JOINT FAO/IAEA DIVISION

of Isotope and Radiation Applications
of Atomic Energy for Food and Agricultural Development

INTERNATIONAL ATOMIC ENERGY AGENCY
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

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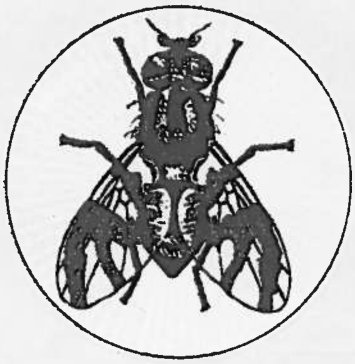
INSECT AND PEST CONTROL

NEWSLETTER



No. 40

December 1987

The Joint FAO/IAEA Division is responsible for applications of nuclear and related biotechnology in food and agriculture.

TRAINING COURSES: 1988

1. FAO/IAEA INTERREGIONAL TRAINING COURSE ON THE USE OF RADIATION AND ISOTOPES IN INSECT CONTROL AND ENTOMOLOGY

   University of Florida, Gainesville, Florida, U.S.A.

   16 May - 24 June 1988

   Deadline for application: 19 February 1988

2. FAO/IAEA REGIONAL TRAINING COURSE ON INTEGRATED CONTROL OF TSETSE FLIES WITH EMPHASIS ON THE STERILE INSECT TECHNIQUE

   BICOT Headquarters, Vom, Plateau State, Nigeria

   23 May - 17 June 1988

   TO PROVIDE INTENSIVE TRAINING FOR AFRICAN PROFESSIONAL AND SENIOR TECHNICAL STAFF IN THE PRINCIPLES, STRATEGY AND APPLICATION OF THE SIT TO ENABLE THEM TO PARTICIPATE IN THE PLANNING AND MANAGEMENT OF INTEGRATED CAMPAIGNS AGAINST TSETSE.

   Deadline for application: 5 February 1988

IMPORTANT !

Applications must be submitted in duplicate on the standard IAEA nomination form for training courses. Completed forms should be endorsed by and returned through the official channels established (the Ministry of Foreign Affairs, the national Atomic Energy Authority, the Office of the United Nations Development Programme or the Ministry of Agriculture); they must be received by the International Atomic Energy Agency, P.O. Box 100, A-1400 Vienna, Austria, not later than the respective dates indicated. Nominations received after that date or applications sent direct by individuals or by private institutions cannot be considered.

CONTENTS

I. INTRODUCTION

A. To Our Readers

We are pleased to send to you the latest issue of this Section's Newsletter, which also contains abstracts, contributed by readers, of recent or on-going research related to the application of radiation and isotopes in entomology.

The Newsletter is intended as a medium for informing our readers of "what is going on" and for providing an indication of "future plans". As far as possible, results or summaries of major activities (e.g. field programmes, meetings, etc.) during the preceding 6 months will be provided. We welcome feature articles on insect and pest control issues for inclusion under "Special Features and Comments".

The purpose of the abstracts is to present you with a preliminary report of research and development activities in the application of nuclear energy to entomological problems and related aspects. Radiation sterilization and isotope-aided studies are stressed, however, articles relating to practical pest control or eradication, e.g. research on mass-rearing, quality control techniques, ecology, genetics, physiology and behaviour of arthropods of agricultural and veterinary importance, as well as computer modelling of pest populations may be accepted for inclusion in the Newsletter. Isotope-related studies of pesticides and toxicology would also be relevant.

Please note that the summaries of unpublished work often represent preliminary reports of investigations in progress and, therefore, such findings are subject to possible revision at a later date. Therefore, the abstracts in this issue should not be published or referred to in articles for publication without first obtaining permission from the authors. We wish to emphasize also that the abstracts do not constitute quotable journal publications.

For your convenience and for printing purposes, we are enclosing with this issue the standard form on which we would appreciate receiving your contribution(s). If you require a supply of these forms, please let us know. Please use a separate form for each item and type your name and address, in capital letters, in the upper left block. The text should be no longer than one side of the standard form and double-spaced. For several reasons, we are unable to edit submitted contributions. These are reproduced by a photographic process, and therefore reflect faithfully, the author's care in preparing the material.

We look forward to receiving your contributions for the next issue and wish to thank all those who contributed to the present issue.

B. ABOUT THE INSECT & PEST CONTROL SECTION

The Insect & Pest Control Section is one of 6 functional Sections of the Joint FAO/IAEA Division based in Vienna, Austria. The main objective of the Section is to advise and assist Member States of the IAEA and FAO in finding solutions to pest management problems and in developing effective pest control strategies based on nuclear techniques and biotechnology.

The main thrust of activities has been the development of the Sterile Insect Technique (SIT) for the eradication or control of major agricultural insect pests and disease vectors in developing countries. In this connection, one of the Section's main responsibilities is provision of technical backstopping for field projects in Member States. This is accomplished by staff members evaluating requests for assistance from Member States, assisting in project planning, preparation of project documents, evaluating experts, advising on TC project implementation, reviewing progress as required, evaluating fellowship training applications, recommending placement for trainees, recommending and advising on the purchase of equipment.

Research support for the Section's programmes is provided primarily by the Entomology Unit of the Seibersdorf laboratory. In addition, other laboratories contribute to the programme through participation in the IAEA's Co-ordinated Research Programme.

Through symposia, seminars, advisory group and consultant's meetings, as well as publications arising from these, information on the Section's activities is disseminated to the international community in general. This Newsletter which is issued twice a year in July and December presents information on the activities of the Insect & Pest Control Section on research and development in Seibersdorf and serves as an avenue for presenting summaries of research findings from all over the world in the field of application of radioisotopes and radiation in insect and pest control.

II. GENERAL INFORMATION

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A. Professional Staff - Insect & Pest Control Section

Headquarters

D.A. Lindquist	Head, Insect & Pest Control Section
E.D. Offori	Technical Officer
A. Van der Vloedt	Technical Officer

Seibersdorf Laboratory

R.E. Gingrich	Head, Entomology Unit; *B.t.* Investigations
A. Economopoulos	Medfly Investigations : Rearing
J. Kabayo	Tsetse Investigations
E. Busch-Petersen	Genetic Sexing of Medflies

BICOT

M. Oladunmade	Project Leader and Officer-in-Charge, Field Operations

B. Entomology Laboratory

The IAEA has an international laboratory located at Seibersdorf, Austria, about 30 km from Vienna. A part of this laboratory, within the Agricultural Biotechnology Unit, is devoted to research involving the use of atomic energy in entomological research.

The primary objective of the entomology programme at the Agency's laboratory is to support and service the Joint FAO/IAEA Division's programmes on insect control. Thus, much of the research is concerned with problems that arise with field programmes.

Research at the Seibersdorf laboratory emphasizes development of methodologies for applying the Sterile Insect Technique (SIT) to eradicate or control insect pests and disease vectors. Because of the dependence of this technique on efficient production of the target insect, much of the research at the laboratory involves development and improvement of mass-rearing techniques. Other major areas of activity include (1) development of methods of radiation sterilization for producing quality insects (in terms of sexual competitiveness and longevity); (2) investigation of handling techniques for large numbers of insects; and (3) supplying insects for field programmes, when required.

In general, research is undertaken to:

1. develop and improve mass-rearing;
2. improve irradiation techniques;
3. develop methodology for "fail-safe" radiation sterilization;
4. develop methods for estimating "fitness" and sexual competitiveness of laboratory-reared, sterilized insects;
5. study possible genetic changes taking place during colonization and mass-rearing;
6. develop methods of shipping insects as pupae, either before or after sterilization;
7. develop release methods for large numbers of insects, both aerial and ground.

At the present time, the following species of insects are being reared at Seibersdorf:

1. Mediterranean fruit fly, *Ceratitis capitata* (Wied.).
2. Tsetse fly, *Glossina palpalis palpalis*.
3. Tsetse fly, *Glossina pallidipes*, *austen*.
4. Tsetse fly, *Glossina fuscipes fuscipes*.
5. Tsetse fly, *G. tachinoides*.
6. Tsetse fly, *G. austeni*.
7. Tsetse fly, *G. brevipalpis*.

The entomology laboratory also assists entomologists in developing countries in planning or carrying out projects involving the use of the sterile insect technique (SIT). In addition, the laboratory serves as a training institution for entomologists from developing countries. These trainees are handled under the Agency's fellowship programme and usually spend from one to six months at Seibersdorf depending upon the needs of the country/institution requesting the assistance. In some cases, the fellows are supported to undertake scientific visits for up to 4 weeks.

Further information on this and other matters may be obtained by writing to:

The Head
Insect & Pest Control Section
Joint FAO/IAEA Division
P.O. Box 100
A-1400 Vienna
AUSTRIA

C. Programmes of the Insect & Pest Control Section

1. Medfly

Among the most devastating pests of fruits in the world is the Mediterranean fruit fly, Ceratitis capitata. Research undertaken on this pest aims to:

(a) develop less expensive larval and adult diets with particular emphasis on locally available ingredients (non-imported) from various parts of the world;
(b) improve rearing systems;
(c) develop laboratory and field quality control techniques;
(d) improve handling techniques for large numbers (100s of millions) of flies;
(e) improve methods of releasing sterile flies in the field from aircraft;
(f) provide emergency supplies of sterile medflies for field programmes;
(g) develop genetic and mechanical systems for separating the sexes.

2. Tsetse Fly

The tsetse fly occurs only in Africa and is the sole transmitter of animal and human trypanosomiasis. The sterile insect technique which is currently being used to combat tsetse is supported by research to:

(a) improve rearing technology with reduced handling of flies;
(b) develop in vitro and in vivo feeding technology for mass-rearing;
(c) develop methods for preserving blood (e.g. freeze-drying);
(d) use blood additives for improving tsetse fly colony performance and offspring quality;
(e) develop synthetic diet for tsetse fly rearing;
(f) improve radiation sterilization techniques;
(g) develop methods of estimating fitness of laboratory-reared, radiation-sterilized flies;
(h) study possible genetic and/or behavioural changes taking place during colonization and mass-rearing;
(i) conduct cross-breeding experiments with morphological mutants;
(j) develop laboratory and field quality control techniques.

D. Co-ordinated Research Programmes

Currently the Section has responsibility for the following five programmes:

1. Title: Development of Methodologies for the Application of the SIT for Tsetse Eradication or Control.

   Participants: 13 research contractors and agreement holders from 9 countries.

2. Title: Development of Genetic Sexing Mechanisms in Fruit Flies through Manipulation of Radiation-Induced Conditional Lethals and Other Genetic Measures.

   Participants: 11 research contractors and agreement holders from 10 countries.

3. Title: Standardization of Medfly Trapping for Use in Sterile Insect Technique Programmes.

   Participants: 9 research contractors and agreement holders from 9 countries.

4. Title: Radiation-Induced F1 Sterility in Lepidoptera for Area-Wide Control.

   Participants: 7 research contractors and agreement holders from 5 countries.

5. Title: Genetic Engineering Technology for the Improvement of the Sterile Insect Technique.

   Participants: Agreement holders have been contacted in several developed countries.

E. Technical Co-operation and Assistance Programmes for which this Section has Responsibility

(a) Medfly	(b) Tsetse	(c) Isotopes	(d) Others
Guatemala	Nigeria	Kenya	Sri Lanka
Algeria	Zambia	Indonesia	Iraq
Libya	Ghana		Pakistan
Tunisia	Tanzania		Mauritius
	Uganda		

F. Experts and Consultants : July - December 1987

Name	Nationality	Location of Assignment	Dates and Task Performed
K.C. Khoo	Malaysia	Vienna	9 - 13 November 87
T. Mukiama	Kenya	"	
A. Robinson	U.K.	"	To review progress
P. Schwalbe	U.S.A.	"	in development of
J. Seawright	U.S.A.	"	genetic control of
H. Townson	U.K.	"	insects and
J. Walder	Brazil	"	recommend further
M. Whitten	Australia	"	research in support
			of the SIT

G. Trainees in Entomology : July - December 1987

(a) Tsetse Group

Dede, P.	Nigeria	87-09-14 to 87-12-13

(b) Medfly Group

Ahmed, E.	Egypt	86-01-22 to 86-08-31 & 86-11-01 to 87-01-21
El-Badan, N.	Egypt	86-01-22 to 86-08-31 & 86-11-01 to 87-01-21
Kafu, A.A.	Libya	86-10-09 to 87-10-08
Wang, H.	China	86-11-15 to 87-08-10
Al-Taweel, A.A.R.	Iraq	87-01-13 to 87-07-12
Blak, M.	Libya	87-06-01 to 87-06-30
El-Ayan, S.	Libya	87-06-01 to 87-06-30
El-Zaidy, I.	Libya	87-09-01 to 87-09-30
Gaggl, K. (cost-free)	Austria	87-05-20 to 88-05-19

III. IN THE NEWS

III. IN THE NEWS

A. Special Features and Comments

GENETIC METHODS OF INSECT CONTROL
(Observations of an Advisory Group)

During the week of 9 - 13 November 1987, the Joint FAO/IAEA Division, invited 8 consultants to review progress in the development of genetic methods of insect control and recommend areas of research to be emphasized in support of the Sterile Insect Technique. The Advisory Group's recommendations were prefaced by the following observations:

i. Definition of Genetic Control

"Genetic control of insect pests" may be defined as:

> "any approach involving the introduction of genetically-altered insects into a population with the objective of population suppression or a reduction in pest status".

Generally, the released insects will have been reared in the laboratory and treated with irradiation or chemosterilization or have been manipulated genetically, or be the progeny of crosses between strains which exhibit some type of incompatibility. Genetic control could include the release of both sexes, or males only, in which (1) all gametes contain dominant lethals induced by irradiation or chemosterilization; or (2) all gametes will give rise to dominant lethals in later generations through some inherited effect, e.g. delayed or hybrid sterility in lepidopteran pests; or (3) released individuals carry chromosomal rearrangements which result in lethal chromosomal imbalance; or (4) other genetic traits such as recessive lethal genes that cause inviability in subsequent generations, lead to a reduction in numbers of the target pest. In some instances, a genetic transporting mechanism such as meiotic drive or negative heterosis could be incorporated into the system to introduce conditional lethal traits or genetic information aimed to replace a noxious form with some non-noxious form.

ii. Rationale for Genetic Control

Despite the development and availability of a wide variety of techniques for controlling insect pests of agricultural, veterinary and medical importance, insects remain a major cause of food and fibre shortage, and a major contributor to diseases of man and livestock in both developed and developing countries. Synthetic pesticides, in particular, have enjoyed a pre-eminent place since the 1940s in the control of insect pests, and will remain an important component of pest control measures for the foreseeable future. However, four factors have led to the need for changes in the ways synthetic pesticides are used: the widespread development of resistance, increasing costs of developing and registering new pesticides, greater consumer awareness of pesticide residues in foodstuffs and other commodities, and the enactment of legislation in many countries to minimize residues and restrict the use of broad spectrum pesticides. Thus, more than ever, there is a need to find alternative methods of pest control that avoid resistance problems and are environmentally less damaging. A number of alternative and novel methods of pest control are being developed and implemented throughout the world. These include biological control, integrated pest management which aims to combine the positive features of chemical and biological control, vaccines, biorational compounds such as growth regulators and pathogen toxins, neuropeptides and synthetic sex pheromones, insect pathogens, and genetic methods of pest control. This report focuses on genetic control but does acknowledge the need to combine whatever means become available to control insect pests safely and effectively.

One form of genetic control, the sterile insect technique (SIT), rose to prominence with the successful eradication of the screwworm fly from the U.S.A. during the 1950s and, more recently, with the elimination of this livestock pest from Mexico. The SIT has also been used to eradicate populations of other species of dipteran and lepidopteran pests, including tsetse spp., old world and new world screwworm, various tephritids, and several lepidopteran pests.

Despite the important successes with SIT and other methods of genetic control indicated in the preceding paragraph, it would be fair to say that the level of success is below the expectations of the early 1970s and a number of programmes have been abandoned because of lack of progress (e.g. olive fly, *Culex* spp., *Anopheline* spp., *Aedes aegypti*, selected medfly trials). Reasons for this lack of achievement include the existence at that time of effective chemical control options, technical limitations in the methods available for treating or manipulating insects prior to mass-rearing and release, inadequate knowledge of the general biology, ecology and behaviour of the target pest, and, finally, social and political problems associated with area-wide eradication programmes. Genetic control can be a difficult concept to "sell" to laypersons, who become bemused when the pest manager releases individuals of the same species. Regionally based control programmes which run across political boundaries can also cause problems for the successful development of genetic control programmes as in the extension of the screwworm fly and medfly projects from Mexico into Central America.

During the past 10 years, co-incident with increasing pesticide usage problems, there have been important advances in the techniques available to the practitioner of genetic control, especially with the advent of molecular biology and recombinant DNA technology. There has also been greater emphasis placed on development of area-wide management programmes based on the principle of preventing large outbreaks through localized suppression. These developments emphasize the need to seek ways of optimizing the effectiveness of genetic control and integrating it with other management tactics.

iii. Availability of Other Pest Control Measures Necessary for Genetic Control Implementation

An important component of successful SIT programmes has been their intelligent integration with a range of traditional methods to ensure effectiveness. For example, chemicals were used before and during the SIT programmes for the screwworm fly in North America. Husbandry and quarantine measures were then deployed to maximize and sustain the impact of SIT in the U.S.A. and Mexico. Similarly, integration measures were a conspicuous feature of successful SIT programmes for *Dacus dorsalis*, medfly, gypsy moth and the pink bollworm. Indeed, the need for more environmentally acceptable means of reducing the abundance of the medfly in Central and South America, and in the Mediterranean region, before initiation of a medfly SIT programme, is now a major concern to pest control authorities and the Joint FAO/IAEA Division.

iv. Integration of Genetic Control With Other Control Measures

Regulatory programmes can be effective in preventing introduction and artificial movement of pests, but new introductions of exotic species do occur from time to time. Provided these introduced populations are detected early (when they are still localized) eradication is a justifiable objective. Likewise, eradication is necessary when total elimination of the pest from localized areas frees those lands for needed agricultural production which is not feasible in the presence of the pest. It is in settings such as these that genetic methods of eradication should be further developed and support systems for their operational deployment maintained. Restricted eradication, either in time or space, may also be attractive when it results in pest containment at a cost less than that needed for continual suppression.

Genetic control methods should also be considered for use in integrated pest management programmes where eradication is not sought. Generally, it is believed that key pests (annually economic) are the best targets for genetic control. Currently, seasonal increases in density of these species trigger the initiation of control activities at a local (field) level. Pest management programmes are being developed for countering these pests on an area-wide level. Genetic control methods are ideally suited for early intervention in a population cycle to forestall later pest densities which would exceed the treatment threshold. In an area-wide programme, this preventive approach is feasible, but on a field by field basis it probably is not practical.

Genetic control methods are generally most useful against small populations, particularly in isolated islands or inland ecological enclaves. Most insects of economic importance, however, may occupy large areas within their normal species range, or may be migratory. In such situations, a more comprehensive approach, incorporating other control components, would be necessary to reduce the population to levels manageable by genetic control methods like SIT. Moreover, such large areas are unlikely to have obvious natural barrier zones and these can only be effectively created by resorting to other control measures like insecticide spraying.

The suitability of genetic control for management of intermittent pests is generally discounted because costs of developing and maintaining necessary technology appear unattractive relative to the simplicity of using chemical control when a pest becomes a problem. However, some of these species may offer great promise for genetic control. By utilizing genetic control methods for intermittent pests when populations are increasing, larger scale outbreaks may be averted. Viewed from a wide geographical perspective, a relatively modest rearing facility could serve a large geographic area.

Insecticide resistance has led to the rapid multiplication of pests to pre-control levels and even beyond. Genetic control methods, integrated with minimal use of chemical insecticides, could facilitate resistance management while contributing to the control of target pests. In recent years, biological control agents have been identified which may replace the use of chemicals against certain pests, particularly the aquatic stages of some insects in the tropics. The integration of genetic control methods into a general control scheme incorporating biological agents would help achieve the overall aim of environmental protection.

The creation of large water bodies to facilitate irrigation farming in certain tropical countries has resulted in the build-up of large populations of insect pests. This is particularly so in irrigated rice fields where the upsurge of medical vectors, mainly mosquitoes, has, by their effect on man, impeded agricultural production. The control of such insects would not only be of medical importance but would also lead to increased food production.

Clearly, there is a wide array of current pest control problems that exist because control practices are flawed or incomplete. Research on genetic control should proceed concurrently with development of other management technologies as integrated pest management strategies (IPM) are devised to meet those needs.

v. The Application of New Technologies in Genetic Control

Interest in the use of novel techniques of relevance to genetic control has been stimulated by the rapid development of recombinant DNA technology, predominantly in *Drosophila melanogaster*. A major breakthrough is the development of gene transfer techniques using a particular transposable element, the P-element, to mediate transformation, thereby making possible inter-specific gene transfer. There are now many laboratories actively engaged in the development of general gene transfer systems suitable for a wide variety of pest organisms. There is little doubt that in the near future gene transfer systems will be developed for pest insects and thereby provide an important new dimension for genetic control.

Gene transformation could be exploited directly to produce novel control mechanisms or it could be used as an adjunct to support and strengthen conventional genetic control methods. It is therefore encumbent on pest managers to seek ways of using this powerful new tool in applied entomology.

Species-specificity, one of the virtues of genetic control, can also be one of its limitations, especially where a species comprises a number of cryptic sub-species. If relevant gene constructs could be developed in one particular species then these could also be used to transform related species. This capability obviously broadens the application of the genetic control approach and permits its extension to insect species where there is little genetic information available. The implications of this concept should not be underestimated. The following two cases will serve as examples as to how these new techniques can be applied:

- genetic sexing of the medfly remains a high priority because of the advantages it provides for SIT control of this species. The development of genetic sexing using classical methods has faced significant difficulties. Gene transfer techniques could open up new possibilities.

- genetic control through modification of the vectorial capacity of insect pests is a concept which has received considerable attention. At the moment the production of non-vector strains is limited by difficulties related to classical selection techniques. However, the molecular cloning, or synthesis, of genes for proteins which suppress the development of parasitic disease organisms, and the subsequent transfer of such genes into vector species, offers an alternative route for the production of non-vector strains.

These are just two examples of how molecular techniques could be of direct relevance to genetic control. However, besides the direct approach, molecular techniques can be of great significance in the supportive research necessary for both the preparation of a genetic control method and the monitoring of its effect.

Among the key requirements in genetic control, is an understanding of the population structure of the target species. Where a population is sub-divided either into sibling species or at the intra-specific level, as is common in mosquitoes, then it is essential to have practical methods of identifying the various taxa. The methods most widely used to date have been hybridization crosses, polytene chromosomes, allozymes and cuticular hydrocarbons analysis. Not only are these technically complex but interpretation of the results can require considerable skill, and the conclusions can remain ambiguous.

Where these methods are inappropriate or inadequate, then the use of recombinant DNA probes should be considered. Species diagnostic probes derived from repetitive genomic DNA sequences have been developed for a number of mosquito and simuliid vectors. ^{32}P or chromagen labelled probes can be used in relatively simple, dot-blot hybridization procedures. The target species DNA used for such studies need not be of high quality, and alcohol preserved material has proved wholly adequate. Such techniques are of value in both the initial survey and in the monitoring phases of control programmes. During initial surveys, southern blots of restriction enzyme digests of mitochondrial DNA may help determine the existence of sibling species.

There is a need for further development and use of molecular genetic markers in the monitoring of released insects. One crucial aspect of monitoring in most genetic control programmes is determination of the mating success of released males. It has already proved possible to identify the source of sperm from DNA-DNA hybridization in the form of dot-blots of individual mosquito spermathecae. It may soon prove possible to use introduced molecular markers to tag sperm of the release strain for detection by such techniques.

The laboratory rearing of insects prior to release requires the use of a number of techniques for monitoring and conserving genetic variability, mating competitiveness and fitness. By permitting regulation of sex ratios during laboratory rearing, modern recombinant DNA techniques might be used to improve the efficiency and economics of rearing programmes. Molecular transformation techniques could be used to introduce genes for insecticide resistance into insects for release to confer fitness superiority in the field.

In genetic control programmes directed against insect vectors of disease, it is important to monitor disease transmission. Some of the new technologies are of considerable value in detecting the presence of disease organisms and in quantitation of the infection. Techniques based on recombinant DNA probes are now available for the detection of vector stages of malaria, trypanosomes, Leishmania, filaria and rickettsial infections. Monoclonal antibodies have proved useful in identifying sporozoites in malaria vectors.

Recently developed biochemical techniques offer relatively simple methods for determining the insecticide resistance status of individual insects. These techniques have obvious relevance to genetic control programmes which involve release of strains with introduced insecticide resistance genes. DNA probes are already available for one insecticide resistance gene and in the near future such probes may be of importance in this area.

Population movement and migration of the target species can seriously reduce the effectiveness of genetic control programmes. There is a need for the development of improved techniques for monitoring migrants. Radio-labelling, genetic and molecular markers offer possible approaches which should be explored.

The release of organisms which have been genetically modified by recombinant DNA techniques is the subject of legislation in a number of countries and may be the cause of some public concern. In view of the wide disparity in policy between countries and the rapidity with which such policies are being developed and modified, it is essential that the Joint FAO/IAEA Division should continue to monitor the situation. It would also be useful to maintain contact with other organizations, such as the FAO (Expert Panel on Integrated Pest Management) which has already shown an interest in this topic. Furthermore, the Joint FAO/IAEA Division may wish to take additional action when it becomes clear that genetic engineering is a component of a specific genetic control field programme.

B. MEETING REPORTS

1. Advisory Group Meeting on Genetic Methods of Insect Control

An 8-member team was assembled in Vienna (9 - 13 November 1987) to discuss the subject of Genetics and related techniques for pest insect control, with a view to identifying areas of research and providing guidelines for activities and projects that could be undertaken to assist developing countries in solving pest control problems. Specifically, the Advisory Group was requested to:

- review progress in the development of genetic methods of control;
- assess new technologies which are relevant to genetic control and determine their availability;
- establish whether the current status of alternative control measures has lessened or increased the need for genetic control measures since 1975;
- assess the likely course of development in the field of genetic control over the next 5 to 10 years;
- examine the role of the Joint FAO/IAEA Division in extending the application of genetic control measures in order to increase agricultural output and production efficiency in developing countries; and
- make recommendations to guide relevant genetic research in support of the SIT.

"Genetic control" was defined as:

> "any approach involving the introduction of genetically-altered insects into a population with the objective of population suppression or a reduction in pest status."

In discussing the rationale for genetic control the Advisory Group stressed the need for alternative methods of pest control, especially in view of the rapid and widespread development of resistance by pest insects to insecticides and the increasing opposition in many parts of the world to the use of broad spectrum insecticides.

The Group drew attention to the application of new technologies for genetic control and emphasized recent breakthroughs in the development of gene transfer techniques that could be exploited in the near future for insect control.

The need to integrate genetic control with other pest control measures was highlighted and criteria were set (with examples) for selecting target insect species for genetic control research, development and possible application.

On the role of the Joint FAO/IAEA Division in research and implementation of genetic control programmes, the Group commended the high calibre of research and relevance of training undertaken at the Seibersdorf Entomology Unit in support of the Sterile Insect Technique and strongly recommended continued activity in the area of tsetse fly and medfly mass-rearing and related research in support of the SIT. Conscious of the limited resources at Seibersdorf, the Advisory Group recommended that the Joint Division should:

i. concentrate on monitoring research developments in other laboratories through the existing Co-ordinated Research Programmes;

ii. collate and actively disseminate research results on the subject, through newsletters and other available information media and

iii. support fellowship training for scientists and technicians from developing countries involved in pest control operations.

2. Research Co-ordination Meeting on Standardization of Medfly Trapping for Use in Sterile Insect Technique Programmes

The Co-ordinated Research Programme on the Standardization of Medfly Trapping was initiated in January 1987 with the objective of developing standard trapping procedures for use in medfly eradication programmes. In view of the fact that no standard procedure has been available for application under various climatic conditions, it was anticipated that the results of tests designed for use in the programme would contribute significantly to a better evaluation of medfly infestations and better quarantine sensitivity and detection.

The meeting discussed results of trapping undertaken in 9 different countries during the months of May to October 1987. Results were presented by researchers from Egypt, Greece, Guatemala, Italy Libya, Mexico, Morocco, Spain and Turkey. The following 5 trapping systems were used by all programme participants:

A. Jackson trap (JT) with sticky insert. Baited with 2.0 ml trimedlure on 1 cm diameter x 4 cm long cotton wick.

B. International Pheromones sticky trap (IPST). Baited with 2.0 ml trimedlure on 1 cm diameter x 4 cm long cotton wick.

C. International Pheromones McPhail trap (IPMT). Baited with 300 ml of a solution containing 9% Nulure, 5% borax, 86% water (by weight).

D. International Pheromones McPhail trap (IPMT). Baited with 300 ml of a solution containing 5% ammonium salt and 95% water (by weight).

D. International Pheromones McPhail trap (IPMT). Baited with 2.0 ml. trimedlure on 1 cm diameter x 4 cm long cotton wick plus 300 ml of a solution containing 9% Nulure, 5% borax and 86% water (by weight).

Results from all countries revealed considerable variations in climatic conditions, host trees and fly population levels at the different trapping locations.

Basically, hot dry (around the Mediterranean basin) and rainy-humid climates (Central America) prevailed during the tests in 1987. Citrus, pear, peach and coffee were the most common hosts in the experimental areas. Population levels from very few flies to several hundreds per trap occured during the various trapping periods, while in certain areas, between first and third replications, the population changed from low to very high level (Greece - Turkey). Inspite of the above, almost all investigations gave similar basic results:

a. IPST trap baited with liquid trimedlure trapped almost exclusively males and higher rates than similarly baited Jackson trap.
b. IPMT trap baited with Nulure and borax trapped high numbers of both sexes. The additions of trimedlure in the above trap seems to repelmMedfly females, as well as both sexes of other fruit flies (e.g. Dacus oleae).

c. It was agreed that for 1988 the following traps will be compared, taking into consideration also the cost and commercial availability of traps:

   A. Jackson + Trimedlure.
   B. As above but yellow sticky insert.
   C. McPhail + Nulure + borax.
   D. " " " + ammonium salt.
   E. " " " + trimedlure.
   F. " " " " + DDVP.

3. International Symposium on Modern Insect Control: Nuclear Techniques and Biotechnology

This Symposium held in Vienna 16 - 20 November 1987 attracted 70 participants from 34 countries and 4 international organizations. A total of 48 scientific papers and 5 posters were presented.

In his opening remarks, the Deputy Director General of the Department of Research and Isotopes, Professor Zifferero referred to two overriding issues that need to be considered in discussing modern insect control, namely, development of resistance to insecticides, and the increasing concern over environmental pollution from insecticide application. For these reasons, he emphasized, and for the fact that newer and environmentally, more acceptable methods of pest control are rapidly becoming available, the timing of the Symposium was appropriate, and the meeting should afford opportunity for all to learn more about the techniques that are likely to shape the direction of insect pest control in the future.

Three keynote papers on radiation and insect control, the potential and status of F-1 Sterility for control of noxious Lepidoptera and genetic perspectives on pest control, set the stage for the theme of the Symposium: Nuclear Techniques and Biotechnology.

In addition to scientific papers dealing with such subjects as radiation sterilization of pest insects, isotope labelling for ecological studies, radiation disinfestation for food preservation, formal genetics and genetic engineering for pest eradication, reports were presented and informal discussions held on several on-going large-scale insect eradication projects involving the application of the Sterile Insect Technique. The Symposium proceedings will be published as an IAEA priced publication during 1988.

4. Task Force Meeting at FAO Headquarters, Rome

A representative of the Insect & Pest Control Section attended the Task Force Meeting held on 30 October 1987 at FAO Headquarters. The purpose of the meeting was to ensure the participation of the Joint FAO/IAEA Division in TCP/NIR/6754(I): Preparatory Activities for Tsetse Eradication in the Lafia Agricultural Development Area, Plateau State, Nigeria.

The objective of the TCP project, which will last for 12 months starting February 1988, are to establish the seasonal prevalence of trypanosomiasis in cattle in the proposed BICOT II area (12,000 km^2 in the sub-humid zone of Nigeria); to establish a methodology to estimate the economic importance of trypanosomiasis in cattle and more critically develop land-use plans for the project area.

C. Field Programmes: Status Report

BICOT

Following the formal conclusion of the project in May 1987, systematic trapping has been undertaken, especially at the project borders, as a way of monitoring possible fly movement into the cleared area. Release of sterile males was also maintained and insecticide-impregnated screens placed at the boundaries as quarantine against possible immigration.

As part of the monitoring and evaluation exercise, periodic checks were made, through surveys, within the various forest patches which constituted the main haunts of the target species before and during the eradication campaign.

The colony of Glossina palpalis palpalis has been maintained at a low level, but will be increased rapidly as soon as BICOT II becomes operational. In the meantime, efforts are being made to locate and rectify the causes of high mortality among the guinea-pig host animal colony. The use of locally collected bovine and pig blood for rearing G. p. palpalis continues to show satisfactory results.

D. What's on in Seibersdorf?

With exeption of the Glossina palpalis palpalis stock colony, which is kept at the level of ca. 40,000 breeding females (80,000 puparia per month), and the G. pallidipes experimental colony, whose expansion was hampered by interference of virus-like particles causing salivary gland hyperplasia and gonadal atrophy, all other in vitro-fed colonies are rapidly expanding with the current (December 1987) monthly puparia production of: 12,000 for G. tachinoides, 500 for G. f. fuscipes, 1,500 for for G. austeni and 2,500 for G. brevipalpis.

Hybridization work was initiated to analyze the fertility of G. p. palpalis (Nigerian origin) and G. f. fuscipes (Central African Republic) interspecific crosses and that of hybrids, and eventually determine the genetic and physiological basis for changes in fertility.

Collaborative work between the Insect & Pest Control Section and the USDA Veterinary Toxicology and Entomology Research Laboratory in College Station, Texas, USA on the nutrition and diets of blood-feeding insects was continued. The work involves the following activities: (1) Extraction and isolation of lipid fractions from diet components, from fly, pupal and larval tissue homogenates using conventional solvent extraction procedures; (2) analysis of extracted lipids by thin layer chromatography to determine lipid class; (3) hydrolysis and methylation of extracted lipid and determination of fatty acid composition by gas chromatography analysis and by mass spectrometry; (4) estimation of cholesterol, triglycerides and phosphorus content of extracted lipid fractions; (5) Extraction of haeme from haemoglobin and preparation of globin; (6) analysis of the yellow factor for lipid content.

A research project was started to check analogues of ATP in an attempt to find compounds more active and more stable than ATP that could be used effectively at very low concentrations. ATP and 16 analogues, including 2d ATP, ADP, 2d ADP, A-tetra-P, AMP-PNP, AMP-PCP were tested. Information obtained so far indicate that some of the analogues, which are known to be highly stimulating to aedine mosquitoes, were much less effective for G. p. palpalis. However, the latter tsetse species can recognize ATP much more effectively than any other insect studied so far. Its ED_{50} (50% gorging) is 5×10^{-7} M and its ED_{85} (85% gorging) is 5×10^{-6} M for female flies. Thus, the concentration presently used (10^{-3} M) is 200 - 1000 fold higher than that required for effective feeding. Tests with normal tsetse colony diet supplemented with ATP at a lower concentration (10^{-4}M) compared to the concentration of 10^{-3}M that is normally used are in progress.

Research was continued to effect improvements in medfly mass-rearing. Different cage materials and hole sizes were tested for oviposition; the oviposition nets were treated with available lubricant-release, to reduce the number of eggs sticking to the oviposition net. The effect of length of photoperiod in egg production was also investigated.

The use of inexpensive materials for medfly diet preparation was investigated, with good results in some cases. The materials were obtained from areas or countries planning to use the SIT, or where potential exists for applying the method to control the medfly.

Preliminary investigations showed that by heat treating (to kill larvae and pupae), spent larval diet could be re-used, provided water and small amounts of fresh nutrients are added and the spent medium recombined with fresh starter diet. Further tests are continuing at the Mexican medfly mass-rearing facility in Tapachula.

Pupation in different media was compared. Naked pupation resulted in small pupae; wheat bran and sand from the Sahara (Egypt) produced good size pupae; the tumbler technique involving collection of all larvae within one day, gave small size puape, however adults survival was good.

The programme for the induction and isolation of temperature-sensitive lethal (<u>tsl</u>) factors in the medfly was continued, with some modification. More than 30 families, containing <u>tsl</u> factors which were active in the egg stage, have been isolated. However the induced <u>tsl</u> alleles were invariably unstable and further inbreeding resulted in the loss of all alleles. In an attempt to remedy this situation the <u>tsl</u> programme has been modified to focus on genes active during the first larval instar.

The T:Y (wp^+)30C genetic sexing strain, based on brown male puparia and white female puparia, has now been reared in the laboratory for 26 generations without showing any signs of instability. Mass-rearing of the same strain was initiated in January 1987. By generation 10, 2.3% fertile females were observed among the brown pupae, the first such females being found in generation 4. A very low level of males (less than 0.4%) emerging from white puparia was observed in almost every generation from the parental generation onwards. However, this level did not increase. The data suggests that the observed low level of instability in this strain was caused by the accidental introduction of foreign gene pools.

The overall viability of the mass-reared T:Y (wp^+)30C did not differ significantly from that of the standard mass-reared "Sohag" strain. Thus, the stability and viability of this strain renders it suitable for inclusion in SIT programmes dependent upon the release of only the male sex.