an entomophagous wasp, Pimpla instigator (Hym. : Ichneumonidae).

Both X-rays and ethyl-methyl sulfonate can induce a cell lethality in the female germ line of *P. instigator*. The experimental conditions permit the isolation of mutants.

M.M. Alam. The Caribbean Agricultural Research & Development Institute, Barbados. Biological and ecological factors affecting populations of sugarcane mothborer, Diatraea saccharalis (Lep. : Pyralidae), Barbados, W.I.

The introduction and establishment of 2 larval parasites of sugarcane mothborer, *Diatraea saccharalis*, in Barbados has led to substantial reductions in the level of joints bored and sugar loss. Concurrent with the introduction of the parasites, there have been changes in cultural practices, especially preharvest burning and the change in predominance of certain cane varieties. The paper discusses the relative importance of the parasites and these ecological changes in effecting the reduction from 16 % to 5 % in joints bored.

E. Swirski, Y. Izhar, M. Wysoki, E. Gurevitz & S. Greenberg. ARO, Div. of Entomology, The Volcani Center, Bet Dagan, Israel ; Ministry of Agriculture, Extension Service, Akko, Israel. Integrated control of the long-tailed mealybug, Pseudococcus longispinus (Hom. : Pseudococcidae) in avocado plantations in Israel.

In Israel, avocado plantations neighbouring cotton fields were heavily infested with and damaged by the long-tailed mealybug, *Pseudococcus longispinus*. Drift of pesticides from the aerial sprays of those cotton fields had upset the biological equilibrium and resulted in outbreaks of the mealybug population. In this paper, the results are presented of studies carried out during 1970-1974 on the phenology of the long-tailed mealybug and of its natural enemies.

A. Honek. Research Institute for Plant Production, Praha, Czechoslovakia. Population density of aphids at the time of settling and ovariole maturation in Coccinella septempunctata (Col. : Coccinellidae).

In *Coccinella septempunctata*, the abundance of adults in the field and the start of their reproductive activity depend on density of aphid populations. This study tried to determine, under field conditions in 1978 and 1979 in Central Bohemia, aphid abundance at the time of settling of overwintered adults in the fields and at the time of ovariole maturation.

B. Pintureau & J. Voegelé. INRA, Station de Lutte Biologique, Antibes, France. A new species near to Trichogramma evanescens : T. maidis (Hym. : Trichogrammatidae).

The crossing study between 2 very similar strains of *Trichogramma* indicates that 2 sibling species were confused : *T. evanescens* Westwood and *T. maidis* n. sp.

W.P.J. Overmeer & A.Q. van Zon. Laboratory of Experimental Entomology, Amsterdam, the Netherlands. A comparative study of the effect of some pesticides on three predacious mite species : Typhlodromus pyri, Amblyseius potentillae and A. bibens (Acarina : Phytoseiidae).

Toxicological responses to 10 different pesticides were determined for 3 species of typhlodromid mites, *Typhlodromus pyri, Amblyseius potentillae* and *A. bibens*, in order to investigate whether or not *A. bibens* might be used as a substitute for the 2 other species in measuring the adverse effects of pesticides. It was found that *A. bibens* can reasonably well be used in place of other typhlodromids.

B. Pintureau & M. Babault. INRA, Station de Lutte Biologique, Antibes, France. Enzymatic characterisation of Trichogramma evanescens and T. maidis (Hym. : Trichogrammatidae). Study of hybrids.

Three enzymatic systems were studied by electrophoresis in two sibling species of *Trichogramma* : *T. evanescens* and *T. maidis*. The esterases of interspecific hybrids F_1 and F_2 were also studied. They confirm that induction of thelyotoky occurs in some females.

W.R. Ingram. Centre for Overseas Pest Research, London, UK. The parasitoids of Spodoptera littoralis (Lep. : Noctuidae) and their role in population control in Cyprus.

20 months survey and laboratory studies of the parasitoids of *Spodoptera littoralis*, carried out in Cyprus in 1971-72, showed the presence of 19 further macrolepidopterous members of the ecosystem, including *S. exigua, Heliothis* spp. and *Plusia* spp. Attacking these were a complex of at least 37 named primary parasitoids and a single secondary parasitoid. Recommendations are made for possible reductions in crop spraying.

J.M.E. Anderson. University of New South Wales, Kensington, Australia. Sex ratios of adult Scymnodes lividigaster and Leptothea galbula (Col. : Coccinellidae) sampled in the field.

This study indicates that certain sampling methods may give erroneous sex ratio data. Correct interpretation of data must involve regular and long-term studies of the population, including seasonal cycles of development, habitat preferences and behaviour patterns.

A. Burgerjon, G. Biache, J. Chaufaux & Z. Petre. INRA, Station de Lutte Biologique, La Minière, France & Institut de recherches pour la protection des plantes, Bucarest, Roumanie. Relation of larval age of Lymantria dispar, Mamestra brassicae and Spodoptera littoralis to comparative susceptibility to nuclear polyhedrosis viruses.

The aims of the experiment were to determine whether the differences in susceptibility to viroses of the larval stages of these 3 Lepidoptera are physiological in nature or related to the amount of virus ingested, varying with larval age. In *L. dispar* and *S. littoralis*, susceptibility to nuclear polyhedrosis viruses is higher in the early stages. In *M. brassicae*, the difference in susceptibility is less precise. An example is given of the extrapolation of laboratory results to develop an experimental field control program against *L. dispar*.

E.G. King, J. Sanford, J.W. Smith & D.F. Martin. Bioenvironmental Insect Control Laboratory & ARS, USDA, Stoneville, Mississippi, USA. Augmentative release of Lixophaga diatraeae (Dip. : Tachinidae) for suppression of early-season sugarcane borer populations in Louisiana.

Augmentative releases of the tachinid *Lixophaga diatraeae* at 3 plantations in south Louisiana at 3 rates resulted in an average of 25 % parasitization by *L. diatraeae* of 1st-generation larvae of the sugarcane borer, in all plots. Therefore, parasite dispersal apparently negated rate effects. Nevertheless, the economic injury threshold was exceeded in the 3 plantations.

A. Ferran, A. Buscarlet & M.M. Larroque. INRA, Station de Lutte Biologique, Antibes & Centre d'Etudes nucléaires de Cadarache, St-Paul-les-Durance, France. The use of HT[18] for measuring food consumption in aged larvae of the aphidophagous ladybeetle Semiadalia 11 inotata (Col. : Coccinellidae).

Total food consumption of aged larvae of the aphidophagous ladybeetle S. 11 inotata can be estimated with isotopic labeling (HT[18]). Compared with a method of estimating consumption based on weighing the prey, isotopic labeling gives good results.

D.J. McKinley, D.A. Brown, C.C. Payne & K.A. Harrap. Centre for Overseas Pest Research, Salisbury & Institute of Virology, Oxford, UK. Cross-infectivity and activation studies with four baculoviruses.

The NPVs of 3 *Spodoptera* species and *1 Heliothis* species were bioassay tested for cross-infectivity. The progeny virus from the test insects was purified and examined by specific identification criteria. This demonstrated that activation of virus was much more common than cross-infection. The mechanism of the activation is unexplained but it seems clear that infecting an insect larva with a NPV from another host can result in infection with the NPV normally associated with that host rather than that used as inoculum.

Michèle Pelloile. INRA, Station de Pathologie Aviaire et de Parasitologie, Nouzilly, France. Investigations on the occurrence of nematode destroying fungi on a pasture in the district of Limousin (France).

During a search for the presence of nematophagous fungi over 17 months in a permanent pasture grazed by a flock of sheep, 390 strains were isolated and identified ; 13 species from 5 genera were found. The possible use of 2 species in biological control is discussed.

O.H. Pavan, D.G. Boucias & J.C. Pendland. Dept of Genetics Unicamp, Campinas, Brazil & Dept of Entomology and Nematology, University of Florida, Gainesville, USA. The effects of serial passage of a nucleopolyhedrosis virus through an alternate host system.

The multiple-embedded velvetbean caterpillar nucleopolyhedrosis virus of *Anticarsia gemmatalis* was shown to be infectious to a variety of noctuid hosts. After several passages of this virus through *Pseudoplusia includens*, the virulence of the progeny virus remained unchanged, indicating heterogeneity in the host and not the virus population. However, between the 3rd and 5th serial passage through *Pseudoplusia*, a latent NPV identical to a single-embedded NPV previously associated from *A. gemmatalis* was activated.

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

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