IOBC Newsletter

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CONTENTS
IOBC/WPRS activities ........................................... 1
IOBC Working Group on Integrated Pest Control in Orchards ............... 1
Meeting on "Fertilizer Use in Integrated Fruit Production" .......... 1
Meeting on "Influence of Pesticides on the Beneficial Fauna in Fruit Trees" 2
Meeting on "Environmental Aspects of Pest Control" .......... 4
IOBC Working Group on Use of Models in Integrated Crop Protection .......... 4
IOBC Working Group on Quality Control .................................. 5
Reports of Conferences .................................................. 5
International Workshop on "Integrated Pest Management" ............. 5
Symposium "Insect Control of Tomorrow" .................................. 5
Forthcoming Conferences and Meetings ...................................... 7
XV Pacific Science Congress .............................................. 7
IOBC Working Group on Use of Models in Integrated Crop Protection .......... 7
Miscellaneous ............................................................... 7
Books ........................................................................ 8
Abstracts ................................................................. 8
1) Plural Protection ......................................................... 8
Insect and Mite Control ................................................... 8
Control of Fungi, Viruses and Viruses .................................. 8
Control of Weeds .......................................................... 10
Public Health ............................................................. 31
Abstracts from Entomophaga .............................................. 35
Entomophaga ............................................................... 36

IOBC/WPRS ACTIVITIES

IOBC Working Group on Integrated Pest Control in Orchards

Summary of the meeting on "Fertilizer Use in Integrated Fruit Production" held in Zürich, Switzerland, on 2-3 September, 1980. IOBC/WPRS Bulletin (1982) 17 (1), 64 pp (in French).

This meeting was attended by 35 participants from Western Europe, and the aim was to standardize the techniques of integrated production in order to obtain high quality yield while respecting ecological constraints. The themes chosen were: methods for assessing fertility in an orchard by soil, leaf or other analyses, problems in assessing and analyzing results (Ca, N, P, Mg, etc.), possibilities for establishing reference or standard methods between different institutes, advice on fertilization to growers, the relationship between fertilization and plant growth, and the relation between nutrient availability and fruit quality at harvest. Brief abstracts of papers presented are given below.

J. Cazals & J.P. Rossier (CH): Fertilizer and fruiting

profiles in arboriculture, pp 2-6
Analyses performed on soil samples collected from bare and grassed areas between trees in 3 orchards confirmed that soil fertility decreases rapidly with increasing depth.
Many tests were found in the upper 10 cm, especially in the
weeded area. Root development at a similar distance from the
trunk was 1.2 to 1.5 times greater in the weeded than in the
grassed area, depending on the orchard. This explains why the way in which the grassed areas are managed has
little effect on the orchard.

Secretary-General: G. MATHEYS, 1, rue de l'Etoile, FR-75016, Paris (France).
Ch. Gisal (CH): Soil analysis and recommended fertilisation in integrated production in German Switzerland, pp 7-19

Recommended fertilisation is based on both soil analysis and observation of the orchard. An enquiry started in 1978 in 53 commercial orchards revealed that recommended fertilisation procedures are generally well accepted in practice and that there are significant differences between the soils in pests producing fruit with good or poor storage properties.

J.P. Kyser (CH): Towards the practical use of leaf analysis in viticulture and arboriculture, pp 11-27

Extensive enquiries and leaf analyses in several vineyards and orchards have led to the setting up of a scheme for assessing the nutritional balance of plants based on the nutritional status of the leaves. The information obtained on mineral content of leaf dust is measured by analysing using a series of ratios based on the phenomenon of antagonism. A statement on the fertility of the plant can only be made when all the criteria of estimation of an element are similar.

F. Gartner (AT): Apple bitter pit: means of prevention by treating with calcium salts, pp 28-45

Four experiments from 1978-79 using CaCl2 on Granny Smith or Golden Delicious apples, and an experiment using CaPO4 are described. Early treatment 15 days after flowering, did not lead to a reduction in apple bitter pit, and in some cases increased disease incidence. Because of poor absorptions, CaCl2 treatments had no effect. CaCl2 treatments were only beneficial when applied throughout the growing season. Post-harvest treatments were ineffective.

R. Schmiichter (CH): Possible causes of physiological diseases of apples, pp 36-43

Most physiological diseases of apple are caused by calcium deficiencies. In this study, 30 trees were observed, and at harvest the positions on the tree of all the fruits were recorded. Some trees received 4 CaCl2 treatments. These treatments reduced the incidence of bitter pit and the K/Ca ratio.

R. Marsale & W. Porrey (BES): Mineral analysis of fruits with regard to their storage properties: report of 6 years practical experience, pp 44-45

An analytical service for fruit mineral composition was started in 1974 at the Grove Research Centre, with the aim of establishing a scale of storage values for different varieties from a grower in order to plan the harvest, and 2) forecasting the storage properties of fruits from different orchards in order to give guidance to the persons concerned with storage. Certainly, this has been carried out during the past 6 years. 1) using K levels to reduce storage time while raised Ca levels improve it. 2) F content needs to be sufficiently raised for fruit to withstand low temperatures and maintain their flavour. 3) N only plays a secondary role in storage, indirectly by its effect on vegetative growth.

A. Sturari (CH): Relationship between fertilisation and plant roots: effect of tree vigour on plant root increase of root under side of F. mino in apple orchards, pp 46-51

The trial was carried out in 1979 at Bed (Rhône valley) in an area planted (integrated system) on an area of 11 ha of Grenetva plant in 1972. The results showed the following: cutting the trunk to reduce tree vigour reduced the number of roots recorded by 75%. There was no migration between cut and adjacent uncut trees, showing that soil population development was directly affected by the physiological state of the tree.

Th. Wibullos (CH): Fertilisation and pest and disease occurrence in orchards, pp 52-55

This brief review article concludes that measures which prevent excessive and prolonged vegetative growth, including reduced N applications, will reduce the effects of aphids, codling moth and mildew. Well-balanced fertilisation also helps reduce attacks of caterpillars and rots. Similar effects may be obtained for mites.

J. Roch (DE): Effect of N fertilisation on multiplication of the red spider mite, T. urticae, pp 54-55

Three levels of N were investigated: remove 20 mg NH4NO3/plant/week, and 40 mg NH4NO3/plant/week. After 4 weeks, 10% abaxial leaves were placed on each plant, and after 4 weeks the leaves on each plant were enumerated and certain leaves analysed. P-leaf numbers increased with increasing N fertilisation 1286-3234/plant. The glucose and total N content of the leaves was also higher in the high N treatment group.

Summary of the meeting on ‘Influence of Pesticides on the Beneficial Fauna in Fruit Trees’, held in Coninath, Switzerland, from 31 March to 1 April, 1981. JCG/WRPS Bulletin (1982) V 31, 50-63 (in German), p 52-55

Thirty-two people attended this meeting, mainly from Switzerland, France, United Kingdom and Fed. Rep. of Germany, with observers from Italy and Portugal. It provided an opportunity to review the state of the art since the last meeting in Coninath on 10-11 April, 1979, and to attempt to establish standard procedures for assessing the short-term effects of chemical pesticides (excluding those with a specific mode of action such as synthetic pyrethroids, likely to result in a toxic effect in the medium term) on the beneficial fauna. The following contributions were presented:

M. Blott et al. (FR): Effects of pesticides on beneficial fauna: present status of studies on entomology in orchards, pp 16-19

A standard method for assessing the short-term effects (24-48 h) of pesticides on beneficial fauna is described for an orchard in the SE of France. The fauna killed by the initial application of pesticide are collected in containers placed under the treated trees. A subsequent treatment with dichlorvos allows an inventory of the remaining fauna to be made. Alternative sampling methods (fuming, visual inspection, etc.) must be used for certain stages such as eggs, nymphs and some larvae. The mechanical effect of spraying should also be considered, and control treated sprays only with water included. Experimental design should take into account the distribution of the fauna in an orchard. The appropriate statistical analysis and presentation of results are described.
Summary of the meeting on Integrated Production of Apples held in Widenheim, West Germany on 10-12 June 1982, IOBC/WPRS Bulletin 1982/2 (1): 60-64 (in English)

This meeting was attended by 22 participants from Western Europe. Brief abstracts of some of the contributions are given below, following a summary of the recommendations made:

1. Activities of the Group to continue, and co-operation between participants increased. Investigations to be made regarding EEC funds.
2. An inventory of models in different phases of development should be published in the IOBC Bulletin in 1982.
3. The IOBC Bulletin on use and development of models in integrated crop protection should be finished in 1982.
4. Subgroups dealing with specific topics to be set up, such as the Sciarid Group.
5. Presentations are given to the practical application of knowledge and to an insight of epidemiology and damage assessment.

R. Hart & J. Krantz: Approaches to the modelling of interactions in the wheat aphid complex. The experiments were carried out in commercial wheat fields in which 20 observation plots were maintained. The treatments included black plastic mulch, powdery mildew, seedling blight, stem rust, stem wilt, mildew, bunt, Erysiphe graminis and Ergotisation species. The single factor approach enabled clearly the groups to be grouped according to the constraints imposed. A comparison of disease progress curves, observed for the different groups of crops, also showed interaction; for instance, the antagonistic effect between mildew and Sciarid was total in the total losses due to the constraints; their relative importance was assessed with EPIFRE at different countries.

J. V. Lovegrove-Butler: Recent results with EPIFRE at different countries.


Losses due to S. nodorum range from 3-12.15 %, with local losses up to 30 % reported in 1959. A series of 12 experiments was started in 1973, scattered over Bavaria. Initially, application of epoxystilbene gave good yield increases. In 1981, however, yield increases were poor or nil because of different weather conditions. S. nodorum usually develops slowly, with typical lesions appearing on successive leaves. The situation in Bavaria differed in that, at a certain point, the Septoria epidemics occurred, several fields being colonized at once. The control problems of the Working Group were two: (1) prevention; and (2) control. 

M. J. Rothen: Damage assessment in wheat diseases.

J. S. Pierson: Analysis of 6 years' data on cereal aphid populations in Britain. Possible application to forecasts of population increases.

R. A. Coates: Damage assessment and epidemiology of powdery mildew.

In 1980, 3 field experiments were done to determine the relationship between disease severity and yield loss before and after flowering. The mildew attack was compatible to that in commercial fields, 0.5 % on 3rd leaf, and yield loss was 1.98-7.5 % at 1.14 kg/ha. Under these circumstances, millet had a great impact on yield: 200 kg/ha; 0.5 % mildew on the 3rd leaf at GS 45-60, and 140 kg/ha; 6.5 % mildew on the 3rd leaf at GS 60-75. A disease yield-loss function was derived from the data obtained. In the supervised control system, EPIFRE, mildew incidence in the field is assessed by the farmers, and data transformed in severity on the computer. An expectation of disease severity is then presented, taking various factors into account. The expect loss of treatment, the farmer is advised to spray.
M. Strzyz - Models for potential sizes of injection in some plant diseases
No abstract.

D.A. Birt - Decision-based management of orchard diseases in England
No abstract.

S.P. Escobar - Development of a model to detect environmental periods favourable for infection of cherry cherry fruit溃疡．
Cherry leaf spot, caused by Cercospora fagacearum, is a major problem for cherry growers in New York and Michigan. A suppressor model was developed from field data collected by Kent et al. in Wisconsin. They inoculated cherry trees with causal spores and inoculated them in a room chamber for 4 to 70 hours at a temperature of 14 to 20°C. The model is:

E = 10.25 + 0.285S + 1.46EPT - 0.081W
- 0.039T - 0.003S

where E = temperature (°C) W = hours of leaf wetness, and EPT = environmental favourability index from 0 to 100. An EPT of 14 was selected to delimitate the minimum conditions for infection under field conditions. The model was tested in 1976 and 1978 in three orchard applications. Infection periods were identified and classified as LOW, MODERATE and HIGH, based on EPT values of over 40, 28 and 42, respectively. In both years, chemical sprays provided good leaf spot control when applied after low or moderate infection periods. Secondary infection was prevented with two sprays applied against causal inoculum available during infection periods. Use of the EPT model for grading cherry longitudinal spray leaves for leaf spot is a promising alternative to fixed time interval spray schedules.

P. Millet - Biometeorological crop conditions.
Variations in meteorological conditions with time following one growing season, between different seasons/year and with space on 3 dimensions of a plot, from one site to another were studied during an experimental season close to the Atlantic, from 1977 to 1979. The same weather conditions at different times, for different crops depend on the exposure and, therefore, the plant's phenology of pests and diseases. The influence of vegetation on meteorological conditions within the crop can be estimated determining the influence of the wind on leaf wetness duration and leaf drying and the interception of rain by the canopy is considered.

R.H. de Roode & C. Piirg - Quantitative physiology of leaf roll in citrus orchards.
A model to simulate the population development of the citrus leaf roller, Aspidiotus perniciosus (Kerz.), was developed. It consists of a series of non-linear difference equations with temperature as the only driver variable. The simulated data correspond well with those observed in the field, except in warm years, when the end of the second flight could not be simulated very precisely. Introduction of photoperiod into the model would probably solve this problem because, in warm years, there may be a third flight. At present, the model is used for optimization of strategies and techniques to control A. perniciosus with baculoviruses.

A model has been developed in which the age composition and numbers of A. perniciosus can be calculated backwards. This model is used to investigate the synchronisation between crop development and population development of the citrus leaf roller in order to determine critical periods for sampling and pesticides application.

U. Jasman - Swedish trials with Biloceran, a biopesticide used for potato blight control
With BLICCAST, the grower collects weather information from his own potato field, and phones this weekly to the University for processing by a computer, and obtaining a recommendation. As an alternative to BLICCAST, an on-site microcomputer named Biloceran has been developed. This instrument is installed between the rows at the time of emergence and collects data on temperature, relative humidity and precipitation every 10 minutes. Every 24 hours, the microcomputer makes a recommendation which can be read by pressing a button on the front of the instrument. Results have indicated that Biloceran could be useful in Sweden, but more work is needed, however, to adapt its use to cultivars of differing blight resistance.

H. Seiter - Development of an integrated production system in arable crops
No abstract.

R. Rahmouni - Development of an integrated production system in arable crops in the Netherlands
No abstract.

Inventory on Models for Integrated Crop Protection
Dr D. Birt is anxious to know whether there have been any new developments in this field, so that an updated inventory may be published in the IOBC Bulletin. Those who have any appropriate information are kindly requested to contact Dr D. Birt at E.M.R.S., Malsleben, Kent, ME19 4DQ, UK.

IOBC Working Group on Quality Control: Workshop held in Gavà on 22 August - 3 September, 1982
The program centred on the state of the art of quality control in the world's major seashore vegetable programs and on their needs for research and development, including Cantharida model, Leptinotarsa model, Orienta fruit fly - Tatarin, Melon fly - Jyam, Moltol - Australia, Moltol, CAVF/LUSA, Medfly - USA, Mexico/Guatemala, Mercurid fruit fly - Tenebrio, Ampharos, Screwworm fly - Pink bollworm, Gypsy moth, Helicoverpa, Bollworm. Following the Workshop, there was a visit to Mexico to inspect the screwy worm and medfly facilities and review the program.

REPORTS OF CONFERENCES
This workshop was sponsored by the International Craps Research Institute for the Semi-Arid Tropics (ICRISAT) during 15-25 November, 1981 to bring together experienced and active scientists from both developed and developing countries to review current information on different aspects of the management of Helicoverpa spp. and to determine priorities for future research. The topics for consideration were grouped under seven main headings, with a review paper and several more specific papers presented in each session.

Mention 50 scientists from 35 research groups in 11 countries (Australia, Germany, India, Mexico, Nigeria,
The Symposium on Insect Control of Tomorrow, held from 15 September, 1981, in the Netherlands, saw the presentation of several new approaches to insect control. The symposium was organized by the European Association for the Study of Insect Pathology and the Dutch Society for the Study of Insect Pathology.

One of the papers presented was titled "Use of natural endosymbionts for insect pest control" by B.S. Bowers. The paper discussed the use of endosymbionts, which are microorganisms that live in the gut of insects, to control pests.

Another paper, "Regulation of insect growth and development using an endosymbiotic system," was presented by G.B. Steel. The paper discussed the potential use of endosymbionts to control insect populations by manipulating the growth and development of the insects.

The symposium also included a paper titled "Insect control with growth regulators interfacing with the endosymbiotic system" by G. M. Chipman. The paper discussed the use of growth regulators to control insect populations by affecting the endosymbiotic system of the insects.

Overall, the symposium provided a comprehensive overview of the latest research in insect control, including the use of endosymbionts, growth regulators, and other novel approaches.

Moreover, the symposium highlighted the importance of research in insect control, as it is crucial for the prevention and management of insect populations, which can cause significant damage to crops and other agricultural products.

The symposium was successful in bringing together experts from various fields to discuss the latest advancements in insect control and to identify new areas for research.

In conclusion, the use of endosymbionts, growth regulators, and other novel approaches holds promise for the control of insect populations, and further research is needed to fully harness their potential.

B.S. Bowers: *Endosymbionts for insect control*, pp. 9-14

G.B. Steel: *Insect control with growth regulators interfacing with the endosymbiotic system*, pp. 15-23

G.M. Chipman: *Insect development*, pp. 24-25

Disparis permits insect survival under adverse climatic conditions and synchronizes the life cycle of individual insects within a population as well as with their food supply. This synchronization might be fully exploited for insect control but it is not at present. Methods currently used and new approaches that might be developed to disrupt the seasonal synchronizations and disperse of plant-eating insects are discussed. For example, the seasonal migration patterns of cereal aphids, the dates, uses of early maturing varieties, and the destruction of crop residues are well-established methods for suppressing populations of pest insects on many crops. In contrast, the possibility of disrupting insect diapause through, for example, the use of non-diapause-inducing insects, aphid parasites, environmental cues, or hormones or other genetocides requires much additional research. Although the ecological, physiological, and endocrinological aspects of insect diapause have received much study, practical methods have yet to be developed to interfere with the programming of diapause. Using the larval diapause of the northwestern corn borer, *Diatraea grandiosella*, and the adult diapause of the Colorado potato beetle, *Leptinotarsa decemlineata*, as examples, some aspects of research into diapause are reviewed. Included is a discussion of the role of temperature choice, the time and frequency of juvenile hormone, and the role of amino acids present in high fiber in the larval meal. Several areas requiring further research are suggested.

K. Dingler: *Pathology of migration in the seasonal synchronisation of insects*, pp. 26-28

Seasonal migrations of insects can be roughly divided into those within the temperate zone, those within the tropics, and those between the tropics and temperate areas. Temperature migrations often involve movements toward diapause sites with correlated winter cycles in reproductive physiology. Many temperate insects have anarform estrous or estrus cycles whose estrus is often synchronized with the summer monsoon migration, but the cycle is likely to be fixed or seasonal migration, rather than a pre-determined migration. Certain seasonal migration may be a prerequisite for migration into the temperate zone by tropical species; the two behaviours occur in several insects. An interesting benefit of tropical-temperate migrations is that *Dipteran* species which apparently have no return movement, by seasonal selection in these cases is utilized. In all cases, migration and diapause is intimately involved with either reseeds of life histories becomes the predominant life history and when to breed. The elucidation of the control of genetic and environmental variables to insect migration strategies is an important problem for entomologists.

G.V. Dathie: *Mechanism of larval plant recognition*, pp. 49-58

Recognition and preference of host plants involve the induction of a complex of metabolic and morphological events. These include the sensing and encoding characteristics of the sign plants, decoding mechanisms in the central nervous system, assessment of access-control systems and deterrent/antinutritive factors, pre- and post-injection factors such as level of satiety, nutrient balance, and environmental factors such as induction and avoidance-learning.

L.M. Schonbohm: *Biological aspects of antifeedants*, pp. 57-69

Certain chemicals of plant origin may inhibit food intake in phytophagous insects. Such antifeedants act at low concentrations and are perceived by specialized deterrent receptors or by the combination of different receptors within the chemosensory input. In some cases, roduction to the presence of
antifungal traits. When we want to find more chemistries which fulfill all requirements of true and effective antifun-
gals, more research on plant chemistry and insect behaviour is needed. Large scale application only becomes feasible when a number of biological as well as technical problems will be solved.

P. Grus: Hills and mines. the ecological approach to pest control in orchards, pp 70-87

Experiments in the Netherlands have shown that over half of the 24 species of arboreal species in apple orchards can be controlled fully or substantially by biological or cultural methods. Thrips and mites are the most important pests in apple orchards. Modern management of orchards requires several other insect pests. An under-
growth of wild flowering plants did not prove helpful to control disease. The control of weeds, a half-metre soil depth is discussed, and a survey is given of ecological and other control methods that can be combined in a IPM programme. Prevent measures should be initiated by the government to overcome resistance against their applications.

B.A. Coetzee: Arthropod resistance to insecticides: a key to pest control failures and successes in North American apple orchards, pp 50-110

Cases of developed resistance in apple artlanaphus in North America, including pests and natural enemies, are reviewed with emphasis on the past 20 years. Resistance to organophosphate (OP) insecticides were first widely em-
ploved. Five pests, including the leafminer, Lepaeria proxima, have developed resistance to OP compounds. Resistance to OP compounds in many arthropod species is documented. The insecticides that have been used on apple orchards in the recent years are: Thrips, tobacco budworm and tobacco mites. A survey of the impact of long-term OP use on resistance to pests, as well as the development of resistance to other pests, is given. Integrated pest management (IPM) and biological control are discussed. The major pest management strategies for apple orchards are discussed, and control measures for pests are given.

T. N. Hohn: Recent trends in insect control in the tropics, pp 112-125

Efforts to increase agricultural production in the tropics must be based on the principles of sustainable agriculture. Insects have been identified as the most important pests of crops, and are the most important pests of crops. Insects are a major threat to crop production, and are a major threat to crop production. Insects are a major threat to crop production, and are a major threat to crop production.

FORTHCOMING CONFERENCES AND MEETINGS

XV Pacific Science Congress

This Congress will be held in Dunedin, New Zealand, from 1-11 February, 1993. The theme is Conservation, Development and Utilisation of the Resources of the Pacific. The Environment programme includes a plenary session entitled "Environment: the Development of the Pacific." The plenary session is scheduled on Tuesday, 2 February, and runs all day. The session includes papers on environmental issues, including climate change, and the impact of development on the environment. The session also includes papers on the environment and development, including the role of the environment in development, and the impact of development on the environment.

World Health Organization (WHO)


There are seven sympoia topics:

1. Insect vectors of human and animal diseases in the Pacific Basin.
2. Agricultural and forest pests in the Pacific Basin.
4. Rice pest management.
5. Pest management systems for the Pacific Basin.
6. Biological control of insect pests of economic importance.
7. Accidental introduction of insects through human agency.

For further details, write to the Convener of the Environment programme, Dr J.S. Pillar, Department of Microbiology, University of Otago, P.O. Box 56, Dunedin, New Zealand.

IDRC Working Group on Use of Models in Integrated Crop Protection

The next meeting of this Group will be held from 29 February to 2 March, 1989 in Luxembourg, Belgium. The general theme will be "The use and implementation of models in integrated crop protection." Those who would like to contribute or attend are invited to contact the convener, R. Rafter, Department of Theoretical Production Ecology, Agricultural University, Bornseestraat 65, 2608 PD Wageningen, The Netherlands. Tel: 083/65 8241.
students taken principally from Central America. The research is grouped into 4 approaches: Agriculture and Food Science, Human Biology, Growth and Development, Applied Nutrition, Agroforestry, and Food Science in further developing into a great variety of foods, food technology, new food sources, animal nutrition, and about 15 programs are underway in this area. Dr. P. Brennan leads the state foods section. He and Dr. Farnes are world-renowned for their work on the nutritional evaluation of beans and other legumes, particularly with regard to protein nutritional factors which cause the nutritional problems associated with beans and other beans. They are discussing the fundamental pathology of these problems, their cause, and the solutions. Although the biochemical study is not a fundamental feature, it is a step towards improving nutrition in Central America.

With regard to Brachia/Platypus spec, it is expected that some are common species which appear at INCA and IBERAP. No specific research has been done on this at IBERAP. It is expected that the Brachia/Platypus relationship is a major influence on the biological activity of the soil. It is unsatisfactory to draw conclusions from the soil activity. Soil research at INCA is not as well established as at IBERAP. It is for this reason that the possibility of a different future collaboration is proposed.

- either by initiating parallel research on the physiological and chemical basis of the soil, which may lead to the development of a soil-forming process,
- or by allowing a student, preferably from Central America, to work successively in both institutes.

It would be impossible to include INCA research in any further research on Brachia/Platypus relationship, because of the time required for the Brachia/Platypus relationship to develop. The collaboration of these workers in a study of the physiology of Brachia/Platypus is fundamental.

BOOKS


ABSTRACTS

Plant Protection

1. INSECT AND MITE CONTROL


Nuclear polyhedrosis viruses isolated from the alfalfa looper, Autographa americana, and a soil mite, Gnathopus sp. were formulated as a virus-bait for wheat grain and tested in greenhouse and field plots for suppressing black cutworm, Agrotis ipsilon. In the greenhouse trials, tobacco mosaic virus-reduced plant damage and the number of cut plants in the greenhouse and field plots when applied at 1x10^6 polyhedral inclusion bodies per kg.


A baculovirus of the alfalfa looper, Pseudoplusia includens, was applied at a rate of 247.16/ha to soybean. Larval population levels, virus induced larval mortality, and viral concentration in the soil and on the soybean were monitored from August to August 1977. Viral application resulted in 80% larval mortality and viral concentration in the soil at 10,000,000 viral particles per kg. A baculovirus of the alfalfa looper, Pseudoplusia includens, was applied at a rate of 247.16/ha to soybean. Larval population levels, virus induced larval mortality, and viral concentration in the soil and on the soybean were monitored from August to August 1977. Viral application resulted in 80% larval mortality and viral concentration in the soil at 10,000,000 viral particles per kg.


LC50 and LC90 values for two nuclear polyhedrosis viruses isolated from the alfalfa looper, Autographa americana, and a soil mite, Gnathopus sp., were determined against black cutworm, Agrotis ipsilon, and mite larval 1-day-old larvae reared at 15°C before testing and (3-day-old larvae reared at 27°C before testing. The results showed that black cutworm larvae have low to moderate susceptibility to these viruses. As the larvae developed, their susceptibility to the viruses rapidly declined. Initial larvae of black cutworm surviving sublethal doses of these viruses was reduced but more larvae of these viruses were significantly different from untreated controls.


A multiplex PCR of H. americana Al-MNPV was tested against H. americana and Syngrapha frugiperda. J. Invertebr. and
S. exigua. H. zea was most susceptible with the LC_{50} in the range of low 10^3 polyhedra/ind. but. S. exigua and S. exigua had LC_{50} in the low 10^5 range. and S. frugiperda was much less susceptible. with LC_{50} in the upper 10^6 and lower 10^7 polyhedra/ind. range. The results of about 426 trials on many polyhedra to produce 50% mortality in S. exigua as in H. zea indicates that this virus. was used in experiment. S. frugiperda.


The dissolution of polyhedra of Autographa californica NPV from Triplaxidenta harvovi was studied to trace. Observations were made in timed intervals using phase contrast microscopy. and scanning and transmission electron microscopy. Dissolution occurred rapidly and in a detectable sequence. Under phase contrast. most polyhedra lost their integuments by 0.5 min. The polyhedra became rounded in appearance with small protrusions on the surface and Brownian movement was observed. within. After 1 min. the envelope of most polyhedra had disappeared. releasing the enclosed virus. The protrusions were also observed under the scanning electron microscope after digestion for 0.5 min. Many shell fragments devoid of internal contents were seen after longer digestion. Internal structural changes were revealed by electron microscopy. After 1 min. exposure. polyhedra were observed in all stages of dissolution. By 3 min. only virions. scattered about in homogeneous medium. could be distinguished.


Two strains of a nuclear polyhedrosis virus (Baculovirus) infecting the cornworm, Pseudalderia antillensis. were examined. The eclipse period was studied. The virus was found to be replicating in the infected cell and was detected in the cell-free supernatant. The virus was shown to be replicating in the cell-free supernatant. The virus was shown to be replicating in the cell-free supernatant.


Ten major polyhedrosis viruses infecting insect hosts in the genus Helicoverpa and isolated in different geographical regions of the world were characterized using restriction endonuclease analysis of DNA digestion with HinfI. EcoRI, and HaeIII. The restriction fragment patterns were found to be highly conserved among isolates from different geographical regions. However, some differences were observed in the restriction fragment patterns. These differences may be due to geographical isolation or different host species. Further studies are needed to determine the significance of these differences.


Two nuclear polyhedrosis virus strains were isolated from Spodoptera littoralis larvae collected from several areas in Brazil. The two viruses were characterized and compared by restriction endonuclease cleavage of their DNA and Southern blot hybridization. The two viruses have no detectable sequence differences in the major common virus isolate, was found.


The Rhinoceros Beetle Project in Wesairyt, Malawi has developed and successfully applied biological methods to control the rhinoceros beetle, a serious pest of coconut palms. By using two specific pathogens, a baculovirus, and an entomopathogenic fungus, Metarhizium anisopliae. The application of virus particularly has markedly suppressed the beetle population and helped revive the palm industry. The viral disease has established itself in the wild beetle population several years after its introduction at a level between 30 and 50%. At that time. an increase in beetle numbers and damage to palm trees was experienced. Therefore, a continuous release of virus into released beetles was proposed. It was argued that, considering the relatively high level of natural virus resistance, further releases of virus into the population would be futile. In a combined research and control program, virus was again released into the wild beetle population, which was already virus infected. The results show that the release of the virus level can be reduced and the preventive biocontrol program can be expanded. The techniques of the control methods are described. The virus release is very easy and cheap; it requires no chemicals, no special equipment, and it is particularly recommended in situations where breeding places are inaccessible or other methods such as biocontrol. A serious and otherwise impossible biocontrol is economically impractical. Above all, the methods are absolutely safe from the standpoint of environmental protection.


Prevalence of the nuclear polyhedrosis virus (NPV) and granulosis virus (GV) was determined in populations of fall armyworm. Spodoptera frugiperda. in southeastern Louisiana. Both diseases reached their peak mean infection rates in mid-August in fall armyworms infected larvae, the NPV at 58% and the GV at 23%. NPV prevalence was about 50% positive at 60 to 70% infection rates to NPV in the samples; GV was positive in all infected larvae. This indicates that granulosis virus is an important factor in the control of armyworms, and a microsporidian was not.


A granulosis virus of Helicoverpa armigera from South Africa was shown to be pathogenic to Helicoverpa zea, Spodoptera frugiperda, S. exigua and Tribolium castaneum on all lepidoptera: Noctuidae.

Evidence is presented to show that the resistance to a granulosis virus in a laboratory strain of potato moth, Phthorimaea operculella is controlled by a single dominant autosomal gene which segregates according to simple Mendelian ratios. This may be one of only a few genes which influence the phenotypic expression of resistance and contribute to the wide variability in resistance to the virus shown by field populations of the moth.


The efficacy of Thricidil 48B and Dield 4B, formulations of Bacillus thuringiensis var. kurstaki, was determined on Choristoneura funebris infestations on tobacco in Alberta, Canada. The formulations caused bollworm populations and protected foliage sufficiently to warrant further field testing with different dosages and galleons. The B. thuringiensis did not adversely affect parasitization, as determined by laboratory rearing of field-collected larvae.

G.E. Cornell et al. (1972). Potential of Bacillus thuringiensis as a microbial agent against the Mexican bean beetle. J. econ. Ent. 75 (2): 345-350

A preparation of Bacillus thuringiensis, which contained a hunt-toxin, was effective in controlling larvae of Euxemota sp. in both laboratory and field tests. At a dilution of 1 x 10^4, a single application of 2.5 g/m² of seed was effective in controlling E. sp. in a field trial. The results show that Bacillus thuringiensis can be used as a microbial agent against the Mexican bean beetle.


In northeast Hungary, B. subtilis has only one generation and renews itself in the late stage. A spring application was tested using a chemical pesticide (Fenitrothion AT-125) against the Helicoverpa armigera. The results show that the use of a combination of Bacillus thuringiensis can prevent the occurrence of the Helicoverpa armigera in the future.


The application of Bacillus thuringiensis and Bacillus cereus to cotton suppressed Helicoverpa spp. populations an average of 88% when compared with the untreated check during fall, and it was more effective in other areas. The authors recommend the use of Bacillus thuringiensis and Bacillus cereus to control Helicoverpa populations in cotton fields.


A soil-dwelling, termite feeding, powder of B. thuringiensis var. kurstaki was used, which was effective on E. sp. and contained 35.52% (W/V) and 3.4 x 10^3 colony forming units/mL. Although the B. thuringiensis is susceptible to the E. sp., it is considered the first report of its susceptibility to the E. sp. In addition to larval mortality, var. kurstaki treatments also reduced larval feeding and body weight gain.


Seven varieties of Bacillus thuringiensis were screened for activity against S. litura. Only B. var. amyloliquefaciens showed high potential activity, with a potency of 0.125 (U/mg) for the first instar.


Bioassays to determine LC50 values of species and crystals of four varieties of B. thuringiensis grown on nutrient agar plates were carried out using 6 and 6-day-old European corn borers. Spodoptera frugiperda larvae. The results show that B. thuringiensis var. amyloliquefaciens is toxic to 6 and 6-day-old larvae. Different rates of purity species and crystals of the bacterial also were tested against monocot and dicotyledonous larvae. Pure species were toxic to 6-day-old larvae, but a combination of species and crystals was necessary for maximum larval mortality.


The activities of Bacillus intermedius and Bacillus thuringiensis in 12 Hecoptera containing Galleria mellonella revealed important. unique relationships between pathogenically and susceptibility. With few exceptions, all active isolates belonged to type 5 and 7. Although a few type 5 and 7 isolates were inactive or moderately active, all 64 Hecoptera type 5B isolates with crystal protein pII 10 active as were 33/38 Hepialus 7 with the crystal protein 5. The work supports the various strains given to these two Hecoptera and each can be divided into two subgroups on the basis of activity, Hepialus 1, 7D, VII, and crystal types a, b, c, d, e and f were not significant to be active, While 41/42 Hepialus 1, VI, and me were considered to be inactive. No consistent correlation between resistance and toxicity and those in other host species was observed. This suggests the presence of a number of factors, those in Hepialus 5 and 7.
and crystal types gal and alg inducing high activity in G. mungo, others inducing moderate low activity in G. mungo but high activity in other species. No isolate was more active than the SSB strain once used in Thailondo, but type 7 isolates are better for fermentation since they are less susceptible to bacteriophage.


Exotoxins produced by three varieties of B. thuringiensis were added at different concentrations to the diets of the black cutworm, the fall armyworm, the European corn borer, and the house fly. By day 7 of treatment, mortality of the three lepidopterans was higher at the lower concentrations of exotoxin than at the higher concentrations tested by key 14 of treatment. Mortality was 90% or greater at all the exotoxin concentrations tested. In the house fly tests, mortality increased with increasing exotoxin concentration. Additional lepidopteran tests were run to study both the anatomical effect of toxin concentration on mortality and the effect of feeding inhibition evident by day 7 but not day 14 in treatments with high concentrations of the toxins. The tests run with the European corn borer with B. exotoxin excluding all, shows that both effects could be attributed to a specific deterrent associated with the toxin, and that the deterrent was not edorous and did not degrade over time. Apparently, the insects were very little of the diet high in exotoxin, stopping quickly upon receiving a higher concentration of the rice meal but, nevertheless, having consumed enough toxic to be killed over time between 7 and 14 days.


Toxicity of B. thuringiensis var. israelensis, but not Bacillus thuringiensis var. kurstaki, has most of its toxic effect on larvae of 25 days at exposure of 50%. The bioderives of one liquid-formulated and two solid-formulated strains of B. thuringiensis var. israelensis were tested. No loss in toxicity was detected for the wasp-formulated formulation of B. thuringiensis var. kurstaki. On the basis of efficacy in terms of percent mortality, the liquid-formulated formulation, 300 and 150 for the two wasp-formulated formulations, of B. thuringiensis var. kurentkaki, was higher than the liquid-formulated formulation in relative differences in the susceptibility of larvae of B. thuringiensis var. israelensis and B. thuringiensis var. kurstaki.

C.C. Beegle et al. (1962). Relationship between histological histostasis-developed potential and field efficiencys of B. thuringiensis isolates with different spatial activities. J. Insect Physiol., 19 (12): 138-146

B. thuringiensis isolates with different spatial activities were not equally efficacious when applied to cattle at the same rate of 1.5 lbs for protection against larvae of the cabbage looper, Trichoplusia ni. Preparations of the isolates were standardized against T. ni larvae. Various gutierrez applied (HD-196 and HD-153) were the most efficacious per applied IU, and a D-27 type variety (HD-170) was the least efficacious per applied IU. A variety thuringiensis HD-249 and a L-1 type variety variant (HD-117) were intermediate in efficacy per applied IU. Speed of kill and, to some extent, differences in the amount of food consumed appear to be responsible for the differences in efficiency per applied IU. When more potent B. thuringiensis isolates are discovered and developed, the recommended field dosage for the new isolates must be determined by actual field experimentation rather than by extrapolation from exudent HD-1's data.


Grain dust, from four large elevators along the Mississippi River near New Orleans, Louisiana, was analyzed for the presence of B. thuringiensis, a pathogen of lepidopterous insects. Both serated grass dust and nonpreferable grass dust samples were taken. A total of 20 stranded and 56 respiratory grain dust samples were analyzed. No insects, alive or dead, insect parts, particles, or tissues of these were observed. Of the stranded dust samples, 55.9% contained B. thuringiensis, while 16.9% of the respiratory dust samples were positive for this organism. Two hundred fifty-five B. thuringiensis colonies were studied, with 30.8% being B. thuringiensis. Serological and biochemical tests showed 94.9% of them to be variety hortens.

The varieties present were mexicanus, tenebrosus, indiana, and tenebrosus.


The discovery of phages of B. thuringiensis opens up new prospects for the investigation of the genetic mechanisms of crystal formation and for the establishment of a genetic engineering of strains with a higher toxicity and wider host ranges against insect pests. This brief communication describes the acquisition of transformation of B. thuringiensis prophage by phage DNA, with a frequency of 10^-4.


A unique type of microorganism has been found caused an unusual disease in larvae of the slower caterpillars, Spodoptera frugiperda. The organism contains DNA and reproduces extracellularly from an infective form of bacillus or californium particles which measure 1.70 x 450 in negatively stained preparations. During initial stages of development, the organism apparently reproduces primarily within vesicles in the cytoplasm of a variety of cell types (including perikaryal granules of the larval body, and troclear matrix cells. Most reproduction, however, occurs in vesicles that circulate in the hemolymph. These vesicles, most of which are derived from tissue cells, measure 2-10 um in diameter, and are highly electron, reach populations as high as 10^10 cells of hemolymph, and are diagnostic for the disease. The pathology caused by this organism, its shape and intracellular appearance, and reproduction within vesicles indicate it is a peculiar type of enterobacter, probably related to those of the genus pseudomonas or a new type of enterobacteriaceae. Among its unusual features are its ability to produce formation of reproductive vegetative forms of host cell components, and its apparent control of the new humoral and membrane synthesis with these animals as a streptomyces. The possible relationship of this organism to bacillusvirus and enterobacteriaceae is a hypothesis.


A study of natural mortality is larvae of the cabbage looper, Trichoplusia ni., feeding on experimental broccoli
plantings in Riverside, Calif., revealed that ca. 30 % of the larvae, collected from July through October 1979, had a disease caused by a nematode-like organism. This disease occurred most commonly in 2nd- and 3rd-instar larvae, where the rates of incidence were 12.8 and 15.2 %, respectively. All larvae that developed patent infections died from the disease. The disease was most easily recognized in larvae which were reared individually in the laboratory on artificial diet. Disease signs included an opaque yellow to white discoloration on the body, incomplete shedding of the molting cuticle, reduced feeding activity, and a retarded growth rate with concomitantly increased larval longevity. At the histological level, the hemocyte of diseased larvae was milky white and contained numerous refractile vesicles that were diagnostic for the disease. Electron microscopy demonstrated slightly curved helicoidal filaments, 160 by 420 nm, developing within these vesicles. Vesicles and parasites also were found in the cytoplasm of epidermal, tracheal matrix, and fat body cells. The disease was transmitted to healthy 3rd instar larvae by infecting them with diseased hemocytes from diseased larvae. About 50 % of the treated larvae developed typical signs of disease and subsequently died.


Zoophthora radicans was released into pasture crop for the biological control of Thripsorticia triflora L. marchalii. At one site an epidemic was initiated, with up to 93 % of larvae being reared within 3 months of the point of release. No rain was recorded during the epidemic and disease transmission could be correlated with prolonged periods of high humidity and low temperatures. The disease did not occur on other aphids but has persisted, probably as resting spores, at one site for many months in the apparent absence of the host. Initial levels of field infection have been variable over the life of a high humidity field cage. A method has been developed to improve this initial infection rate is described.


T. inornis has been found attacking timothy grass throughout much of eastern Canada and the United States, reaching peak sizes in Ontario and Quebec. The two species of fungi isolated and described are Zoophthora radicans = Entomophthora sphagnorum and Entomophthora cactorum. This is the first report of an entomopathogenic fungus affecting the European skipper or any other hexapod.


When corns of Beauveria bassiana are injected into the haemocoel of corn earworm larvae, it appears that a positive correlation exists between exocellular proteolytic activity of the fungus and entomopathological manifestations. One inside the haemocoel, defense mechanisms (including phagocytes) are incapable of overcoming the fungus and an important event in a terminal mycosis cascade involves preferential invasion of the gut wall. Such invasion helps explain the observed inhibition of feeding by infected larvae. Although histopathological changes seen in gut tissues suggest that a gut toxin is produced, evidence for such a toxin could not be obtained in preliminary tests. Biochemical changes are seen in hemolymph components; however, these are viewed as being due to general intoxication rather than to specific activities of the fungus, at least up to the time that a general necrosis is established. With the loss of larval immunity, nutritional stress, nutrient depletion, and, possibly, toxin production in gut tissue and failure of defense mechanisms, the infection spreads quickly and a terminal mycosis results.


A procedure is described that can be effectively used to measure the activity of cerebral preparations of the entomopathogenic fungus Beauveria bassiana. 1st instar 3rd instar larvae are exposed to a focal light surface treated with visible condens. After 48 h, larvae are transferred to an untreated, aerated, sacrificed (12 h), and the bioassay is terminated 5 days later. The lesion-mortality correction equation for this bioassay was $Y = 2.142 + 1.335X$. The calculated $IC_{50}$, $LC_{50}$, and $LC_{90}$ were 82, 139, and 290 median counts per mm², respectively.


The effect of pesticides on development of Beauveria bassiana was examined both in field conditions and in the field. The commonly recommended late blooming fungicides and systemic pesticides were found to affect the metabolism of the fungus. Field experiments with the Colorado potato beetle, Leptinotarsa decemlineata, supported laboratory findings.


Cytolytic acid is present on the surface of corn earworm, Helicoverpa zea, and suppresses growth of B. bassiana. The experimental fungicide CCA 48988 and the insecticide permethrin show little inhibition of the fungus. Field experiments with the Colorado potato beetle, Leptinotarsa decemlineata, supported laboratory findings.


Beauveria coccinea sp. nov. was found on Leptinotarsa decemlineata in Ecuador and is characterized by ellipsoidal conidia covered with a distinct mucilaginous layer. Another
B. javanae species, commonly encountered on Cocos nucifera in Brazil proved to be identical with \textit{bactria amphiopas}, originally described from a coconut in Indonesia. The new combination \textit{Beaverti amphiopas} is proposed. Details of the occurrence and ecology of both species are described.

M.S. Stoliczka et al. (1983) Identification of \textit{Acanthura amphiopas} which harbors Beaverti amphiopas larvae & infects larvae of \textit{Acanthura amphiopas}. A Metabolite of a common soil fungus, \textit{Penicillium amphiopas}, which inhibits soil bacteria and growth of \textit{Beaverti amphiopas} was identified. The production, extraction, and purification of the metabolite is described. Two-dimensional thin-layer chromatography, reverse phase chromatography, mass spectrometry and bioassay data indicate that the metabolite is pyrrolizidine. The implication of pyrrolizidine in \textit{B. javanae} and its subsequent effect on the potential role of \textit{B. javanae} as a control agent of soil-borne insects is discussed.


\textit{N. ricini} MRRL-5895A was used in these studies, and was shown to cause larvae death. Although it was difficult to determine the cause of fungal infection, the authors assumed that fungal growth in the larval gut with no apparent fungal growth on the larval integument indicated fungal infection via ingestion of conidia. Most fungal infection was probably through the larval integument.

D.C. Buscall et al. (1982) The relative susceptibility of six arthropod species to infection by \textit{Nucifera ricini} treated with \textit{Acanthura amphiopas}. J. Invert. Path. 39 (2), 238-240

The inoculum species included \textit{A. amphiopas}, \textit{Pseudococcus includens}, \textit{Spodoptera exigua}, Helicoverpa zea and \textit{Tribolium castaneum}. Two Florida \textit{N. ricini} isolates, \textit{V1 74} and \textit{V1 71}, were used. The results of the comparative assays demonstrated unique differences in the insecticidal activity of some inoculants to these two \textit{N. ricini} isolates, thus providing a format for the selection of specific strains against defined pest complexes.

C.M. Isgro et al. (1983) Susceptibility of larvae of \textit{Tribolium castaneum} and \textit{Anoplophora viewed} to \textit{Acanthura amphiopas} and \textit{Nucifera ricini} inoculated into intrahemolymphic injections of cornula and blastoconders of \textit{Nucifera ricini} larvae. J. Invert. Path. 39 (2), 238-240

The LD$_{50}$ for larvae of \textit{T. castaneum} injected with blastoconders of \textit{Nucifera ricini} was 4.30 x 10$^3$ hyperbolic bodies/larva; the LD$_{50}$ for injected cornula was 28.000 cornula/larva. The dose-mortality regression line for blastoconders was $Y=4.8504+0.5487X$. Larval mortalities of \textit{Anoplophora viewed} and \textit{T. castaneum} at 100 blastoconders/larva were 0.40 and 0.5%, respectively. At a dose of 25,000 cornula/larva, larval mortalities for \textit{A. amphiopas} and \textit{T. castaneum} were 0.4 and 0.5%, respectively. Thus, larvae of \textit{A. amphiopas} were $>$100 times more resistant to injected cornula and blastoconders, respectively, than were larvae of \textit{T. castaneum}. Resistance of \textit{A. amphiopas} to \textit{N. ricini} may be due to the great nutritional barrier, as in other behavior, but may also be a function of an internal physiological response.


Combined scanning and transmission electron microscopy was used to study the fine structure of the developmental stages of \textit{Nucifera ricini} infecting host larvae of \textit{Acanthura amphiopas}. Larvae were exposed to leafhoppers, which perished and generated the cuticle within 6 hr post-inoculation. Within 24 hr, penetration of the larval cuticle had reached the cuticle epidermis and, via a stinging mechanism, infected the hypodermal body stage in the hemocoele. The hypodermal bodies, suspended and spread throughout the host larvae. By 7-9 days post-infection, the majority of larvae were uninfected. Within 12 hr post inoculation, numerous conidiospores emerged, resulting in the formation of mycelial growth over the entire cuticular surface. Numerous hyphalized conidia were formed on phloem present on the aerial conidiophores.


Studies on the best resistance of the conidia of \textit{Metarhizium anisopliae} showed a clear correlation to the initial temperature conditions. The medium lethal temperature for 36 min of exposure in a suspension was 42°C, but 50.3°C at 100% RH, 57.9°C at 95% RH, and 66.8°C at 93% RH. The experiments on the effect of artificial sunlight indicated an extrapolated half-life of the conidia under field conditions of 1 hr, 30 min for 24 hr incubation at 25°C in the dark following exposure and about 2 hr, 45 min for 48 hr incubation.


Separate groups of subterranean termites (\textit{Reticulitermes}) were exposed in a controlled environment to \textit{Metarhizium anisopliae} or \textit{A. amphiopas}. Individuals were removed after varying time intervals and hindgut contents were placed onto potato dextrose agar. Various spores first appeared in the hindguts within 8 hr of inoculation. Fungi spores were pathogenic to worker termites were pathogenic of healthy termites. Histological examination showed that the hindguts of the inoculated by \textit{M. anisopliae} occurred exclusively through direct invasion of the integument on 24 hr after death. \textit{B. javanae} invaded, primarily through the alimentary tract, 12 hr prior to termite death.


Subterranean termites (\textit{Reticulitermes}) sp. were exposed to a wide range of \textit{Metarhizium anisopliae} for 4, 8, 12, or 48 hr transfer disease to previously healthy termites. Healthy termites inoculated with virus-like agents on diseased, individual and thereby became infected. Termites which have been killed by the fumigants are avoided by healthy individuals and are not effective in spreading disease than are exposed living termites.
One strain (223) of Brachystola massa, two strains (N-22, T-27) of Brachystola sp., and three strains (Tonga-108, MM-775, of Asthenophysa amoeneles) were tested for their pathogenicity to workers from a colony of Coenonymma formosanus. A microinjection method for estimating and applying the inoculum was employed in these tests. On the basis of LD50 and fiducial limits, the pathogenicity, in descending order, was: MM-775 > T-27 > N-22 > 223 > T-22. Because of heterogeneity, the fiducial limits of the Tonga strain overlapped all of the other isolates except for MM-775. Except for the Tonga strain, M. phlebophora appeared to be more pathogenic than Brachystola LD50 and 1:1:1 isolates were also determined.


Electrophoretic analysis of mycelial preparations of 17 isolates of Herbasutella kumasiensis demonstrated extensive variability in isozyme content. Many isolates possessed distinct electrophoretic sects or groups with different individual isolates. Coefficients of similarity based on isozyme patterns closely followed the morphological scheme used to separate H. spumalina into three varieties. One exception, the several-normans var. varulans was very close to the aerophilus-greenish-grey var. biicolor. The electrophoretic data demonstrate that extensive differentiation among the H. spumalina isolates is occurring at the subisolate level without apparent morphological changes.


A laboratory colony of Aecysthyrophila phlebophora has been found to consist of 2 biological strains in their susceptibility to the post aphid. The F1 mosaic of each of these strains which killed an average of 94% of the susceptible or biotype did not kill a single resistant aphid. Clones were established and have bred true for over 25 generations on bean buds and over 16 generations on lousewort. Seven of 8 field populations tested contained the resistant biotype. Eleven isolates of E. nozakii were tested against the 2 clones and 2 were found to attack the resistant biotype as readily as they attacked the susceptible. This is the first time that field populations of aphids have been reported to contain a biotype resistant to a fungus disease and also the first time strains of a pathogen have been found capable of attacking an otherwise resistant biotype.


This entomogenous fungus has been established as a natural biological control agent of H. paniculata in Pike and Spalding counties in central Georgia. The occurrence could play a vital role in the management of alfalfa in the state. Comparisons of entomophagous and 25 gophers with these from midwestern H. paniculata fields suggest that the fungus is E. phenacum.


Experiments were conducted to study the effects of time, temperature, and light regime on primary spore formation at 90% RH for the three major pathogens of Aecysthyrophila kumasiensis. Only small differences were detected between the continuous light and continuous dark regimes. Entomophthora kumasiensis produced large numbers of primary spores (5 x 10^9) per aphid only at temperatures between 10 and 20°C. The majority of primary spores were formed during the first 24 hr. Primary spore production with Entomophthora m. cupulata ranged from 7 x 10^9 to 10^10 per aphid at 5 and 10°C to 3 x 10^10 at 15 to 25°C, with most spores being formed during the first 24 hr. It is suggested that rainfall is more likely to be important for the transmission of E. cupulata and E. m. cupulata than for E. kumasiensis because of its greater resistance to wet weather.


In field populations of the European corn borer, O. nubilalis, there is a significant inverse correlation between the prevalence of corn borer infestation with the microsporidian Nasonia pyramida and the prevalence of parasitism by the introduced braconid Macroc erus grandis where infections with N. pyramida exceed 45%. This relationship occurs geographically and from year to year. Corn borer infestations with N. pyramida, the source of infection for M. grandis, is significantly related to corn borer density in the cornfield. These findings strongly suggest that N. pyramida has a significant adverse effect on field populations of M. grandis and may help explain the diminishing role of this and other introduced parasites as natural controls of the corn borer in the United States.


Nasonia locustae was applied to rangeland by aircraft at dosage rates of 2.1 x 10^6 and 2.1 x 10^6 spores per ha when the major grasshopper species, Melanoplus differentialis, were present. Treatments were compared with a standard rangeland insecticide treatment with 360 ml of 65% technical malathion per ha, and compared with no treatment. Each plot was 2,332.3 ha, and each treatment was replicated four times. The high level of N. locustae caused significant reductions in grasshopper densities during the season of treatment (1975). A parasitism of grasshoppers caused by the fungus Entomophthora sp. occurred earlier in the second season and reduced the potential for expression of subsequent effects by N. locustae. Nevertheless, the high level caused significant reductions, and the low level appeared to cause slight but not significant reductions in grasshopper densities during the two subsequent seasons (1976 and 1977). Parasitization of grasshoppers by entomopathogenic fungi and parasitoids decreased sharply in malathion plots, but tended to increase in N. locustae and untreated plots.
Spores of the microsporidian *Pneumocystis carinii* were found to be released in the broods of *Drosophila melanogaster* when the flies were exposed to *S. mansoni* eggs in vitro. The number of spores released was proportional to the number of eggs ingested by the flies. Differences in the number of spores released by male and female flies were observed. The results suggest that the microsporidian can be transmitted horizontally between individuals through the ingestion of eggs or infected tissue. Further studies are needed to determine the mechanism of transmission and the role of the microsporidian in the disease process.
average life span of adult female wasps was 26.3 days and during this period wasps deposited about 442 eggs and killed about 101 hosts by host-foming. From these results the intrinsic rate of natural increase was calculated to be about 0.3 females/day.


The maximum rate of prey consumption and the functional responses of 4th- and 5th-instar nymphs, preprodaceous, unarmed adults, and reproductively mature females of Nabis americans were determined. Consumption increased with nymphlet linear and was greater for reproductively females. Attack rates were highest and handling times lowest for reprodacively mature females, whereas preprodaceous adults had the lowest attack rates and highest handling times of the stages tested. Attack rates were in turn with prey type and structural complexity of the universe.


The parasitoids of the cotton bollworm, Heliothis zea and tobacco budworm, H. virescens, larvae collected from cotton and interplanted sesame were determined from 1971 through 1974 in the Mississippi delta. Greater numbers of Heliothis larvae (especially H. virescens) were found on cotton than on sesame and were more often parasitized. Apanteles marginiventris and Cotesia sphaerica were the most abundant parasitoid species reared from Heliothis larvae on cotton. 4.7% of larvae (34.9%), respectively. Although A. marginiventris frequently attacked larvae on both crops, only one C. sphaerica was recovered from Heliothis larvae infesting cotton during the entire study.


In gypsy moth larvae infected with the gypsy moth nucleopolyhedrosis virus were exposed to Apanteles melanoamea females, separately and in combination with noninfected larvae. Significant differences observed among the number of parasitoid-host contacts and percent parasitization percentages observed in various treatment indicated that the parasitoid preferred noninfected larvae, making fewer efforts to parasitize virus-infected individuals. Since the noninfected and virus-infected larvae were different in a number of ways, several factors may have contributed to the behavioral discrimination evidenced.


Heliothis virescens eggs labeled with radioactive phosphorus were placed in an east Texas cotton field, and 77 radioactively labeled larvae were harvested. These two captures consisted of 14 species and 2573 identified only to family. Similarity placed, H. virescens eggs: exposed to parasitization after the rate of spinthraeretum averaged 77% prediction in 24 h. When noninfesting predators were excluded from plots, egg prediction averaged 66%, and no plots where noninfesting predators and able predators were excluded to parasitize the 4-Centum, egg prediction averaged 43%. The seasonal cumulative percent prediction on H. virescens eggs averaged 77.6 and 86.4 for 24 and 48 h, respectively. By-vase sampling of predator numbers and whole-plant clipping of the Heliothis spp. egg numbers revealed a total range of 137 (preparasitized-egg ratio). The equation Y = 1.45 (log Y, N) = 0.02 with an r value of 0.68 predicts the percent Heliothis spp. egg prediction. Using the log predict-egg ratio as the predictor. Predictor efficiency values were calculated for several species or groups of species and presented as number of eggs individually consumed per 24 h. Eggs consumed per individual per day ranged from 14.2 eggs for Chalcidionia clausens to 0.3 eggs consumed by Sphex albiventris.


Beauval wasps, Apanteles expostilis, are at once of their host's oenothera. Eulophus phaeus, for hours, with on the limb of each host plant searching for the parasite. Encounters with larvae on the outside of webs were frequent and usually resulted in parasitoids turning away. Head-exiting identified by esophagitis was effective in knocking parasitized plant off the stem. Benign or carnivorous, facilities traveled to web-woven, eating less than 1 min per web. Overall, the defensive mechanisms exhibited by the parasitoids and their distribution on and in webs were effective in deterring parasitoids.


Predators killed about 95% of the western spupa, Bactrocera ocidentalis, pupae placed in one site in north-central Wisconsin. We infer that most of this mortality was caused by the spider wasps.


The longevity, fecundity and sex ratio of Gephyrotus morus, a paraparous natalist of Eristalis vitellae, were determined under laboratory conditions 22°C and 50% relative humidity, with food, and averaged 24.6 days, 21.5 days, 32.4 per individual and 1.6 males 1 female respectively. A significant correlation was obtained between the age of female parasitoid and her progeny production capacity (0.900.003).


The incidence of parasitism and disease was recorded during a survey of Perlophora noctuella populations from the major Australian potato growing areas. High levels of parasitism were found in most regions, though the composition of then at the three major sites showed marked geographic variation. There were also differences in the parasitism of larvae in leaves and in tubers. Some locations larvae were infected by a granulosis virus, which appears to be as close to a low frequency throughout the potato moth's range in Australia.

In May 1978, two females of Apteropus pods introduced from New Mexico were released in an apple orchard at the University of Georgia, Athens, Georgia, for the control of the spotted swordtail Poecilia reticulata. In the fall of 1978, A. pods reached an average size of 2.4 % of the overwintering third-generation females of P. reticulata. In the fall of 1979, the rate of parasitization by A. pods had increased to 35.7% in the original release orchard. A. pods is firmly established in the Georgia area, and recoveries have been made from as far away as Amarillo, Texas. G.P. Watterson & J.M. Steure (1982). Parasites of black moulded aphids and their effect on aphid populations in far-west Texas. Environ. Ent. 11 (2): 357-367

One primary parasite, Aphiella peruoidea, and five previously unreported secondary (suspected) parasites, M. koevans sp., Astrophorina sp., Aphiella sp., Dendrocerus sp., and Sphaerophoria sp., were identified from the larvae and pupae of M. koevans. In far-west Texas pear orchards, Aphiella peruoidea was found in significant numbers, but populations varied greatly among orchards. During most of the growing season, less than 6% of collected M. koevans specimens were parasitized by A. peruoidea, but up to 52% were parasitized in one orchard in October. Other species parasitized <1% of M. koevans populations.


Aegrotus and the ladybeetle Heliophilus quadrivittatus were found at several sites on the eastern edge of the Rocky Mountains in southern Alberta at altitudes of 1200-2430 m, and also in the Copper Hill (1760 m), just east of the town of Pincher Creek. The beetle is found on the plains region where they feed on psylla and grain aphids to the aggregation sites in fall, and return to the plains in spring. A. quadrivittatus can survive southern Alberta winters, but some protection is needed in high mortality sometimes occurs in isolated areas of the aggregation sites. Supercooling was found that the greatest resistance against cold occurs during mid-winter, but a considerable amount of cold hardening occurs during the fall. The most critical period for survival appears to be April and May when the beetles have lost much of their cold resistance, and a late spring cold period could cause high mortality.


Factors affecting the mortality of Coleomegilla maculata larvi were investigated at Guelph, Ontario from 1976 through 1978. It was found that most of the overwintering mortality of beetle occurred at the end of the winter. Parasitism by Pericomenis coleoptera reduced survivorship of overwintering beetles. There was no significant difference found in overwintering mortality of beetles caged at three different densities. Predation of eggs of C. m. longis was 44.8 and 48.6% in 1976 and 1977, respectively. Stage-specific mortality for the cootshells of the first generation as corn (primarily C. m. longis Guelph) calculated for the period from egg to pupa was 58.9% in 1977. In 1978, mortality from egg to pupa of C. m. longis was 95.4%. C. m. longis displays a type IV survivorship curve of Bradibonk.


The effects of temperature and prey density on Coleomegilla maculata adults feeding on Myzus persicae were used to investigate their impact on the C. maculata-M. persicae interaction. Seven temperature ranges from 15°C to 32°C were employed in the study. No prey densities per temperature and two prey densities per prey density were used. An enzyme kinetic equation was used to describe the response with temperature in the green peach aphid intrinsic rates of increase and the C. maculata and adult and larval search rates. The larval and adult handling times were determined to be largely related to temperature over the range studied. The strongest impact of C. maculata adults and 3rd instar larvae on green peach aphids was simulated by substituting these equations into two adult growth rate models. Both models indicated that C. maculata 3rd instar larvae and adults would be most effective in reducing the aphid population in temperatures above 29°C.


The present paper elucidates the functional response of Tetranychus (Hemiptera: Tetranychidae) showing sigmoid type of relationship between the number of eggs laid or host Ulais cocticoccus parasitoid and their density. This relationship is described using an exponential equation Y = 101 + 8.72 X which indicates that within 13 min of exposure period, in an area of 0.6 cm², the number of eggs laid by the parasitized cohort exceeded 341. This type of functional response is contributed to be the most stabilising one. At low host densities (1-510), the parasitoid was unable to locate the host in 50% cases. At high host density (>200) the parasitoid quickly approached the host quicker and stays on the leaf of the host plant longer than at low densities (4-201). The number of arachnid encounter and striking by the parasitoid increases with the increase of host numbers. The ways tends to eradicate almost an area of a parasitoid nest as the height, which is initiated by arachnid encounter with parasitized hosts. Different functional response to functional relationship to functional response are explained and discussed.

C.G. Wilson et al. (1982). The introduction of Tetranychus parthenogenetica, an internal parasite of the spotted alfalfa aphid, into South Australia. J. Aust. ent. Soc. 21: 19-27

Tetranychus parthenogenetica was introduced into South Australia in August 1977 as a parasite of the spotted alfalfa aphid Macrosiphum albifrons. A mass rearing technique was devised whereby approximately 2000 T. parthenogenetica could be released at each 14 fields, as primary release sites every week. A total of 39 primary release sites and 629 secondary release sites, associated from these with the help of farmers, were established by the end of April 1978. T. parthenogenetica was being recovered every week in samples
from all 15 primary release sites and from most of the secondary release sites that had been visited. T. callidus was capable of dispersing relatively long distances (at least 30 km) from release sites. By the end of November 1979 when the last releases were made, the parasite was considered permanently established throughout the region to the east of Spencer Gulf and in some areas to the west. T. callidus appears to be the only effective biological control agent.


Two specie in parasites, Gregaria hylobilis and Opticus pygmaeus, parasitizing the adults of H. abyssus are described. The prepupae of G. hylobilis are a parasite of the gut of H. abyssus, which has been reported previously to occur in the gall bladder of solitary gammarids, gammaridids, and spermatozoa is described. The life cycle of the gregarine G. hylobilis infecting the Malagasy tilapia of host examined at light and electron microscope level is discussed. Some data on the relative importance of host-parasite relationships are also discussed.


By reputation, ground beetles are known to be predators. However, neither carabid adults nor larvae come in contact with corn rootworms. Also, the rootworms have become adapted in all stages at avoiding ground-dwelling predators. Carnibich and rootworms have different habitats, and they seldom come together. It is more accurate to call these carabid larvae than predators.


A study of the oviposition behavior of adult Thaumastoccluda on three prey species. Environ. Ent. 11 (1): 159-161


Certain aspects of temperature and water relations were investigated in individuals of two hemipteran species that live in arid habitat. Thermal tolerance, measured as critical thermal maximum (CTM) was consistently higher in G. pygmaeus (CTM = 47.5 °C) than in G. abyssus (CTM = 47.4 °C). H. abyssus had higher resistance to water loss at high temperatures than G. pygmaeus, whereas both species had rates of water loss that were generally higher than other arthropods that inhabit arid zones. Feeder water loss was higher in H. abyssus than in G. pygmaeus (5.5 °C day compared with 2.7 °C day). H. abyssus had a significantly higher amount of cellular lipid per cent; its 13.5 mg vs 8.9 mg. H. pygmaeus (5.5 °C/SD = 1.62) Older adults had lower rates of water loss than did newly emerged adults (5.0°C/SD = 0.00).


Some biological aspects of the nematode parasite Fasailia peregrina were studied. Nonovipositing females lived longer than ovipositing females. Parous survival was strongly affected by relative humidity. Females survived best at 21.9% r.h. (11 % and 45 % r.h. raised 65.7% mortality within 32 hr. Total number of eggs laid was not influenced by 49.1 % r.h. at 26.5%. Lowering of the r.h. increased the proportion of uneggs laid on the first day to 91.1, 6.5, and 3.9 %, respectively. at 45, 57, and 11 % r.h. The parasite could complete development in melolonthids (Plasmodium crassus) growing in young exuviae of grass. Grass in clumps provided good protection to meabolooths against P. peregrina.


Life cycle studies of Tribolium brevicollis and Tribolium pretiosum were conducted at various humidity and temperature conditions. The intrinsic rate of natural increase $r$ was higher for T. brevicollis than for T. pretiosum at 30 and 35°C, and was higher for T. pretiosum between 18 and 22°C, due to differences between the 2 spp. in development, longevity, fecundity, sex ratio, and number of progeny per host egg. T. brevicollis had a higher fecundity than T. pretiosum, but its development was slower (ie. 10 %), and was retarded facultatively at temperatures of 20°C and below, probably due to disuse. Ovipositional behavior of T. brevicollis and T. pretiosum was similar, but differed in the duration of the different reproductive activities. Superoviposition occurred by both species when the host egg supply was limited and exposed to more than 1 female simultaneously. T. pretiosum laid more eggs per host egg than T. brevicollis at various parasite densities. When eggs were exposed to both species simultaneously, oviposition was intermediate between the number of eggs laid by each species separately. From this, it was clear that an emerging progeny was T. brevicollis and T. pretiosum, respectively, and these proportions were independent of parasitoid density. The results may explain the distribution of T. brevicollis and T. pretiosum in California, and may assist these insects for mass-release and establishment attempts.
Further testing indicated that interactions between the host and its food plant are the source of attraction to viriparous females. The proportion of females on the host plant was significantly reduced at host feeding sites where viriposition and subsequent parthenogenesis had occurred previously. This information may be useful in the development of methods to control these parasites, thus conserving important natural resources.

E.A. Polak & K.H. Oosting (1982). Biology of Tricho-

The biology of Tricho gramm a bivencipilum reared on eggs of Trichoplax ra ni and the influence of Snow white and hoedic conditions on the parasitization strategy of the adults were studied. Egg, larva, pupa, and adult stages on described. Development of these stages lasted ca. 3, 3.1, and 5 days respectively, at 25° C. Reproduction is biparental, autotrophic. The prepupation period lasts ca. 3 hr for the pharate adult and was minimal in the scutellum. The solubility of T. ra ni as a host was maximal in the bleated stage of the Embryos. The feeding scores sharply in the early stages of development, and increased greatly in the later stages of embryological development. A single male female reared from a host egg was larger and more fecund than females from eggs yadina. To obtain 5 females of T. ra ni by 1 female host females were reared from the host egg density was limited. Thus, preventing parthenogenetic parasitism. The number of your property per host egg and the male proportion of the sex rate were inversely related to the host egg density over a range of limited host densities.


Laboratory tests showed that Oras sativus and the common green dialbug, Wezidius armatus were able to locate and destroy eggs of the pest bokchoy. Euphyas tuberculata. D. sativus appeared to be the more efficient egg predator. The average daily mortality of bokchoy adults and nymphs attributed to the feeding of the coccinellids. Hypothenemus conger and Coelocnemis ovatus, the common green lacewings, Ctenosara caucas and R. americana ranged from 1.8 to 3.2, with the exception of C. caucas adults, which averaged 4.8 nymphs.


Barnacle scale, Coerebula stenidiformis, caused serious damage in several groves in the Lower Rio Grande Valley of Texas during 1955. Mealybugs bactro was the most numerous scale insect, followed by thecision, Aulacaspis yezoensis, and the unknown encrust. Effectiveness of the primary parasites was limited by the hyperparasites. Parasitoids were released at 10-20. Pteromalus puparum and Chelonus intermedius. Parasitization by primary parasitoids varied from 4 to 51%, and that by hyperparasites 0.6 to 56%, Individuals per host varied from 1 to 2 for primaries and 1 to 9 for hyperparasites. A single incident was found in research plots of a possible association between increase in barnacle scale and use of Doffield. Because of the effective biological control, barnacle scale may completely on Texas citrus during 1977.


Tests conducted in a large field cage demonstrated that the technician, Long method, was used to sections of the cages containing the host Drosophila, Syrphus ruficornis, and the larva, the parasitized host, the aphid, and the parasitized host. Dinaria suecicola. Within sections of the cage, the parasites were able to distinguish between adjacent infested and uninsected plants.


The average longevity of adult females of three species of Cactoblastis cactorum parasitoids was estimated at 36 to 40 days under field conditions. Cactoblastis cactorum suggested predation as a major cause of mortality. When parasites and aphid predation had average longevity of 30 days (45 days 35 days and minimum 20 days). The number of parasites produced ranged from 71 to 115, with an average of 94.5. The female sex ratio of their progeny averaged 1.41:1. The maximum mean progeny production per day (mg) was 1.9. The frequency of increase was 0.134 per female per day, and the reproduction multiplied 42.43 times in the generation time of 28.7 days.


The effectiveness of these three different strains of Pyrrhocoris apterus to control the two-spotted spider mite Tetanychus urticae. to their susceptibility to parasites were compared under practical glasshouse cultural conditions in the Federal Republic of Germany. Despite large differences in rearing techniques, no marked differences in the ability of the parasite to control the pest in the glasshouses were observed. P. perditus obtained from the Universitat of Stuttgart-Hohenheim, that were kept in laboratory rearing for at least 25 years using detached dean leaves, performed as good as predators in commercial use obtained from the Dutch company "Klopper & Son", Biekorf en Rockenburg or from the Glasshouse Crop Research Institute, Leithamphillie, England. While "Klopper" strain of P. perditus was found to be resistant to the fumigant, Alkyl W 1050 (methylsiloxane). Total mortality of the strain "Hohenheim" was recorded following sprays of this chemical. The use of the resistance to the fumigant strain of P. perditus allowed the integration of the predator together with Alkyl W 1050 (methylsiloxane), taking advantage of the side effect of this preparation of the plants. Sprays treatments with Fungitrol (dimethanil, Simplot
treated with Bayticol (tributyltin-leucine, 20 ppm), a solution of sodium bicarbonate, water, and a complex of citric acid and sodium bicarbonate, did not affect the growth of P. cepacia in vitro. However, when the same solutions were applied to the plants, a significant decrease in the number of bacteria was observed.


R.M. McPherson et al. (1982). Incidence of anthracnose on soybeans in the United States. *Crop Sci.* 22: 1051-1053. The incidence of anthracnose in soybeans was studied in various states in the United States. The results indicated that the disease is more prevalent in the southeastern states.

M.V. Pate et al. (1982). Comparative effectiveness of azoxystrobin and chlorothalonil as seed treatments for the control of Phoma dogatica. *Crop Protect.* 1: 3-15. The effectiveness of azoxystrobin and chlorothalonil as seed treatments was compared for the control of Phoma dogatica. The results indicated that azoxystrobin was more effective than chlorothalonil.

M.D. Hare (1982). Sensitivity of selected wheat rusts to the cereal thrips, *Helicoverpa zea*. *Phytopathology* 72: 105-110. The sensitivity of selected wheat rusts to the cereal thrips, *Helicoverpa zea*, was studied. The results indicated that the thrips is a significant pest of wheat.


C.J. Martin (1982). Parasitism of the apple black leafminer, *Phyllonorycter cerasi*, by *Neuroptera* was investigated in the field. The results indicated that the parasitoids were effective in controlling the pest population.

Three of them recorded for the first time, attacked *P. cepacia* inoculants, their primary parasitoids, or both in commercial apple orchards. *Euopea minima*, a primary parasitoid, was determined in 14/16 (87.5%) of samples collected from different areas or locations. Emergence of *S. multistriatus* and *E. minima* was synchronous, however, that of *S. multistriatus* preceded the appearance of *E. minima* in laboratory cultures. In 1978 and 1979, parasitism was lowest in the second and highest in the third (last) generation during each year. In the third generation of 1978 and 1979, percent parasitism was higher on spray-treated trees at Surprise in the first generation of 1978-1979.

M. Pate & B.A. Croft (1982). Comparative effectiveness of azoxystrobin and chlorothalonil as seed treatments for the control of *Phoma dogatica*. *Crop Protect.* 1: 3-15. The comparative effectiveness of azoxystrobin and chlorothalonil as seed treatments for the control of *Phoma dogatica* was studied. The results indicated that azoxystrobin was more effective than chlorothalonil.

Fourth-mottled leafminer, *Celtidochra karskii*, and adults of its parasitoid, *Chrysinthera laricis* and *Dihelicoccus neociaris*. *Environ. Entomol.* 11 (3): 750-755. Fourth-mottled leafminer, *Celtidochra karskii*, was significantly less susceptible to acaricides and mite control than were adults of its parasitoid, *Chrysinthera laricis* and *Dihelicoccus neociaris*. *Bacillus thuringiensis* was used to control the leafminer and its parasitoid.

field-collected strain. In situ and Jor 'in vitro' methanogenesis in three classes of compounds, i.e., those causing high mortality (>50%) in both stages (cakes, methanotrophs, methylocytes, denitrifiers, methanomal- philes), high mortality of one stage (lysoxybacillaceae, phamemometer; deformis, ovum, and low mortality (<50%) in both stages (lowphamas, methanomal- philes, primatamae, plus several fungicides and insecticides).


In selections of two greenhouse populations of the predatory mite, Amblyseius felicis, a 4-fold increase in resistance to permethrin was achieved after 12 permethrin applications. The initial populations were established by mixing a variety of laboratory colonies, and adding a few individuals from recently collected field colonies. One population was treated alternately with azinphosmethyld and permethrin; it developed permethrin resistance more slowly than did the population receiving only permethrin-resistant mites. A third population, maintained from the laboratory colony with the highest initial resistance level, showed no increase in resistance. After selection all three populations showed remarkable similarity in the greenhouse on plants sprayed with recommended field rates of permethrin. All three populations also maintained resistance to azinphosmethyld, whether or not they received selection with this compound. These permethrin-resistant predatory mites may provide biological control of pest mites on crops where synthetic pyrethroids are used to control other pests.


The mechanism of insecticide resistance, the inheritance of resistance, and cross-resistance to different insecticides were investigated in a carbaryl-resistant strain of the potato mite, Neohelicus cubensis. Resistance extends to the aryl carbamate insecticides propoxur and fenitrothion, but not to the oxime carbamic insecticides methylparathion or to phenylcarbamate insecticides. Resistance appears to be related to high levels of oxidative detoxification, which seems to be present even in the egg stage. Genetic analyses showed that resistance is primarily due to a single, incompletely dominant gene. Carbamate resistance in N. cubensis seems very similar to that observed previously in other species.


Impact of five insecticides against Rhizobium peas, the aphid vector of blueberry blight strain and its predators from ground and air applications are reported. Primordia and aphid populations demonstrated the greatest reduction in aphid populations, yet had the least impact on predators. No predators were found in the plants receiving the treatments 6 days post-application. Malathion and carbaryl reduced insect: predation ceased from the ground but were not effective in air application plots. Diazinon was the least effective insecticide tested. Blueberry aphid predators included, Prius sp., Aphidius aphidians, Chrysopa carnea, Coleomegilla maculata, Hoplodrur us coreus, and Scymus sp.


The toxic residual activity of four pesticides, phosmet, carbaryl, dimethoate and demethoate, were tested against natural enemies of the citrus mealybug, Pseudococcus citri. Species tested included five parasitoids, Phytococcus communis, Platyctonus univulvatus, Liposcelis, daurica and Aphis- mos persicivorous and two predators, Ctenopagopus monos- stichus and Synaphidion forbesi. These natural enemies were exposed 24 h to pesticide residues on leaves of commercially treated citrus at intervals of 1, 9, 18, 33, and 50 days post-treatment against the majority of natural enemies tested. Dimethoate and demethoate toxic residue activity decreased significantly in 9 days against the majority of species tested.


Strains of the predatory mite, Amblyseius felicis, which were variable-resistant to a synthetic pyrethroid permethrin, showed multiple-resistances to DDT and to azinphosmethyld. In a resistant strain selected with permethrin, cross- resistance to a variety of pyrethroid types, including natural cycle pyrethroids and several synthetic pyrethroid com- pounds, were demonstrated. Mechanisms of resistance relative to field insecticide use patterns and possible uses of these insects in future integrated pest management programs are discussed.


Thirty-five insecticides used in rice in Asia were tested in the field against Nippongorus hagana. The most important predators of the pest, Cyniobius lividulus, Microsellal stenodactyla and predations spiders, Lyssomanes rufipes, were also monitored in the test plots. Ten insecticide significantly reduced numbers of N. hagana, but pyrethrin and ethyl alcohol gave the most consistent and effective control. Most insecticides did not significantly reduce predation of spiders and M. stenodactyla compared with untreated checks, but they did reduce numbers of C. lividulus. All treatments caused emergence of N. hagana, resulting in a significant increase in numbers of the pest in the treated plots than untreated checks. Resurgence was apparently not caused by the toxicity of the materials against predators, elevated the insecticides had no effect on N. hagana.


Hexamerus sp. were recovered from natural populations of barnacles in Japan. Lysmata dispar in Hokkaido, Japan. This parasite has a strict distribution, and it appears to favor winter, deciduous forest areas and not Lysmata dispar in Hokkaido, Japan. This parasite has been used extensively for aquatic and terrestrial purposes, where gyno neonate must be removed from the environment. Hexamerus sp. emerged from host barnacles but not in spring and summer. Its seasonal distribution is probably due to the environmental conditions experienced by the gyno neonate.
(To May to 19 July), during which a maximum of 40. 84 %
parasite occurred at a maximum rate of 783 miracidia
per 100 ml. hatched in infected water. Hatching was
highest during periods of rainfall. Under natural
conditions, maximum of 61, 77, and 86 per 100 hosts
were recorded. Other L. nomaëtae infected included
Eumicrostomum caproni and an unidentified actinid
species.

C.M. MacVittie et al. (1962): Field tests of antimetr
cants to extend the infection period of a non-vanous
nematode, Neascuspectra carposome, against the

H.K. Kueh & B.J. Grieve (1982): The nematode
Neascuspectra carposome and the bitter arena, an
decay disease of fruit and vegetable plants, in soil
and of adults emerging from soil, J. Invert. Path. 39 (2),
192-197

The nematode, Neascuspectra carposome, affected
bitter arena in soil even in concentrations as low as 0.01
nematode/g of soil surface. Plants were less susceptible
so nematode infections in soil than pepper, with mortality ranging from 19 to 24 %
and 10 to 83 % for pepper exposed 3-5 days and 6-8 days to the
nematode, respectively. Longer exposure 8-10 days to the
pepper to the nematode resulted in higher mortality with a
positive relationship with increasing concentrations. Adults of
S. carposome were susceptible to nematode infections as they
emerged from the soil. The higher nematode concentrations (0.01
nematode/g of soil) caused 100 % mortality. The majority of
nematode-infect ed mortal	ity occurred within 24 to 48 hours after emergence. The susceptibility of
emerging S. carposome adults to S. carposome offers a new
denomination for insect control.

R.A. Hedding & B.A. Miller (1983): Use of a nematode,
Heterorhabditis heliobia, to control black night nettle,
99: 211-216

Application of aqueous suspensions of infective juvenile
Heterorhabditis heliobai, isolat T327, to the soil resulted
in up to 100 % parasitization of larvae of the black vine
webworm, Oederthelma scabiosa, in pot, cage, and
pots in nurseries, and over 17 % parasitization on
caged cayman and strawberries. Pea and newly
emerged larvae on grass were also parasitized by the
isolate. T310, produced 92.5 % mortality of 0.
scabiosa larvae we pot-caged cayman in glasshouse. We was
less effective on strawberries. Neascuspectra carposome was
found to be less effective than H. heliobai T327 strains. The
use of these nematodes provide an economical and effective
method for controlling G. kola pikoi on planted plants in
glasshouses and nurseries.

W.R. Simons (1981): Biological control of Oederthelma
scabiosa with the nematode Neascuspectra carposome
in the glasshouse, Neth. J. PI. Path. 87:199-209

A Heterorhabditis species, found in dead larvae of
Oederthelma scabiosa, was tested for its efficacy as a
biological control agent of this insect in glasshouse
experiments. In a preliminary test, all wasiv larvae were
killed in pots with guacamol 59. 8 % in strawberries and 50 % in
cayman. In a second test with strawberry plants, good
results were obtained when the nematodes were applied
about the time the larvae were infesting. At a dosage of 100
nematodes per cm of test area, 90-97 % of the larvae
were killed and 90 % of the plants remained uninfected. A
dosage of 50 nematodes per cm2 produced nearly the same
level of larval mortality, but left 30 % of the plants
infected. Both early and late application of nematodes
protected the plants sufficiently, because too many larvae
survived, in a third test with strawberry, cayman, and
peppers, soil treatment with 50 and 100 nematodes per
1cm2 gave comparable results at both application times, i.e. one
and three weeks after hatching of the wasp larvae. In
strawberries 160 % of the larvae were killed and all plants
remained in good condition. Also in cayman, nearly all
tavel were killed and all plants remained in good condition,
although the test systems had less free space in comparison
with control plants, without insects. In strawberries, 12-15 %
of the larvae survived, whereas 20 % of the plants
died, indicating soil set soil structure, soil moisture and
conditions of the plants have an important impact on the
control results. A dosage of 50 nematodes per cm2 appeared
to be too low in all cases. The results of these experiments
open new perspectives for control of the black vine weevil
in glasshouses.

H.K. Koju et al. (1981): Laboratory and field
evaluation of Neascuspectra carposome against the
em leaf beetle and the western spruce budworm. Can.
Ent. 113: 381-390

Laboratory tests showed that em leaf beetles, Pterophorus
benedicti, larvae and pupae were susceptible to the nematode
Neascuspectra carposome; adults were less likely to be
infected because of their dispersal ability. Spruce budworm,
Choristoneura occidentalis, larvae were susceptible to the
nematode and 90 % were necrotized in the laboratory. A
nematode in 2. g. aquosus Volck, oil suspension against em
leaf beetle or spruce budworm larvae did not significantly
reduce the populations when compared with controls.
Deposition of the infective nematode may be a factor in the
variable results for em leaf beetle and spruce budworm larvae
and may have been factors in the poor results for spruce
budworm. However, significant population reduction occur.
in nurseries in treatments against em leaf beetle in
liter. This nematode may be used against beetle pupae in
interception with other control tactics.

ill Behavioural Means

G.E. Hemenick (1981): Field evaluation of the natural
female pheromone of Lucas elevus. Environ. Ent. 10:681,
822-824

Traps baited with 30-50 female equivalents of natural
female pheromones were tested for efficiency in capturing
lab-cultured male oak fruit flies during the 1979 olive
Phenomene traps were reliable for detection and estimation of Heliothis armigera adult populations in crotalaria fields. An increase in male catches in traps was usually followed by an increase in larval density, but no correlation was found between the two. Phenomene traps may therefore serve as a warning device indicating potential attack, but larval counts are required before deciding on control procedures.


Two tobacco budworms are treated throughout the growing season with a blend of three allelopathic and one cryotoxin component of the sex pheromone of the tobacco budworm, Heliothis virescens. Captures of tobacco budworm males in pheromone-based cone traps were greatly reduced in the pheromone-treated fields compared to the control field where treatments were not applied. Treatment of 6.5 mg of laboratory-reared females confined on mating tables in the plot on the control field were reduced from 68 to 68.6%. However, it was necessary to ignore the pheromone-disrupting effects to control the tobacco budworm, Manduca sexta, and green stink bug, Acrosternum hilare. Because these insecticidal treatments also killed tobacco budworm larvae, it was impossible to assess the full impact of the pheromone treatments on control of theec budworm. Nevertheless, these results indicate that the air ventilation technique will be adequate for control of the tobacco budworm in tobacco if similar conditions are available for control of the tobacco hornworm and possibly other pest species.


The parasitoid Cardiostola nigriceps responds to a kairomone from host Heliothis virescens by exhibiting an increase in speed and turning over unit time. The parasitoid turns back toward the interior of the cage when the pheromone is removed. Experiments with C. nigriceps females are more responsive to the kairomone of H. virescens than inexperienced females. Observation results in the immediate departure of C. nigriceps from a kairomone punch.


Two formulations of potato tuberworm, Phthorimaea operculella, sex pheromone, strain-4, cis-3, cis-6, 9, trans-2, 5, 11, 13, tri-cyclodec-1-en-1-acetate, 78-91 and PTM-1 = strain-4, cis-3, cis-6, 9, cis-11, 13, tri-cyclodec-1-en-1-acetate PTM-2 were tested in the field during 1980 and 1981 in Lima, Peru. Mixtures of PTM-1 + PTM-2 were more attractive than PTM-1 alone. Tuber damage of potato clone DTS-13 was reduced in one trapped crop. Fields with low moth populations during winter planting of 1980 did not sustain economic damage. When moth populations were high during summer planting of 1980, potatoes clone DTS-13 sustained 42% tuber damage.


A synthetic pheromone, applied by air on corn, caused a reduction of 10 to 20% in the number of males entering corn, a reduction damage to maize caused by larvae of a root-borer, Ensema sororius, by 74 to 84%. Lesser doses of 0.2 to 0.7% were less effective.


The combination of Z4-11-hexadecenyl acetate (Z4) octadecen-1-0 in male caterpillar. Neither
compound alone produced trap catch. Optimum rates were from 1 to 7.3 hexadecanol to octadecanol in natural rather than the optimum dosage was 0.45-0.50 to 0.45-0.50 mg of GZ-19-1-hexadecanol (GZ-1)-octadecanol. The strongest effect on the trap catch was produced by hexadecanol followed by GZ-1-hexadecanol. Addition of either GZ-1-octadecanol or GZ-1-hexadecanol, in combination with the two-component trap, increased the trap catch. The results of the two-component trap were more than those of the trap alone with females.


Screening trials were conducted in commercial fields of bluegrass grown for seed to identify sex attractions for the cutworm pest, Protophthalmus obscurus Zell. The two traps used in both the male and female trap catches. Traps baited with the two-component trap caught more insects than traps baited with females.


Four insect growth regulators (IGRs) were used in the present study: BAY 58141 [1-

4-(2-thiazolyl)ethynyl]benzene-3,5-diols and methoprene, and MIN 8193-2-aminopyridine (2,3-dimethyl-2-piperidine) were applied at 5 ppm to wheat. Percent of grain, were evaluated against Oryzaephilus surinamensis, Tribolium confusum, Rhizopertha dominica, and Sitophilus oryzae. At 30 ppm and 0.5 ppm, these compounds were highly active against the eggs and larvae of O. surinamensis, R. dominica, and S. oryzae. Moreover, hexadecanoic acid and methoprene also affected the subsequent progeny production of grain and insecticide-treated food for 2 days. ME 687 appeared to be the most active compound tested. Dimethoate and methoprene had no adverse effects on the development of S. oryzae. The larvae of both species of larvae were free of any adverse effects on the development of S. oryzae. The larvae were free of any adverse effects on the development of S. oryzae.


Following an antifungal (2% Concordia, Myclobutanil treated on the field plot, for two consecutive weeks, the number of beetles on the treated potato plants was significantly higher (P < 0.01) compared to that on the untreated control ones. Laboratory-choice experiments have also strengthened the above. S. decemlineata mosquito-origin insects have been identified as a major group of insects in these fields. It is thought that the phenomenon is primarily caused by the differential increase in the survivorship of the two groups of insects and to a lesser extent, by the retardation of the untreated groups, because of the presence of various developmental stages. The unusual distribution of eggs might bear some effect on the decrease of a local Colorado potato beetle population.


Curing moth: C. ferinapomala. By sterile insect release (SIR) was assessed in 32-526 ha of apples and pears in the Similkameen Valley, BC, from 1976 to 1978. In preparation for SIR, the moth population was first reduced to low numbers by removal of neglected trees in 1972 and by chemical sprays in 1973. Sterile 155,000 male and female moths were released in each orchard 2 or 3 times weekly from 1 May until early September. A total of 25,600 sterile moths had been released in 1976, 38,500 in 1977, and 31,800 in 1978. Populations of sterile (marked) and wild moths were monitored by sex pheromone traps, and damage was assessed by fruit examination as harvest. Control was very good except for a few orchards in which overwintering populations were too high to achieve adequate overcrowding with sterile moths. Damage exceeded the economic threshold 0.5% in early of 16 treated orchards in 1976, in 18 or 19 orchards in 1977, and in 0 of 157 orchards in 1978. Results in 32 orchards showed that when wild populations were brought down to extinction all cooling moth control measures can be omitted for 2 or more years depending on degree of orchard isolation. Overcrowding of mating moth sprays from 1976 to 1978 did not result in any important change at population levels of other apple pests. Cost of control by SIR was $225/ha per year ex. $8.94 for chemical control.


Laboratory-reared irradiated, laboratory-reared nonirradiated, and field male gypsy moths. Convolvulaceae, and Lepidoptera dispar were compared for their responses to various doses of the synthetic pheromone (4-adamantane), and for the periodicity of this response. In a sustained-flight test. The proportions of males responding from each group were not significantly different (P > 0.05). Time of day and dose-response were significantly affecting percent male response, male response was greatest during the afternoon at 13.08 and 15.08 at L50 and at doses of 25 and 50 ng (4.0%) and 50 ng (2.5%). Response periods for males exposed to various doses of L. dispar were not significantly affected by time of day, but were related inversely to pheromone dose. These results support previous field studies, which have shown that laboratory-reared males were more responsive than nonirradiated males, which were more responsive than laboratory-reared males.


Males Spiranea elata, irradiated with 15 krad of gamma irradiation, were released at rates of 44 and 91 to 44 treated males into a simulated emery warehouse. The
matting competitiveness of irradiated males was 91 to 93% as good as that of the untreated males, and the percentage of lattered males and untreated males were released, the frequency was 91 to 93% of the F1 progeny was offspring of the parent that was irradiated and irradiated sufficient genetic damage. A to be sterile when irradiated. These results suggest that populations of the tobacco root within tobacco varieties might be greatly reduced or eliminated by the release of a high ratio of sublethal males.


The authors report an unusual case of extrachromosomal inheritance in the parasitic nematode, Haemonchus contortus. The trait, termed %daughters = 0.4, is transferred from the father and causes the males of carrier males to produce only females. After introduction of low frequency, the trait increases in predominance in an experimental population within a few generations. The D1 trait is of biochemical interest because of its potential inheritance, and may have practical applications as a biochemical control agent in pest organisms with haplodiploid sex determination.

16 Techniques


A new system was developed for mass production of eggs of Diatraea grandiosella for use in mass-studies. The system utilizes large screen cages to which pupae are added weekly. This provides a continuous source of adults for oviposition. The method is divided on both sides of vertical walls and divided into sections easily removed from the cages. A detailed account is given of the materials, construction and daily operation of the cage. After the increased efficiency of the new system over the previous cage system is discussed.


Modification of methods used in a multiverricular larval rearing test for rearing Heliotis spp. pupae, particularly the tobacco (3C) Bca female in H. virescens; male) [from the intergeneric (H. virescens male in H. subflexus female), are described. Essential components of the unit is a filter glass tray, a polyethylene insert with 900 cells, and a polypropylene cover with 150-mm openings. More than 10 million BC pupae have been produced during the last 4 years in North Carolina with this unit. Minimum egg density determined to be two to four eggs per cell. Neither benomyl nor folpet affected growth or development of BC larvae when incorporated into the larval diet at rates from 0.25 to 2.5 g/kg (0.5 to 5 g/kg) of the larval diet. A 15-seed method consisting of the mold Taphrina minor. The pupal harvesting method collects pupae in a cushioned tray, separates pupae from large particles with a grating, and encases smaller, healthier larvae with a high-volume blow-up.


A prototype unit of an automated conveyor box larval rearing system was developed by the standard tray method in rearing of the medfly, Dacus cucurbitae, the oriental fruit fly, B. dorsalis, and the Mediterranean fruit fly, Ceratitis capitata. All phases of larval culture are facilitated by the belt-rearing system; moreover, rearing can be done at a constant temperature of 27°C, unlike the tray system, which requires cooling of the culture to 20°C on larval losses due to overheating. Overall labor costs can be reduced by 80%.


A simple liquid medium which enhanced the production of conidiospores by an isolate of the entomopathogenic fungus Trichoderma harzianum is described. Spore production was obtained using cultures that included a liquid solution of plastic tubing, 30% polyethylene glycol, and glass bottles. A method is successful for stimulating larvae 0.3 mm in length for two to three days and the third or fourth instar larvae are described.


The virulence of the NPV of D. saccharis for mass-bred larvae, Orgyia pseudotsugata, spruce budworm, Choristoneura fumiferana, and gypsy moth, Lymantria dispar, for larvae of the saltmarsh caterpillar, Euxoa acuminata, was enhanced after successive passages in the alternate host. In all cases, yields of 2×10^9 polyhedra per insect were obtained per E. acuminata larva, which represented at least a fourfold increase in O. pseudotsugae and C. fumiferana NPVs obtained from the respective natural hosts. The O. pseudotsugae NPV-E. acuminata system appears to be an excellent system for producing large numbers of bacillae for both virus yield and activity. The C. fumiferana NPV-E. acuminata is not promising on the basis of virus activity.


Heterorhabditis bacteriophora is reared economically on an artificial medium consisting of commercially available nutrient broth, yeast extract, and vegetable oil. These components are cooked with flour and coated onto polyester-polyethylene screen, autoclaved, inoculated with a suspension of the bacterial symbiont (Xenorhabdus luminescens) of the nematode, and incubated at 25°C for 24 h. The bacterial growth on screen provides an excellent rearing medium. Up to 10 million infective juveniles are produced per 250 ml rearing flask in one month.


A procedure has been developed which allows production of 75,000 eggs per month of the legume pod-beetle, Maracia tenuis. The legume-cultivation technique allows optimal numbers of pods placed in the mass-rearing cages having on average 100 legumes was 10. The storage life of the pods of the months was 1.2 and 9.5 days for females and males, respectively. The optimal number of beans in the rearing box was 50. The survival declined sharply above a density of 50 per box.
Artificial diet is described for laboratory rearing of Crotalus atrox and Heliosa ammodytes. Inbred lines of cells grown from skin of these species have been maintained. Neuroblastoma cells of Crotalus are more sensitive to the diet than cells of Heliosa. The diet consists of a mixture of monosodium glutamate, glucose, BSA, and cysteine.H. ammodytes and C. ruedi were used to test the effects of a supplement of calf serum on survival. The results showed that the survival rate of H. ammodytes was higher than that of C. ruedi. The diet was also tested on other species such as H. ammodytes, C. durissus, and L. mormyrus. The diet is suitable for use in the rearing of these species.

**References:**


Four sampling methods for *Ocypus kueneni* populations were compared for efficiency using coefficients of variation. On this basis, none of the sampling methods were uniformly superior to any other, but a cluster of 0.01 ha samples was chosen as the best method because of the aggregation of the more common eggs and parasites. From the estimated population variance per egg mass, it was calculated that 100 g masses should be sampled per plot to give an error bound of 0.2 pantanal per g mass in 0.2. A common area of variance indicated that random among study areas was the largest source of variance, and that among days, within days, and plot configuration variations were not significant. In terms of population between cost and accuracy, the sampling scheme selected consisted of a mixture of 0.01 ha samples and parasitoid samples on 1000 and 10000 ES on sunny days. This sampling scheme was found satisfactory under field evaluation.
microbial test (flora AS 27), which provides for a standardized bioassay of the entomotoxic activity per cell of *Fusarium proliferatum* (strain 1.1.4.3.1.1.4.3.1.2) on a selected soil microbial isolate. Following inoculation and incubation with a sterilized Tatum re-suspension in sterile sterile air, the entomotoxic activity is measured as described by a 89% final emergence rate. Since the rate of mosquito larval filter feeding is nominally (0.01 ml/hr), a larval test challenge using 2 larvae held in 4 ml of fish fluids in near complete larval filter feeding of a test challenge within less than one hour. As a consequence, a larval test challenge can be directly expressed in terms of ingested dose. Using the standard standardized larval test challenge procedure, a comparative evaluation of several commercial formulations of Bt, both liquid and crystalline powders, has been reported.


A bioassay method is described, in which termite workers from one colony of *Solenoterus* were used as test to determine the virulence of one strain of *Mucorainium uncinatum* originally isolated from *Anoplura.* The termites were sprayed with suspensions of conidia and kept for 11 days at 25 ± 2°C and approximately 100% relative humidity. Data on mortality after 8 and 11 days were plotted, and so, LC50 and 99% fiducial limits, slopes, and G for the bioassay. The mean LC50 was 5.16 ± 0.67 x (10^6) conidia/ml after 8 days, and 3.56 ± 0.63 x (10^6) conidia/ml after 11 days. The weighted mean slope was 0.789 ± 0.025 after 8 days and 919 ± 0.927 after 11 days. This study shows that *Mucorainium* is a promising candidate for biological control of *Solenoterus.*


Precipitin test techniques were utilized for the identification of predator-prey interactions. The species of interest is *Arachnida* *gummiota.* Helodromas, sea, and *Pseudococcus* includes. The test was sensitive enough to detect a prey in a whole body extract of one small predator or from a midgut extract of a larger predator. Some cross-reactivity among the prey species was found which limited somewhat the specificity of the test. However, test results from field-collected predators indicated the precipitin test in a simple and rapid technique which can be used to examine the number of encountering predators and prey in soybean fields.

v) Integrated Pest Management, General Papers


A prototype pest management system for cotton incorporating data handling and decision making by computer was progressively modified during 1978 and 1979 to increase its efficacy and practical feasibility. A more realistic assessment of crop status was developed. Threshold population densities of pests, as reflected in labor requirements, were reduced. Accurate, sequential sampling on terraces three times a week and by simulation of field development during weekly intervals between plant samples. Decision making was refined using recent experience. The developing system, tested in 1978-79 on 14 ha field and in 1979-80 on 365 ha of cotton grown on four farms, maintained fields in commercial levels without immediate usage was decreased by 49%.


During the 1970s, an integrated insect control programme in cotton was developed. The Texas Agricultural Extension Service, in cooperation with the Texas Pest Management Association (TPMA), has been successful in implementing the programme on a wide scale. The steps from research to transfer of the new technology package to farmers are described, together with the basic elements required, and problems associated with statewide implementation of TPMA. By 1980, more than 56,600 acres and 750 farmers were in various stages administrated by TPMA.


Stand risk rating for the southern pine beetle, *Dendroctonus frontalis,* in a first step toward dealing with a serious but sporadic insect problem. Two approaches, one utilizing readily available resource data, the other employing data derived from aerial photographs, illustrate application of current knowledge to meet the pest control needs of resource management - the primary role of integrated pest management. During a 16-month period in Louisiana, high-risks stands accounted for 14% of inoculations per 1003 acres, four times the rate of high-risk stands in Texas high-risk stands accounted for 9% of inoculations per 1000 acres during 1979-1980, almost five times the number for stand.


Among the species of the genus *Diaspsora* that occupy the United States, oviposition and adult collection sites are closely related to the presence of suitable larval hosts. Adult species in the genus *Diaspsora* are multivoltine polyphagous species in the *Cynipidae* group are multivoltine polyphagous (except monophagous). The genus-specific differences in volitization are attributed directly to the seasonal availability of the host plant, and only indirectly to the climate. In the *Cynipidae* group, melittinism combined with a narrow larval host range and limited search capabilities suggest that oviposition behavior is the primary determinant of whether the newly-hatched larva reach a suitable host. Reviews of the biosynthetic, architectural and taxonomic records indicates that *D. virginiana* (sensu lato) and *D. barbara* have become pests of corn by convergent evolution. This evolutionary view presents new avenues of research that are discussed in the text.


The development of ecologically safe pesticides is a major area of the chemical industry to Integrated Pest Management (IPM). In a first selection process nowadays, only pesticides with acceptable mammalian toxicity are promoted for further development. A further step in our company is the screening at an early stage in the laboratory against the following representative beneficial species: 27
Antirrhoes nemarum (flower bug). Chrysoperla carnea (carrot fly). Coccinella punctata (lady beetle). Coccinellidae (ladybug family). Coccus (reproductive stage) and Aphis (reproductive stage). Laboratory selection pressures are then complemented by field selection through the whole beneficial complex in deciduous fruit and cotton. New approaches to the chemical synthesis aim at the type of selective. Experiments to evaluate responses such as chlorophyllin and thiamphenicol. Effects are also made to synthetic compounds similar to natural plant products, which have hormonal and behavioral effects. One such compound, CGA 29 , is currently in development. In the field of deciduous fruit, a further diversification is derived from Bactrocera zehntneri. The aim is the development of insecticides in various crops both within selective residues. A first such long-term project has been started in deciduous fruit and will last for several years.


Conventional insect control methods are being replaced by integrated pest management (IPM) programs which are based on detailed biological, ecological and systematic information. Some of the new discoveries and techniques applied in IPM programs against scale insects and other related topics are reviewed here.


Cotton is more heavily invaded with insects than any other crop in the United States. In southern Texas, this heavy treatment resulted in insecticide-resistant strains of cotton bollworm, Helicoverpa armigera. In the late 1960’s and early 1970’s, an integrated insect control program based on new short-season cotton varieties and traditional cultural practices has restored production in the area. The new system has been widely implemented because it produces higher net returns by reducing the use of insecticides, fertilizer, and irrigation.


Living organisms are used as biological pest control agents in (i) biological control, primarily for permanent control of introduced parasitic pests or introduced pests of perennial crops, (ii) augmentative biological control, for temporary control of native or introduced pests of annual crops grown in monoculture; and (iii) conservator or natural control in which the agroecosystem is managed to maximize the effect of native or introduced biological control agents. The effectiveness of biological control can be improved if it is based on adequate ecological information and theory, and if it is integrated with other pest management practices.


The effect of natural enemies on populations of western yellow-striped armyworm, Spodoptera prasina, was assessed in tilled alfalfa in the Sacramento Valley of California. Analysis of partial age-specific life tables indicated that egg-to-pupal revealed that most of the generation or real mortality of S. prasina occurred during the egg-smart-larval age interval.

Experiments revealed that such mortality was largely due to a complex of polyphagous predators. Predators included larvae of Chrysoperla carnea adults and larvae of Coccioidea punctata, G. punctulatus, D. viridula. Throughout the season, parasitoids were observed. Parasites and diurnal had a relatively minor impact on populations of S. prasina. The results provide further support for biological control of insect pests in temporary agroecosystems and illustrate the importance of polyphagous predators in such biological control.


Methods of estimating the probability of encounter and probability of parasitism given encounter are described for situations in which a host patch that has not been encountered by a parasitoid cannot be distinguished from one that has been encountered but none of the hosts have been parasitized. These methods provide estimates of quantities that do not vary with host density per patch unless parasitoid behavior changes, and therefore are the appropriate ones to use to detect effects of host density on the intensity of parasitism. An example is given, using published data on the parasitism of Heliothis zea eggs by Trichogramma spp.


Pest populations are frequently regulated below their potential levels of abundance by natural enemies, host resistance, or other biological interactions. However, if these insect populations are not regulated to levels below the threshold levels of abundance, they exhibit a pattern of cyclical behavior that is associated with infestations.


The rate of establishment of exotic natural enemies introduced against exotic pests in the United States. Lepidoptera, and Coleoptera were found to be inversely related to the number of species introduced at a given site and time. The number of exotic insects does not contribute to the relatively low rate of establishment in biological control.


The rate of establishment of exotic natural enemies introduced against exotic pests is inversely related to the number of species introduced at a given site and time. The number of exotic insects does not contribute to the relatively low rate of establishment in biological control. It is suggested that, in cases where less-than-complete control was obtained through multiple species releases, the number of species capable of effective control of the target pest may have been completely excluded. Because of this possibility, use of the empirical approach of releasing all available species of natural enemies, with the hope that the best species or combination of species will be selected in the field, should be questioned. In modern biological control, a more rational release strategy is in order.
2. CONTROL OF FUNGI, BACTERIA AND VIRUSES


Controlled suspensions of five fungal antagonists of Fusarium oxysporum f. sp. radicis-pestis were applied to the roots and crowns of tomato transplants at the time of planting. The suspension contained 5 × 10^6 conidia of each of three isolates of Trichoderma harzianum, one isolate of Aspergillus niger, and one isolate of Penicillium funiculosum. The pathogen was added at the time of planting, 5 to 10 cm from the transplant at 4, 50, 360, and 5800 chlormequinox per plant in 20 ml of water. The incidence of disease increased as the inoculum density of the pathogen was increased in unamended soil not augmented with the antagonists; disease incidence, however, did not increase as the inoculum density was increased in fungicidal soils that were augmented with the antagonists. At 5800 chlormequinox per pathogen, plant disease incidence at harvest was 7 % in soil augmented with antagonists and 37 % in nonaugmented soil. The pathogen population decreased from 800 to 200 propagules per gram in soil augmented with antagonists, but increased from 1000 to over 5 × 10^6 propagules per gram in nonaugmented soil. Yield was not affected significantly by treatments or planting date.


After 77 years of being attacked by the chestnut blight fungus, American chestnut trees continue to sprout from gradually declining root systems. The blight fungus in Italy is now associated with virus-like agents that limit its pathogenicity, and attempts have been made to introduce these alleles into the big chestnut fungus in the United States. If a way can be found to halt the spread here of strains of the fungus with controlling agents, it may be possible to save the American chestnut trees in our eastern forests.


The substrate is prepared in large plastic bags. Chopped straw is moistened with an aerial solution, to which sufficient is added of 2.5 mg/l of vinclozolin and 2.5 mg/l of alfalfa. Each preparation is employed to treat a soil that has been previously infested by Sclerotinia minor. In amended plots, lettuce drop was significantly reduced compared with non-inoculated controls in spite of the short period between T. harzianum application and planting. Visual chemical control with vinclozolin still gave the best results.


Prolonged exposure of insects and soil of Trichoderma harzianum in the fungus-borne nematode did not produce isolates tolerant to the fungicide. Exposure of four wild strains of T. harzianum to the fungicides chlorophenicol, proquinazid, triadimefon, and vinclozolin resulted in selection of several isolates tolerant to these fungicides. Some of the fungicide-resistant isolates grew better initially on media containing the fungicides than their respective wild strains did. Other isolates lost their tolerance after being etiolated in fungicide-free media. Cultures of certain isolates of the wild strains W-6 and T, tolerant to chlorothalonil and triadime- fon, respectively, germinated better on media containing high concentrations of the fungicides than did cultures of their respective wild strains. Exposure of cultures of the wild strain T-14 to 0.1 % triadimefon chlorothalonil for 4 wk reduced germination by 80 % when the cultures were placed on a fungicide-free medium. Maximum exposure of conidia of T-14 (1 ML), a chlorothalonil-tolerant isolate, reduced germination by only 20 %. An iprodione-tolerant isolate cultured from the Egyptian strain T produced more mycelium, as measured by inhibition of mycelial growth of Sclerotinia sclerotiorum, than did the wild strain. The fungicide-tolerant isolate of strain T-1 (T-1) (procyclic25M) reduced white rot of cotton caused by S. sclerotiorum more effectively than did T-1 or other fungicide-tolerant isolates. The iprodione-tolerant isolate T-1procycl25M and iprodione combined with T-1procycl25M gave the best control of white rot of cotton in the field in Egypt.


The mechanism by which Chrysosporium gloeosporioides, applied as a suspension to squash, sunflower, and pea seeds, reduces damage caused by larvae of the seed-eating maggot, Heterogena platura, and sunflower plant pathogens was investigated. Chrysosporium gloeosporioides germinates rapidly and covers the seed coat with a dense net of mycelium soon after seeds are placed in soil. However, if seeds are not treated with G. gloeosporioides before planting, other organisms rapidly colonize the seed coat during germination. Seed loss without treatment is high because the growth of pseudomonads on the seed surface enhances the selective medium in the soil. The results suggest that seed pathogens may not be the only agents causing damage occurring on the seed coat during seed germination. Treatment of seeds with G. gloeosporioides reduces the logarithmic growth of pseudomonads on the seed coat but affects neither bacterial populations in the soil surrounding the seed nor germination of Fusarium solani, C. gloeosporioides, or Sclerotinia minor. No treatment, on the other hand, reduces mycelial growth on the seed coat or in the soil surrounding the seed. A water-immobile antibiotic was extracted from C. gloeosporioides treated seeds. After isotopic examination of other possibilities, it was concluded that this water-immobile compound is responsible for the reduced pseudomonad suppression, pseudomonads responsible for stimulation of seedling damage as well as the sunflower plant pathogens.


The concept of biological control differs somewhat depending on whether one is an ecologist, a pathologist, or a plant pathologist. In the restrictive antemorphic sense, it means exploitation of single or multiple ways this is practiced in few cases only in plant pathology. Our purpose is to point out recent progress in this field in the light against soil-borne diseases involving the total resistance of soils, total success has been achieved. Whether the antagonism has been brought about by the induction of suppressive soil or by the addition of very active control agents such as Trichoderma attacks. By lactic acetic, Saccharomyces, Lactobacillus, and other pathogens and has been reduced. Integrated control of panning, soil-borne pathogens using solar heat treatment, spray chemotherapy, and biological control agents as suggested. Trichoderma has also shown a good antagonistic property against several parasites such as Sclerotina purpurea.
3. CONTROL OF KEEDS


Cirsium arvense is introduced since 1947 in Ontario, and is becoming slowly on the western provinces in the provinces. The weed is not a good control agent because its reproductive capacity does not compensate for the resistance of its resistance to herbicides. Thus, it is noted that C. thurae is not present in the spread of the rust Phoma pannlumata. Further stress factors from other invasion of pathogens are needed to control this resistant weed.


The galley, Eringia cardui, native to Europe, was released at 24 locations across Canada, starting in 1974. It became established in Ontario, Quebec, and New Brunswick but died out in all but one location in western Canada. Evidence for winter mortality in the west does not explain the failure of these colonies. Although galls, in particular those on the main shoot, raise the height of Canada thistle, so far the impact on the host weed Canada thistle, is slight.


Cirsium and thistles are introduced Eurasian weeds causing major problems in pastures, ranges, croplands, and along state highways in many parts of the USA. Two of the most problematic species are Cirsium arvense and Cirsium occidentale. They have been able to rapidly take over mismanaged lands, especially in overgrazed pastures. In the search for an effective long-term control measures, several biological agents were imported into the USA. Two European weeds which have been released have become well established and have potential as biological control agents of the months thistle: Rhinocladiella brevipes, a thistle bud weevil, was first introduced from France in July 1963 to three states: California, Montana and Virginia. It has subsequently been released to at least 13 other states. Equis of the weed are in leaf burs and the developing larvae feed on tissues of the receptacle, preventing seed formation. Significant impact has been reported in Virginia, Montana and Massachusetts. A second weed, Centaurea aphrodisia, was introduced for host specificity testing under quarantine in 1970. Based on results of the tests, it was officially approved for field release in Virginia in 1974 and has become established in at least 15 other states. Several other states have subsequently released this host-specific weed which is currently being evaluated for efficacy in thistle control. Equis is cut in leaf burs, larvae feed towards the crown and kill the growth point. Compatibility studies of both weeds, with 2,4-D, the most commonly used herbicide for thistle control in the USA, revealed that adult survival, fecundity and viability were not adversely affected. With proper timing, the herbicide and both weeds can be compatibly used in an integrated program for control of Cirsium thistles.


Two foreign species of weeds have been introduced into North Dakota for the biological control of thistle: Carduus nardus - Rhinocladiella brevipes, a weed feeding on leaf buds, and Carduus horridus - Rhinocladiella brevipes, a lower stem mining species. R. brevipes has been unsuccessful for several generations and is showing some promise for thistle suppression in Walton County, but releases of C. horridus have been unsuccessful. The pigweed flea beetle, Diabrotica virgifera, which is native in southern United States, has been introduced into experimental sugar beet plots in the Red River Valley for using its effects on control carduus. This pest is the most damaging carduus species. Although both larvae and adults of these beetles feed heavily on pigweed, damage to weed species is too low at the season for them to be effective in suppressing weed growth or feed on an individual basis. A significant survey for native insects on carduus has been conducted. Feeding by isolated populations of various carduus, particularly northern beetles, has been observed. Several foreign species of flea beetles and a stem boring beetles are anticipated for release against leafy spurge.


Cpolitician in addition to being evaluated as a host specific for prickly stink is now tested in agronomic crops. Of 38 plant species tested, only buckwheat (Arctium tomentosum) and prickly stink (C. politianum) were successful. In growth chamber experiments, disease symptoms on prickly stink seedlings were severe after single and multiple dew periods of 16 hr. In greenhouse tests, introduced disease led to 100% suspension of 9x 10^5 conidia per ml applied at 1781 ha killed 84-95% of the prickly stink plants. 30
Grass carp > 300 mm T.L. were stocked in Lake Baldwin, Florida during 1978-1984. Fish were distributed in the lake at a rate of 1000 fish ha^-1. A comparison of growth rates of grass carp in Lake Baldwin was conducted with those in Lake Baikal. Growth of grass carp was significantly faster in Lake Baldwin than in Lake Baikal. The size and shape of fish in Lake Baldwin were similar to those in Lake Baikal. The growth rate of grass carp in Lake Baldwin was found to be higher than that in Lake Baikal. The results of this study suggest that grass carp in Lake Baldwin are more likely to be a problem than in Lake Baikal. The findings of this study have important implications for the management of grass carp in Lake Baldwin.


Chondrillaoccurs in south-eastern Australia. The abundance of Chondrilla is limited by the natural habitat. Biological control has been used to limit the distribution of Chondrilla. The results of this study suggest that biological control can be effective in limiting the distribution of Chondrilla. The results of this study have important implications for the management of Chondrilla in south-eastern Australia.


The introduction of natural enemies of water hyacinth in the White Nile has been successful. The results of this study suggest that the introduction of natural enemies of water hyacinth can be effective in controlling the distribution of water hyacinth. The results of this study have important implications for the management of water hyacinth in the White Nile.


A study was undertaken to determine the effects of some formulations of B. thuringiensis var. israelensis in outdoor containers. The results of this study suggest that the use of some formulations of B. thuringiensis var. israelensis can be effective in controlling the distribution of mosquito larvae in outdoor containers. The results of this study have important implications for the management of mosquito larvae in outdoor containers.


The genetic structure of agricultural plant populations has been recognized as an important factor in their vulnerability to resistance to disease and pest attack. However, in the biological control of weedy plants, the potential significance of the population genetic structure of the target species appears to have been severely underestimated. An examination of the degree of control achieved in the two different control attempts demonstrated a significant correlation between the degree of control achieved and the dominant mode of reproduction of the target plant. Where sexual reproduction was effectively controlled, significantly more plants were killed than when sexual reproduction was not effectively controlled. It is suggested that the genetic structure of the target species has important implications with respect to the selection of species to be controlled, using biological agents.

b) Public Health


Two commercially formulated and registered B. thuringiensis var. israelensis were tested in Montana. The results of this study suggest that the use of some formulations of B. thuringiensis var. israelensis can be effective in controlling the distribution of mosquito larvae in outdoor containers. The results of this study have important implications for the management of mosquito larvae in outdoor containers.


B. thuringiensis var. israelensis was effectively controlled by applications of B. thuringiensis var. israelensis to outdoor containers. The results of this study suggest that the use of some formulations of B. thuringiensis var. israelensis can be effective in controlling the distribution of mosquito larvae in outdoor containers. The results of this study have important implications for the management of mosquito larvae in outdoor containers.


Field tests of B. thuringiensis var. israelensis were conducted in a moderately to heavily polluted pond in Oregon.

31
Lane Co., Oregon containing a mixed population of Coleus penn. and C. parviflorus. Five dosages were applied ranging from 0.4% to 1.6% kg/ha. Reductions of 73-99% were observed after 48 hours, but with no significant differences among the dosage rates tested. One week following each test, treated areas had returned to pre-treatment levels of larvae, but with significant differences in age class distribution. Laboratory bioassays produced confinement EC₅₀'s approx imately three times higher in water from the log pond compared with those conducted with distilled water.


B. thuringiensis var. israelensis serotype 16-14 and B. thuringiensis var. kurstaki were evaluated in the laboratory and in a 32-fram, open-end cylinders embedded in the bottom of the larval pool. Estimates of LC₅₀s were lower for fourth instars in the field at a mean of 15.9°C than in the laboratory at 21°C. The greater efficacy in the field was attributed to high daytime water temperatures from 29.1°C following treatment and exposure of the larvae to substantially greater aerates of toxic material in a larger volume of water than in the laboratory. The regression of probit on log Ho was linear over the entire range of mortality caused by B. serotypes, increasing the difficulty of estimating LC values. B. serotypes was significantly less active than B. thuringiensis.


Formulations of B. thuringiensis serotype H-14 were evaluated in the laboratory for larvalicidal potency against the Aedes albopictus and Aedes aegypti larvae. The 3 formulations tested were: standard (PS-78 water-dispersible powder; an experimental water-dispersible powder [ABG-6108]; a water-dispersible concentrate [SAN 402]). Mortality was recorded for batches of 25 second instars exposed for 24 hr at 29°C and 1600 ppm, respectively, for the 3 formulations. When compared with the PS-78 standard the relative activity at LC₅₀ levels was 0.25 for a 24 hr and 0.54 for a 48 hr exposure to ABG-6108, 0.25 for 24 hr and 0.34 for 48 hr exposure to standard SAN-402. It is concluded that while formulations with less than optimal performance are not available for application, those formulations with higher activity deserve evaluation for use in field applications.


Laboratory bioassays using 3 formulations of B. thuringiensis serotype H-14, PS-78, and R1527-78 were conducted with 3 species of mosquito: Aedes polynesiensis, A. pseudoscutellaris and A. aegypti. Additional bioassays were performed with A. polynesiensis and A. pseudoscutellaris at 5% and 24°C and distilled water, respectively. Mortality was recorded for batches of 10 instars exposed for 24 hr. The results indicate that all 3 formulations are active against Aedes aegypti, A. pseudoscutellaris, and A. polynesiensis. Additional formulations were evaluated with A. pseudoscutellaris to determine the effect of toxic material in a larger volume of water. The regression of probit on log Ho was linear over the entire range of mortality caused by B. serotypes, increasing the difficulty of estimating LC values. B. serotypes was significantly less active than B. thuringiensis.


The efficacy of specific treatments of B. thuringiensis serotype H-14 treatment with different dosages of suspended particulates containing a concentration of salt or clay particles in 0.5 mg/ml. Fresh whole-fruit, B. thuringiensis var. kurstaki was similarly affected by the soil and clay particles. Sand-sized grains did not have a strong effect on efficacy except when finely ground into particles of 60-200 mesh. Suspension of the bacteria before the addition of B. thuringiensis var. kurstaki did reduce their suppressive effect on the bacteria.


Mammalian biomedical research involving inhalation of water from the lower part of the trunk of standing palm cocoons are a feature of the Tokelau Islands (Northwestern Polynesia). Rainwater from them is used for drinking and culinary purposes. From 25 May 1978 the population of this mosquito on the island of Fakaofo, Fakaofo Island was exposed to improved Rootjumemactus confusus in sand culture. A temporary establishment was confirmed in August 1978 and a monitoring visit in November 1980 revealed that the worm was still causing infections in at least 5 of the 33 larvae initially treated. Subsequently 15 May 1981 the adult additional additional larval. The establishment but this persisted for only 15 years following a single inoculative application. Data presented suggest the future usefulness of R. confusus as an environmental risk and an integrated mosquito control methodology designed for the Tokelau.


The effect of seven photoperiods, day length 24 L: 0, 24 L: 12 d, 24 L: 12 d, 24 L: 12 d, and 24 L: 12 d was observed on larval activity. The ability of Rootjumemactus confusus as a biological control agent of Culex fatigans larvae was studied. The ratio of first instar larvae of C. fatigans and R. confusus, and in the same species at 10°C, studied. The different photoperiods at lower, optimum and higher temperature ranges were observed on the larval activity. The survival of the larval exposed to infection and photoperiod was at 12 L: 12 d the number of nematodes per larva was higher. The number of infected larvae surviving at 12 L: 12 d was lower. At all the temperatures and photoperiods the survival of the infected larvae was found to have correlation with the increase in decrease in the photoperiod. The interaction between temperature and photoperiod was also observed. The survival of the infected larvae and the number of parasitized per host was maximum at the optimum temperature range.
Various concentrations of the nematode *Heterorhabditis bacteriophora* were added to dishes containing second, third, and fourth larval stages of the mosquito *Culex pipiens*, respectively. The infective stage nematodes were ingested by the mosquito larvae; they then penetrated through the alimentary tract in the neck region and entered the haemocoel. A melanisation reaction killed many invading nematodes, but heavier concentrations overwhelmed the hosts’ defense reaction and 100% mortality of third- and fourth-instar larvae was achieved using between 170 and 200 nematodes per host. Death was either due to the nematode releasing cells of the symbiotic bacterium, *Heterorhabditis bacteriophora*, into the haemocoel or to foreign bacteria (possibly *Pseudomonas aurantica*), which were introduced by the penetrating nematodes. The potential use of this nematode as a biological control agent of larval culicine mosquito is discussed.

Preliminary mammalian safety tests were conducted on the entomopathogenic fungi *Metarhizium anisopliae*. No animals died or were clinically ill after ingestion or exposure to *M. anisopliae*. There was no evidence of systemic irritation; and tissue lesions were confined to local sites at which large numbers of spores were collected. There was no histologic evidence of spore germination in mammalian tissues. *M. anisopliae* revealed its structural complex with twin nuclei and spores after 2 weeks of exposure to mice or bats but not at the end of week 3. Fungi were recovered from local germination sites, but the spores were sterile 21 days after exposure. We concluded that this test (to reveal no evidence of human or mammalian pathogenicity of *M. anisopliae*)

**References**


The oviposition behavior of the predatory mosquito, *Toxorhynchites anthropophagus*, was examined in a 1.6 m² nursery yard in St. Joseph County, Indiana. A total of 120 laboratory-reared *Toxorhynchites* females were released. Egg production was monitored by checking for eggs daily in 38 marked trees distributed in 4 distinct habitats. Of the 334 eggs recovered during the 28-day period after release, 45% were from trees of 20 trees in a wooded area, 20% were from 20 trees in a completely shaded tree, 22% were from 20 trees in a partially shaded plot, and the remaining 1% were recovered from 20 trees in an exposed tree plot. *Toxorhynchites* eggs were found in every available substrate sampled in the study area, and in both types of shaded tree plots, but only 15% of the trees sampled in the exposed tree plot received any eggs. On the 24th day after release, 7% and 4th larval *Toxorhynchites* larvae were common in stunted trees. The high fecundity and the preferential oviposition in stunted areas indicates that *Toxorhynchites* should be considered for the control of mosquitoes that develop in shaded trees.


In the present investigation, field trials on the experimental basis for the control of *Culex* spp. mosquitoes were made. The male pupae were irradiated with a gamma radiation dose of 8000 R and the irradiated pupae as well as emerges sterile male adults were transported and released in the field (in Thrissur). The egg rafts were collected and observed for viability. Up to 90 percent sterility was recorded and a significant decline in the population density was observed.


A strain of *Culexquinquefasciatus* with European cytoplasmic and chironomid sexing, including a male-linked translocation, was reared and males were released in two villages near Dalit which were surrounded by a 3-4km buffer area. One of the villages was treated with 15000-50000, 20 males were released per day per village and they produced very high rates of males released to wild males. As a result of matings of wild females to released males, up to 49% of the eggs laid in the villages showed cytoplasmic incompatibility (tertiary bar), despite continued releases, the sterilization rate planed and eventually declined. This can partly explain why mating with wild females in the village but it was concluded that immigration of already inmated females must also have had an important influence. The trend in the wild adult female population and the breeding in the release villages in comparison with untreated villages indicated that the releases produced partial population suppression.


A combination of varying chimeronosterone dose and exposure time, the ability of the compound bis-alcohol, P-Bis (1-(1-phenyl)-N-nitro-phosphonothioamide, to induce sterility in adult male *G. m. morsitans* has been evaluated by making sterilized males to normal females and measuring their fecundity over 90 days. The product of dose and exposure time in hours is a constant for a given level of sterility reduction. The duration of antennal responses of males to transitory encounters with G. m. morsitans eggs pheromone and bis-alcohol is such that a fertility reduction to less than 10% can be achieved within the dose range of bis-alcohol that causes no reduction in antennal response, and within a time period that is less than 75% of males are exposed to remain in contact with the decoy. Chemosterilization with bis-alcohol has no apparent deleterious effect upon the ability of males to engage in normal copulatory activity with a female and within the limits of laboratory experimentation such males compete equally with normal males to secure a mate. The prospects for utilization of a sex pheromone/chemosterilant system to achieve sterilization of G. m. morsitans males in the field are discussed.


A method for the continuous culture of *Entomophthora muscae* in adult house flies (Musca domestica) is described. Using this method we have maintained the host-parasite system in the laboratory for more than one year. The ability of the isolate to cause fatal infections in virtually all of the house flies at risk has remained constant. The fly *Musca domestica* (the entire flies *Musca domestica* have been used as the seed fly (M. domestica) are susceptible to this isolate. The stable *Musca domestica* cultures and the fly (Phaenicia regina) and the false stable fly (Musca autumnalis) were not. *J. Invert. Pathol. 55 (3): 477-488.

The adult and larval stages of *Entomophthora muscae* are described. F. muscae develops into red or brown in the rotifers of *Bithelis golfier* which is totally sterilized. The insects become recovered in the pericidal cavity of several aquatic Polymastia, in the kidney of amphibian tadpoles. The adults were experimentally obtained in the laboratory mouse exclusively.


Under laboratory conditions, the giant Malaysian prawn was found to prey upon two major South American species of schistosome vector snails, *Bithelis golfier* and *B. angustiparum*. Juvenile prawns fed on the snails with a consumption rate of 2.5-5.5% of prawns body weight per day, whether they were given an alternative food source (55% body weight per day in rearing culture) or not. Post-larval prawns consumed 25% of prawns body weight per day in addition to the isotonic ration. The potential of M. rosenbergii to serve as the biological control of schistosome vector snails in pond ponds as well as its commercial value as an aquacultural commodity is discussed.


Decontamination is made of the pathogenicity of *B. angustiparum* var. *lancetii* for larvae of *Pholcus phalangioides*.
larded populations of the European corn borer that were infected transovarially with Nosema conscns. The insectic- and N. conscns acted independently in reducing slash damage by the European corn borer. There were no differences between percentage infected and intensity of infection in larvae treated with insecticides.

ENTOMOPHAGA

Many of you have been aware of recent dissemination in publishing Entomophaga and have voiced criticisms of the Journal. Recent delays in publication and poor quality of some numbers have been due entirely to the publisher whose contract we have at last been able to terminate. The Editor, Mr. Hopkin, has now been able to negotiate a new contract with a Los Angeles publishing house of high reputation with wide international links, so in future we can justly expect a high quality of production. Incidentally, there will be some increase in cost, though we hope that this will fall with increase in sales.

Entomophaga is specifically the Journal of the Global IOBC but naturally Regional Sections are concerned that it meets their needs, while the West Palaearctic Regional Section has administrative and financial responsibilities for it. A representative of this committee, chaired by the Editor, has been set up in order to examine how Entomophaga, as the only international journal devoted primarily to biological control, can henceforth meet the needs of biological control workers throughout the world.

At present, the policy of the journal is to accept original papers on biological methods of control against any natural enemies, diseases and weeds. Whilst papers on natural enemies are of prime importance, the journal also accepts contributions on other biological methods of control. Moreover, in keeping with its subtitle A Journal of Biological and Integrated Control, contributions are welcomed on integrated control, notably where they involve significant biological control components.

We urgently solicit your current and constructive criticisms on the above terms of reference for the scientific content of the journal. We would also welcome comments and advice on all other aspects of journal content, organization and objectives. Furthermore, we need advice on how the journal can better satisfy the needs of regions, especially in the tropics and sub-tropics. We therefore invite you to communicate on how there are at present relatively few contributions from that region which are published. Advice on how to improve these contributions is welcome. Entomophaga is your journal, and we therefore request your advice and comments in order to improve it.

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