IOBC Newsletter
n° 11-12, 1979

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Obituary

Robert van den Bosch, Chairman of the WHRS

With the deepest regret and a sense of irreplaceable loss, we announce the unexpected death of our friend, colleague, and leader, Professor Robert van den Bosch (59), on 19 November 1978.

As a lifetime specialist in biological control, he had an understanding of the importance of natural enemies in the control of pests; he pioneered in the development of the ecologically sound method of pest control known as integrated pest management. He searched for natural enemies of pests on the continents of Europe, Africa, and Asia, spending much of his hunting time in Iran, Pakistan, Afghanistan, Kashmir, and Japan. His search resulted in the successful importation and utilization of several natural enemies of several fruit fly, block scale, spotted alfalfa aphid, alfalfa weevil, walnut aphid, and various pests of ornamentals. He pioneered in the development of integrated control for alfalfa and cotton pests, and in the formulation of the fundamental concepts of integrated pest management. His expertise is demonstrated in his more than 150 publications.

Van's work included not only being a researcher, a teacher and an administrator in the Division of Biological Control and in the Department of Entomological Sciences, but he was also concerned with the biological, economic, and social implications of agricultural technology on the environment and humanity. He saw so clearly our mutual problems, their causes, and their solutions. He was a deeply sensitive man who was compelled by his concern to voice and write his opinions in his inimitable style not only to academics, but also to farmers, politicians, environmentalists, farm workers, agronomists, in truth, to everyone, and he courageously fought to see them implemented.

To those who really knew him he epitomized the virtues of love, honesty, humanity, and unswerving courage — everyone recognized Robert van den Bosch as a free thinker.

His wife, Peggy, his colleagues, students, and friends wish to establish a lasting memorial honoring him for his contributions to all in the form of "The Robert van den Bosch Memorial Fund." Contributions may be sent to the International Center for Integrated and Biological Control, University of California, 1050 San Pablo Avenue, Albany, California 94706, USA.

G.B. Haffner
Secretary-General: G. MATHYS, 1, rue La Nobre, FR-75016 Paris (France).
In this review paper, the author draws attention to various examples in the Vinc北海 of plant breeding for resistance against arthropods, and explains the host-pest interactions involved. The influence of natural selection, domestication and plant breeding on host plant resistance is first discussed. Distinction is made between the terms resistance and tolerance. The development of an insect population on varieties with different levels of resistance and tolerance is illustrated, using the components of damage threshold. The importance of host plant resistance in the absence of chemical control measures is dealt with, in the presence or absence of natural enemies. Consideration is then given to the impact of host plant resistance on the various strategies of integrated control, such as use of pesticides only when the damage threshold is exceeded. The possible adverse effects of resistance in non-persistent virus disease transmission, arising from vector behaviour of the vector on susceptible host varieties, is pointed out. The contributions of plant breeding to integrated control through other invertebrate characters, such as morphological characters which influence the predator or parasitoid activity of natural enemies, is discussed. The successful introduction of integrated control strategies, such as host plant resistance, must be accompanied by frequent extension programmes for individual farmers. Certification of breeding and seed production of insect resistant varieties at regional stations, from where the seed is distributed to local farmers, is important for those countries lacking the means to support all farmers individually.

Resistance to Pesticides

Reisert Mechanics and Counter Measures

By J. Paltoven, Agricultural University, Wageningen, Netherlands

The mechanisms by which fungicide resistance develops are discussed in detail, and the need to decide whether to reach the site(s) of action in the fungicidal class either to decreased permeability, increased (decreased) or decreased (increased) target sensitivity (decreased) or changes in the metabolism of a pathogen (circumvention of the site of action, compensation for the inhibitory effect). Generally, increased resistance may develop through mutation of a single gene, e.g. carbendazim resistance in Aspergillus niger, or several loci for resistance may be present. Heredity and xenobiotics may also play a role in development of fungicide resistance, as may hybridization. Build-up of a fungicide-resistant population in the field depends on, among other things, the vigour, virulence and competitive ability of the resistant strains. Counter measures against fungicide resistance are then discussed. The potential vulnerability of a fungus for resistance to a new chemical can be investigated, but extrapolation to the field cannot necessarily be made from in vitro experiments. Attention should be given to the possible use of non-fungicidal chemicals which increase the host plant's resistance. Judicious management of fungicide applications may reduce the chance of serious resistance problems arising in practice.

Development of Alternatives Chemicals for Control of Resistant Pests

By G.P.𬍛sliou, University of California, Riverside, USA

Increasing resistance or cross resistance in pests to synthetic insecticides has prompted the search for alternative
chemicals for control of resistant arthropods. One class of insecticides which will play an increasingly important role in pest control is the pyrethroids. However, cross resistance is evident in certain of these compounds has already been noted, e.g., 50c and 2000c cross resistance to permethrin in Lepidoptera species and Spodoptera exigua, respectively. Evidence suggests that the resistance is polyfactorial. "Target site insensitivity" to the organophosphates and carbamates, frequently seen in certain strains of the pest, now occurs also in several insect species. Carbamates with higher lipolytic and lower mammalian toxicity are being developed, in are inhibitors of insect development (inhibition of methylenetetraacetate, unmeasured). Research continues on anti-juvetile hormones of plant origin, and the identification of toxic natural products which regulate plant leaf structure and development by pest species.

**Pest Control in Grain Storage in Developing Countries: An Overview**

By B.J. Choony, CSIRO, Canberra, Australia

The safe storage of grain must be based on the proven principles of sound storage practice if long-term efficacy is to be achieved, viz., adequate drying of the commodity, a high standard of hygiene, suitable storage and transport facilities, regular inspections, minimum and judicious use of chemicals, and use of resistant varieties. Physical means of eliminating pests are desirable, but costly. Control strategies for developing countries are discussed, both at the local, subsistence level, and on an international scale. Insecticide and capacity to carry out improvements in storage systems are the major constraints currently limiting introduction of insect control methods. Storage, cleaning, and sorting strategies are outlined: drying, cleaning, which retains the principal economically-usable quality for disinfecting and insecticidal, storage, grain, in airtight or non-airtight, nitrogen atmosphere, use of CO2, light tight storage or use of a nitrogen atmosphere, heating and cooling techniques, including fumigation. Grain storage is an integrated stored crop, insecticidal control strategy approach, often in combination with these strategies. In conclusion, the author emphasizes the need to improve communication. Intensive research and development creates a rapidly changing situation in which it is difficult for workers in developing countries to keep informed on current activities and technology. It is recommended that FAO give high priority to assessing the situation and correcting the deficiencies in the exchange of information if the scarce resources available in the storage pest control field are to be used to maximum advantage.

**Use of Granulosis Viruses in Biological Control**

By J. Huber, Biologische Bundesanstalt, Darmstadt, Fed. Rep. of Germany

The ratite, development and successful uses bacteriolytic in insect pest control are discussed. Most research has been concentrated on the control of stored grain pests, 5-10% of which exist, or are being registered, in the USA and Canada. Field experiments with granulosis viruses (GV) have been limited. However, promising results have been obtained with the GV of *Lepisiosoma pomonella* in Australia, USA, Canada, Switzerland and Germany; application of 10^4-10^5 particles ha gave comparable or better control than chemical insecticides. Moreover, this GV is also effective to *Rhyzopertha dominica*, a serious pest of pines in Australia, a single application of the GV of *Plodia interpunctella* spinocelli was reported to give control at least equal to 8-10 pesticide applications. Although the GV of *Aegosposoma velutinum* acts too slowly to prevent crop damage, it may be useful in long-term control of *larvaria* populations. Other potentially valuable GV include those of *Plodia interpunctella* (traps for stored wheat infestations), *Agrotis segetum*, *Chortionodes indicus* and *Dactylenaena ama* in the latter case, the GV not only reduced the existing population, but also the 2nd and 3rd generation following application.

**Development of techniques for the production of granulosis virus preparations for microbial control of the codling moth, *Laspeyresia pomonella* (L. (Lep. Tortricidae)) and control of production cells** (Brussel, J. [1965]. *Bull. Soc. ent. belge* 75: 155-211)

Techniques have been devised for mass production of the virus. As a preliminary step, the viability of alginate larvae for virus production was investigated. Dispersing L. larvae under short-day conditions could be infected more easily than those obtained under long-day conditions. The infection of a larval population ranging from 2 to 8 larvae g^-1 of 1- to 5-day-old L. larvae dipping into a virus suspension containing 10^5 virus particles ml^-1 resulted in a high rate of infection, with optimal larval weight. After infection, larvae were fed again.

Two results for mass rearing of codling moth larvae were computed: one based on age and the other on weight. The latter was preferred because of its resistance to bacterial and fungal contamination. In order to avoid virus syndromes, mass breeding of larvae has to be separated from the virus production unit. L. larvae as infected with the virus were driven out of the mass rearing medium by the application of heat. With the aid of a special device, the larvae leaving the medium were collected and dipped into the virus suspension. Larvae were then transferred to an agar medium into which they were inserted and continue to develop. Four days after infection, the heavily infected larvae were driven out of the medium by means of a heated sand bath, and finally collected for virus production. Forty to 65% of the larvae present in the medium before the first heating were obtained as virus infected larvae. The average virus yield is of the order of 5.5 x 10^6 virus particles per rearing tray. An average multiplication factor of 4.5 x 10^6 has been calculated. Storage of virus material proved to be best when glycogen was added and subsequently frozen at -20°C. The costs of virus production approximately equal the costs of a commonly used insecticide. Costs are doubled by addition of skin-milk powder or Esfall (detergent) for practical application.

**International Workshop on Bacillus thuringiensis in Darmstadt, Fed. Rep. of Germany**


A colloquium organized by H.T. Detoruge (USA), H.D. Burgers (UK) and A. Krieg (Fed. Rep. of Germany) for the Society for Invertebrate Pathology (SIP) took place in Darmstadt, Fed. Rep. of Germany, on September 6 to 8, 1978. It was the second Workshop dealing with *Bacillus thuringiensis*; 25 experts from 8 nations (North America, Western Europe) participated, all of them being actively engaged in research on and application of *Bacillus thurin-
genus (Bt.), and belonging to Research Stations, University of Industry.

Papers and discussions centered on the following topics: 1) fungal spectrum; 2) soil microorganisms; 3) chemistry of crystal toxins; 4) microbial production of insecticides; 5) formulations and preservation of arthropod cryoprotection; 6) studies on application to stored products in agriculture, forestry and stored products.

Further, reports were given on the activity of certain Bt. active against medical pests, as far as this efficacy was not due to non-specific exotoxins. This refers to the effect of various strains of Bt. (different serotypes) on Aspergillus and fungi and, particularly of serotype Hr., on mosquito larvae. Here, new developments are apparent.

In the section on serology, crystal antigens of Bt. were of particular interest. In biotechnology, emphasis was placed on the use of recombinant techniques for the production of virus proteins and as well as on the isolation and characterization of the biotechnological group of the crystal glycoprotein.

Recent contributions to the genetics of Bt. indicate that the crystal toxin is coded by a plasmid. In addition, transduced-plagines have been isolated which may facilitate genetic engineering with Bt. in the future.

The scientific programme included a visit to the insect pathological laboratories of the Institute for Biological Control (IBA) and of the Laboratory for Cell Biology (Biology Institute, Technical University of Darmstadt). Main emphasis was given to demonstration of the production of insect pathogenic viruses in vitro, as well as in vivo. Examples were shown of the diagnostic and pathology of insect diseases, quality control of preparations containing viruses and bacteria, as well as results of field tests with insect pathogenic viruses and Bt., with special consideration of application technology.

One of the conclusions was that the use of Bt. preparations as a selective means of control of plant pests (epidiasporon larvae) has become increasingly important throughout the world, particularly in the USA, USSR (not represented at this workshop) and, more recently, in South America and South-East Asia. Additionally, the development of specific anti-rice virus preparations based on Bt. is of great interest to WHO.

Optional Testing of Pesticides for their Incidence on Beneficial Arthropods in the Federal Republic of Germany

The Working Group of the WPBS on Pesticides and Beneficial Arthropods, headed by Professor Ehrig, Darmstadt (DE) has established and reached agreement on 9 successive guidelines for evaluating the impact of pesticides on the following species, 4 of which are recognized by the BBA (*).

Laboratory methods:

- Trichogramma conaeae Mark (representative of the micro-hymenoptera)
- Coccinella septempunctata L. (representative of the superfamily Coccinelloidea)
- Chrysopa carnea Steph. (Chrysopidae)
- Pseudoperiplaneta americana L. (Dictyoptera)

The official testing performed by designated institutes is not compulsory but can be requested at a cost of 500 DM. For more details: Dr. Heyrath, Biologische Bundesanstalt für Land- und Forstwirtschaft, 3500 Braunschweig (DE).

G. Matthes

Notes on Biological Control in the Solomon Islands

By J.H. Stapley, Ministry of Agriculture and Rural Economy, P.O. Box 25, Honiara, Guadalcanal

Introduction

Biological methods of control have been reasonably successful in the Solomon Islands in recent years. Such methods are to be encouraged, not only because of the dangers from wide-spectrum insecticides and possible damage to the environment, but because of the difficulties associated with the use of insecticides in these remote islands. There is the problem of transporting material, the high cost of insecticides which is increasing all the time, the reluctance of the local people to purchase spray machinery and their inability to use it when available.

Examples to Date

Trichitesia bennigseni Fos., a parasite of the coconut leaf beetle, Brontispa longissima Guerin, became established in the Solomon Islands after its introduction in 1960. The parasite is still present but incidence of Brontispa is now much reduced. Use, in practice, of the Geocephalum amandii against the mudlet bug, Anagyrus sp., is now well documented. Geocephalum is known to exert pressure against the Panorpa sp. moth. If this is not successful, it is planned to release Rhododendron corymbium into wild populations of Panorpa sp. in 1975.

The Brown Plant Hopper on Rice

During 1975, good control of the brown plant hopper (BPH) was achieved on irrigated rice on the Guadalcanal Plains by means of 2 naturally occurring predators, Cyrtothrips quadricorne and C. bilineatus. All rice fields were under constant surveillance to determine the relative population densities of BPH and its predators. It had been known since 1971 that BPH was a limiting factor in rice production, and historians had been controlled by aerial spraying. The importance, from the International Rice Research Institute (IRRI) in the Philippines, of BPH-resistant rice varieties provided a temporary solution. However, after 18 months of continuous growing of these varieties, the resistance appeared to break down. P. Quadricorne, a new species of BPH had arisen. All varieties subsequently imported from IRRI have been attacked by BPH in a greater or lesser extent.

New varieties of rice have been found to exhibit tolerance to BPH, and grow better than resistant varieties. Some BPH develop on tolerant varieties, so allowing populations of Cyrtothrips to build up and persist. The interactions of rice varieties, BPH and Cyrtothrips are complex, but certain facts are clear. Varieties susceptible to BPH allow rapid development of the hoppers, which cannot be controlled by Cyrtothrips. However, a variety exhibiting tolerance is more slowly colonized by BPH and, consequently, there is time available.
Ctenobothrus populations to have a far greater pestiferous influence.

By planting tolerant varieties, the rice grown during 1975 was kept reasonably free from BPH, except when it was necessary to spray against armyworms. Ctenobothrus populations were drastically reduced by spraying, with consequent rapid development of BPH, leading to bigger infestations. An alternative control approach might be to use Bacillus thuringiensis against armyworm. Although this product has given satisfactory kill in laboratory tests, aerial applications has so far been disappointing. The problems of budding predators in BPH control on rice in the Solomon Islands were discussed at the International Rice Conference in Los Banos, in April 1977.

Conclusions

The methods described above to control the brown plant hopper on rice, and those suggested for control of bollworms on cotton in the control programme benefiting from being self-operating once initiated. These controls have been developed by approaching the problem in a practical rather than an academic manner. It is likely that the predatory action of Ctenobothrus had not been effective previously in the rice varieties accustomed too quickly to attack of BPH; the crop was either lost or sprayed, with consequent elimination of the predator. The importance of BPH as a major pest on irrigated rice in the Solomon Islands is due to the crop being a monoculture in the mid of 300,000 acres of grass plant. Similarly, Sogatella has become pests in the Islands due to the crop being a monoculture in cleared bush. If one could only swap the location of the 2 crops around, the pest problems would not arise.

Information from the Maldives

A survey of the Natural Enemies of Sugarcane Aphids in Penang, Malaysia

G.T. Lim & Y.C. Pan, Entomology Dept, Sugarcane Exp. Sta, Gula Perak Berhad, Malaysia

Three species of sugarcane aphids, namely, Conocephalus berlesei (Zehntler), Lantispis spurius (Zehntler) and Hyperaspis solatria (Thun.), were recorded in the Gula Perak Berhad plantation. A survey was made of the natural enemies of these important pest species. Among the former, there were two species of hyperoctomegus parasitoids and 23 species of predators, as follows:

Order/Taxonomy

Hymenoptera

Aphidolambia

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Coleoptera

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Aphidolamilies
A method for measuring the incidence of various fungicides on the development of Eutypella apalaiphila (Th. & Th.) Peron. & Wint. is described, in connection with studies of the preventive, curative and acaricidal activity of 19 fungicides.

D.E. BECKING, Agriculture Canada Research Station, Regina, Saskatchewan, Canada. The basis for host plant specificity in Tephritis diacrita and T. hermanni (Diptera: Tephritidae).

This paper reports observations which indicate that host plant compatibility between the poll-feeding tephritids, Tephritis diacrita Loew. and T. hermanni Loew, and their respective host plants, Saxifraga squarrosa and S. stolonifera, provides the basis for host specificity in these closely related flies.

W. H. WADSWORTH, University of Florida, Homestead, Florida, USA. Sexual differences in feeding on a new Lactuca repisa (Denn.) Lactuaceae. A significantly greater number of adult females Lactuca repisa (Pall.) was found feeding on corn male foliar (127, 128, 10) than was expected from the male/female ratio (1:1.65) caught in plot pans. The apparent requirement of the females for more food than the male is offered in an explanation of the differences in their feeding activity.

E. E. TURBÉ, T.R. ASHLEY & R.R. MITCHELL, U.S. Department of Agriculture, Gainesville, Florida, USA. Pseudococcus brevipes (Hemiptera: Pseudococcidae) and Myzophyllum inermis (Hemiptera: Myzophyllaeidae) from Arachis hypogaea in field corn. Three species of leafhoppers known to be present on Arachis hypogaea were found to be feeding on the leaf blades of corn plants in 1975 and 1976 at Homestead, Florida. Nine adult species of predators, representing the Chrysoperlae, Phaonidae, Exochorinae and Formiinae, emerged from these leaves. All species of predators from the leafhopper complex that feed on Arachis hypogaea are also reported as parasites of A. hypogaea; a natural pest of corn. Therefore, these leaves on A. hypogaea may be a source of the parasites found mating S. brevipes.

Kerla S. WETZEL & V. TAMADA, University of California, Berkeley, USA. Interference between two nuclear polychloro-

benzene isomers of the antipyrin, Prochloraz isopropyl (U.S.). The level of Prochloraz isopropyl (Furadon) is susceptible to 10 nuclear polychloro-

benzene isomers (NPX) (NPF), the typical (TRF) and 12 non-specific isomers (NFX) (NF) with the interference between the 3 viruses is studied primarily in the tobacco and the tomato.

A. G. VAN ZON & M. W. VAN ESCHE, University of Amsterdam, Netherlands. The effect of some fungicides on Phytophthora parasitica (Acacia: Phyllodercidae).

The effect of 11 fungicides on different developmental stages of Phytophthora parasitica (P. ulmi) was investigated. Special attention was paid to the extent that these compounds have on the survival of adult females and juveniles, on the budding of eggs and on the longevity of the females. It appears that each genus and species combination is influenced by the species, based on their effect on red soil on females and nearly healthy juveniles; with very few exceptions, all with little effect on the adult females in the suspension culture and with moderate effect on the juveniles and not of any influence on leaves (100% mortality) as the recommended concentrations.

E.S. FOSTER, University of Florida, Gainesville, USA. Effect of paratrazol on growth and development of Eutypella apalaiphila. The effectiveness of Paratrazol on growth and development of Eutypella apalaiphila was evaluated. By Paratrazol (50% water wettable dust), at 500 ppm of water, to evaluate the effects of the plant. Applied at 500 ppm, Paratrazol was shown to increase the plant size and volume, plant growth, and productivity. The overall effect of the use may advance control of the seed in the field.


6
build up in pine forests. Three generations occur in London Province, and this need could be used for controlling pine beetles here.


The history, present status of cultivation, and pests of cotton in China are reviewed. Recent progress in the introduction of cotton pests, natural enemies, time, and growth and development stages of cotton are illustrated. Management is an important part of cotton pest management systems widely used throughout China. Incorporation of crop management, comprising cultural, chemical and biological measures. Mass relocations include of an adequate distance from cultivated cotton fields, which prevent overwintering and reduce beetle numbers. This also provides a longer season for pest management efforts for future harvests.

Announcements

Biological Control of Plutella xylostella

Entomologists engaged in research on the biological or integrated control of Plutella xylostella and interested in forming a group to facilitate exchange of ideas and/or parameters for determining the potential of Plutella xylostella as a pest of Plutella xylostella. The insect is a major pest in temperate and subtropical regions.

The Cornell National Association of Researchers and Technical (CONICET), the Fundación para la Educación la Ciencia y la Cultura (FEC), and the Asociación de Economía (AME), all agree to hold a seminar to encourage and expand the body of knowledge about the pests and their management in the Americas. The seminar will be held in July and August 1978. The seminar will address pest management strategies and control measures, including biological and chemical control methods.

Cockpea	From Entomophasis 23 (4), 1978 - additions

W.G. Harter et al., USDA, ARS, Citrus Insects Research, West Palm, Texas, USA. The introduction and establishment of parasites of citrus blackfly, Aceria pensylvanicus in Florida, USA are reviewed. The parasites have been introduced to control the citrus blackfly, which is a major pest of citrus crops in Florida. The parasites have been successful in controlling the blackfly population, reducing damage to citrus crops. The parasites have been released in various areas of Florida, and their impact on the blackfly population has been monitored. The parasites have been found to be effective in controlling the blackfly population, and their introduction has been successful in managing citrus blackfly populations.

Book Review (by Elizabeth A. Baker)

Provisional Atlas of the Neighbours of the British Isles


By means of five maps, the Atlas presents the geographical distribution of British birds, butterflies, moths, spiders, fish, and amphibians. It is a valuable resource for biologists and ecologists, as well as for the general public interested in wildlife conservation.

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