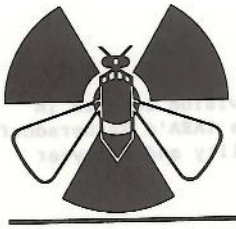

Insect and Pest Control Newsletter

JOINT FAO/IAEA DIVISION OF NUCLEAR TECHNIQUES IN FOOD AND AGRICULTURE
INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA

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CONTENTS

I. GENERAL INFORMATION

A. The Staff

Our staff, including both those in the Joint Division located in the Vienna International Centre and those in the IAEA's Seibersdorf Laboratory, are listed below with their nationality and the year they started working in Vienna.

Name	Duties
Joint FAO/IAEA Division	
Björn Sigurbjörnsson, Director	
L. LaChance, Deputy Director	
Insect & Pest Control Section	
D.A. Lindquist (USA, 1980)	Fruit Flies
A. Van der Vloedt (Belgium, 1974)	Tsetse flies
B. Butt (USA, 1988) (terminated 31 May 1990)	F-1 sterility
Seibersdorf Laboratory	
R. Gingrich (USA, 1980)	Head, Entomology Unit, microbiology
A. Economopoulos (Greece, 1985) (terminated 27 July 1990)	Head, medfly programme, medfly mass-rearing
U. Feldmann (FRG, 1988)	Head, tsetse programme, tsetse mass-rearing
M. Vreysen (Belgium, 1987)	FAO Associate Professional Officer, tsetse mass-rearing
P. Kerremans (Belgium, 1987)	FAO Associate Professional Officer, medfly genetics
G. Franz (FRG, 1989)	Medfly genetics

Bill Butt returned to retirement in the USA after 21 months as a US cost free expert. Bill also worked at the Seibersdorf Laboratory 1972 - 1974.

Arishidis Economopoulos returned to Institute of Biology "Democritos" National Research Center in Athens, Greece in July, after over 5 years at Seibersdorf. In December, Aris will take the Chair, Department of Biology, University of Crete, P.O. Box 1470, 711 10 Heraklion, Crete, Greece. We congratulate him on his new position.

Jim Carpenter, USDA, ARS, Tifton, Georgia, spent a 5 month sabbatical (January - May 1990) at Seibersdorf, measuring radiation sensitivity of various strains of the medfly.

B. What We Want from You

To make this Newsletter "News", we need your input. Please send us information on your SIT and genetic control programmes including plans and opportunities. We would also like each of you to send us

slides, video tapes, reports or publications on your research. We would also welcome important citations or brief write-ups on action SIT programmes, as well as summaries of research activities and abstracts.

We are enclosing the standard form for submission of your contribution. Please use a separate form for each contribution 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. We are unable to edit submitted contributions. The abstracts in this issue should not be published or referred to in articles for publication without first obtaining permission from the authors. Please direct contributions and requests for information to:

The Section Head
Insect and Pest Control Section
Joint FAO/IAEA Division of Nuclear
Techniques in Food and Agriculture
P.O. Box 100
A-1400 Vienna, AUSTRIA

C. The Programme

The overall programme of the Section, including Seibersdorf, is divided into three project areas: tsetse fly, medfly and newer methods of control which include F-1 sterility. We have active R&D programmes at Seibersdorf on tsetse fly and medfly.

Currently the Section has the following Co-ordinated Research Programmes:

1. "Laboratory and Field Evaluation of Genetically Altered Medflies for Use in Sterile Insect Technique Programmes".

2. "Standardization of Medfly Trapping for Use in Sterile Insect Technique Programmes".

3. "Development of Practices for Area-wide Tsetse Eradication or Control with Emphasis on the Sterile Insect Technique".

4. "Radiation-induced F-1 Sterility in Lepidoptera for Area-wide Control".

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

II. MEETINGS

A. Past

1. A Training Course entitled "The Use of Isotopes in Entomology" was held on 13 May - 23 June 1990 in Gainesville, Florida, USA. The course was attended by 20 students from 20 countries.

2. A Regional FAO/IAEA Training Course entitled "Tsetse Control with the Sterile Insect Technique" was held on 7

May - 1 June 1990 in Accra and Wa, Ghana. Details of the course are discussed in the tsetse section.

3. A Training Course on the New World Screwworm was held on 17 - 22 March 1990 in Tripoli, Libya. The 45 participants represented 12 countries.

4. A National Workshop/Training Course entitle "Nuclear Techniques in Entomology" was held on 11 - 22 June 1990 in Malaysia with 21 participants. Part I of the course was on application of radioisotopes in entomology and Part II on genetic insect control. The course also included a trip to the Cameron Highlands where a programme on diamondback moth is proposed.

5. A New World Screwworm Consultant Group met in Vienna on 8 - 12 January 1990. The three consultants developed a proposed programme for the eradication of the New World Screwworm from North Africa.

6. The first research co-ordination meeting of the CRP on "Genetic Engineering Technology for the Improvement of the Sterile Insect Technique" was held in Vienna from 16 - 20 October 1989. The participants in this programme are all agreement holders from developed countries. Their task is to assist the Insect and Pest Control Section in designing a research programme utilizing genetic engineering and molecular biology which is applicable for scientists in developing countries. In addition, they may undertake specific research in their own laboratories on problems of direct application in developing countries. A report of the research co-ordination meeting has been published by the Joint FAO/IAEA Division and is available at the Insect and Pest Control Section's office.

B. Future

1. Research Co-ordination Meeting on "Standardization of Medfly Trapping for Use in Sterile Insect Technique Programmes", Casablanca, Morocco, 5 - 9 November 1990.

2. Research Co-ordination Meeting on "Laboratory and Field Evaluation of Genetically Altered Medflies for Use in Sterile Insect Technique Programmes, Vienna, 24 - 28 September 1990.

3. Third International Symposium on Fruit Flies, Antigua, Guatemala, 14 - 20 October 1990.

4. FAO/IAEA Seminar for Africa on "Animal Trypanosomiasis: Tsetse Control, Diagnosis and Chemotherapy Using Nuclear Techniques", Nairobi, Kenya, 11 - 15 February 1991. See details of the seminar in the tsetse section.

5. A Regional Training Course is proposed on F-1 Sterility in the Asia-Pasific Region during June-August 1991. The dates and location will be announced in the next Newsletter.

III. MEDFLIES AND OTHER FRUIT FLIES

A. Fruit Flies at Seibersdorf

Release of genetically sexed medflies into 22 hectares of mango and citrus in Israel resulted in economic control as reported in the April 1990 (No. 44) Newsletter.

For 1990, the second and final experimental application in Gvullot, the following has been decided:

1) No Trimedlure medfly male traps will be used because, due to their attractiveness, they do not allow accurate population estimates in the test and control groves.

2) In April - May, the LADD trap (yellow panel with dark-red sphere in the center) will be compared with an all-yellow-panel trap. Particular attention will be given to the sex ratio of trapped flies. This comparison will determine which trap will be used during the remainder of the experiment.

3) In further experiments, the "Hawaiian" dry trap baited with Trimedlure and DDVP plugs will be compared with the above traps. The Hawaiian trap is suitable for a hot and dry climate.

4) Also, in April - May the fluorescent powder-marking technique will be tested to determine its reliability under local conditions. In addition, a study will be conducted on whether sterilized flies (primarily females) can be separated from wild or unsterilized flies by examining the content of their abdomens with a magnifying lens in the field. It appears (Nitzan, personal observation) that this technique may provide accurate and practical results.

5) In Seibersdorf, a recently established colony of the white female pupa sexing strain presentely has a very low breakdown. Weekly shipments of 2.2×10^6 sterilized males from this strain will be sent to Israel during 6 June - 19 December 1990.

6) At the end of May (one to two weeks before releases start), two successive bait sprays of malathion in protein water solution will be applied on special boards hung in some of the fruit trees.

7) The number of pupae per emergence-release bag will be reduced to about 4000. This should result in a better distribution of released flies (more bags for the same area) and improved adult survival in the bags. It will also allow increased releases in "hot spots" and orchard edges.

8) In the citrus and old mango groves, all flies will be released as adults from paper bags on the ground. In the young mango grove all releases will be from pupal stations. The release stations are designed to protect the pupae from high temperatures and predators.

9) A few helicopter releases of adults in bags will be applied in the old mango groves. On these occasions, half the insects will be released from the ground and half from the helicopter. The latter will be marked with a different colour of fluorescent powder. The application will provide experience in releasing insects by

helicopter, and will also compare the distribution and survival of flies released from air with those released from ground.

10) The kibbutz Tze-elim, where the medfly will be controlled by aerial bait spraying will again serve as the control.

11) Adult populations, both released and wild, will be monitored throughout the control period.

12) The quality of medflies will be monitored at Seibersdorf before shipment and at Rehovot after shipment.

13) Fruit fly infestations will be studied extensively. Thus, early maturing varieties of mangos and feijoa (Feijoa sellowiana) fruits, found in the kibbutz yards, will be examined in addition to late maturing mangos and citrus.

A genetic sexing strain has been constructed, based on the new temperature sensitive lethal (tsl) mutation and the translocation chromosome T(Y;5)$wp^{+}tsl^{+}$(30C).

From the preliminary tests of this strain (see figure 1) the following conclusions can be drawn:

1) A temperature treatment during the first 48 h after egg deposition prevents female eggs from hatching.

2) To obtain this effect, temperatures of 32°C and above are required.

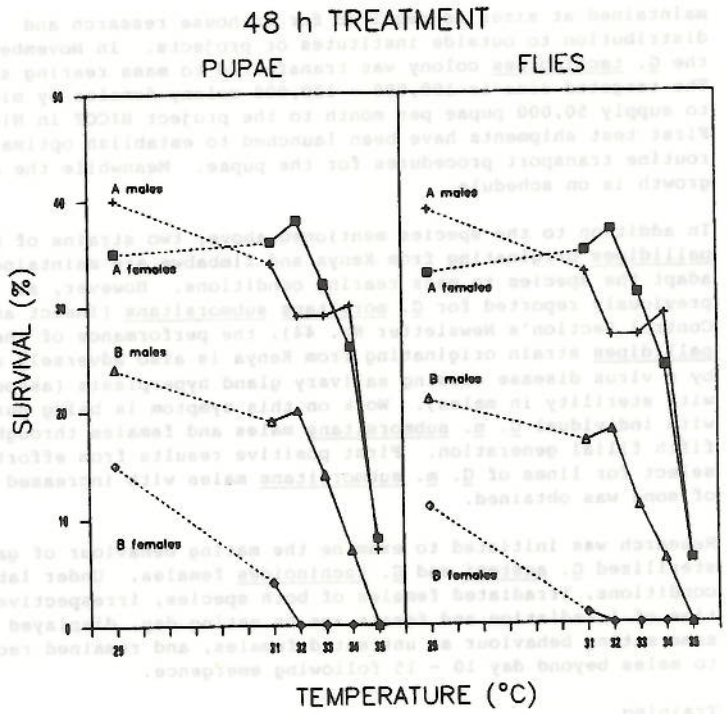
3) With respect to lethality, the heterozygous males are unaffected by temperatures around 32°C.

Therefore it seems possible to use this tsl mutation for the separation of males and females. The advantage is that the females can be killed very early (i.e. egg stage) with the result that less larval diet is consumed compared with the wp based strain.

Experiments are under way to improve the overall productivity of the tsl strain and it is planned to test its behaviour under mass rearing conditions. In parallel we have initiated experiments to map the wp locus via radiation induced deletions. Because it seems that wp and tsl are very closely linked we hope that these experiments also allow the localisation of the tsl mutation.

During the development of the wp strain for mass rearing, certain characteristics such as reduced egg hatch and reduced flight ability appeared to be inherent in this strain. These observations suggested that the wp genetic sexing strain might be sterilized at a lower dose of radiation than that used to sterilize the wildtype medfly. Research efforts were focused on studying the radiation biology of the wp genetic sexing strain and the competitiveness of this strain after receiving a sterilizing dose of radiation.

Although data from these studies are still being analyzed, the following observations can be made: (1) Emergence and flight ability of the wp genetic sexing strain were not affected by irradiation (up to 10.5 krad) but were always lower than that of the wildtype; (2) Egg hatch of wp males (x wildtype females) was always lower than egg hatch of wildtype



$$A = wp^{-}tsl^{+}/wp^{-}tsl^{+} \times T(Y;5)wp^{+}tsl^{+}/wp^{-}tsl^{+}$$
$$B = wp^{-}tsl^{-}/wp^{-}tsl^{-} \times T(Y;5)wp^{+}tsl^{+}/wp^{-}tsl^{-}$$

(figure 1)

males (x wildtype females). The sterilizing dose for wp males was lower than the sterilizing dose for wildtype males; and (3) The competitiveness of wp males was lower than the competitiveness of wildtype males. The results from these studies should provide a better understanding of the wp genetic sexing strain's performance during the field trial.

Soluable fermentation products produced by Bacillus thuringiensis have been found that are pathogenic for adult medflies. These agents are being biologically and chemically characterized to determine their utility in bait sprays to suppress wild population of medflies prior to the release of sterile males.

IV. TSETSE FLIES

A. Tsetse Flies at Seibersdorf

Seven tsetse fly species of economic importance are reared at Seibersdorf by exclusive use of the in vitro feeding technique. Stock colonies of five species, namely Glossina palpalis palpalis, G. tachinoides, G. fuscipes, G. austeni and G. brevipalpis are

maintained at sizes as required for in-house research and distribution to outside institutes or projects. In November 1989 the G. tachinoides colony was transferred to mass rearing status. The targeted size is 100,000 - 120,000 colony females by mid 1990 to supply 50,000 pupae per month to the project BICOT in Nigeria. First test shipments have been launched to establish optimal routine transport procedures for the pupae. Meanwhile the colony growth is on schedule.

In addition to the species mentioned above, two strains of G. pallidipes originating from Kenya and Zimbabwe are maintained to adapt the species to mass rearing conditions. However, as previously reported for G. morsitans submorsitans (Insect and Pest Control Section's Newsletter No. 44), the performance of the G. pallidipes strain originating from Kenya is also adversely affected by a virus disease causing salivary gland hyperplasia (associated with sterility in males). Work on this symptom is being pursued with individual G. m. submorsitans males and females through the fifth filial generation. First positive results from efforts to select for lines of G. m. submorsitans males with increased number of sons was obtained.

Research was initiated to examine the mating behaviour of gamma sterilized G. austeni and G. tachinoides females. Under laboratory conditions, irradiated females of both species, irrespective of time of irradiation and female age on mating day, displayed the same mating behaviour as untreated females, and remained receptive to males beyond day 10 - 15 following emergence.

B. Training

The 2nd Regional Training Course on Integrated Control of Tsetse Flies with Emphasis on the Sterile Insect Technique, jointly sponsored by the Government of Ghana, the FAO and the IAEA, took place from 7 May - 1 June 1990 at the headquarters and tsetse laboratories of the Ghana Atomic Energy Commission (GAEC), Kwabenya, and the field station of the DAHP Tsetse Control Unit in the Damango/Mole area, with visits to the headquarters and laboratories of the Veterinary Services in Pong Tamale and the laboratories of the Animal Research Institute, Achimota.

The training course was officially opened by Dr. A.M. Laryea, PNDC Deputy Regional Secretary for Agriculture, Greater Accra, in the presence of representatives of the FAO Regional Office for Africa, the UNDP and the Directors of the relevant institutions dealing with tsetse and trypanosomiasis control.

Nine invited lecturers including six from Ghana, honoured our invitation and had very positive interactions with the trainees. Dr. K. Gyening, the newly appointed FAO Regional Animal Health Officer (Tsetse and Trypanosomiasis) at the Accra Office, outlined and discussed the FAO Programme for the Control of African Animal Trypanosomiasis and Related Development.

While at GAEC, all afternoons were spent on laboratory work with high priority being given to dissection techniques related to morphological features, tsetse fly reproductive physiology, induced sterility and fly handling during laboratory rearing. All the practical work was prepared and conducted as team work with three

trainees per team. Preserved and live specimen of six different economically important tsetse fly species were available for detailed study. Each team had two dissection microscopes and one compound microscope at its disposal.

During special sessions, trainees made oral presentations on tsetse/trypanosomiasis research and control activities in their respective countries.

In addition to the lectures and practicals at GAEC, the course programme included an 8-day visit to the Damango/Mole area in the Northern Region for practical field training. Before initiating the survey and monitoring work in two selected areas of the Mole Game Reserve, introductory lectures and demonstrations were given at the Pong Tamale laboratories on conventional trypanosomiasis diagnostic methods, the use of ELISA (with fresh monoclonals brought from ILRAD by Dr. K. Gyening) and tsetse suppression methods.

During the field work on the Mole and Samole rivers, six teams of three trainees each were responsible, under close supervision of the course management, for entomological monitoring using both biconical and monoconical traps in a latin square concept. During three complete (24 hours) evaluation cycles with trap interchange at defined trapping sites, more than 1,500 tsetse flies (Glossina tachinoides, G. p. gambiensis and G. m. submorsitans) were dissected and all relevant data on physiological status transferred to coding sheets for detailed analysis. Moreover, for demonstration purposes, cattle in a selected crushpen at Larabanga village were parasitologically examined and given a pour-on treatment with Bayticol (Flumenthrin 1%). Experimental animals (goat and sheep) were also used to demonstrate adult tsetse fly feeding (e.g. for mark-release-recapture studies) under field conditions.

During the final week of the training course, the programme highlighted the life cycle of the parasite and the factors that determine the vectorial capacity of tsetse flies. Special attention was also given to the use of the Cobalt-60 source, dosimetry and general radiation protection aspects, blood collecting at the slaughterhouse, blood quality control, and membrane-making for in vitro feeding of tsetse flies. The course ended with special considerations on area-wide tsetse control, project planning, inputs and implementation.

The course was attended by the following selected trainees:

Mr. Etienne FONDJO	Cameroon
Mr. Yao YAO	Côte d'Ivoire
Mr. Momodou CEESAY	Gambia
Mr. Charles E. ANNOH	Ghana
Ms. Doris DANKWA	Ghana
Mr. Andrew Yahaya DOKURUGU	Ghana
Mr. Emanuel Frimpong MENSAH	Ghana
Mr. F.P. OLOO	Kenya
Mr. Issa DEGOGA	Mali
Mr. Bello ROUA	Niger
Mr. Datugun Lazarus DENGWAT	Nigeria
Ms. Furaha MAKISHE	Tanzania

Mr. Issa Said KHAMIS	Tanzania
Mr. Koffi KWAKU	Togo
Ms. Loyce OKEDI	Uganda
Mr. Joseph OKELLO ONEN	Uganda
Mr. Denver LUMAMBA	Zambia

All trainees, within their originally formed teams, were given a test, for which the following questions were prepared by the course management:

1. List factors which are important in determining infection rates in natural populations of tsetse flies.
2. What use can be made of DNA probes in tsetse biology?
3. How does the sex of a fly affect its vectorial potential?
4. State why the determination of the age structure of a natural tsetse population is important as a prelude to any tsetse control programme.
5. List the procedures you would follow in planning and conducting a comprehesive tsetse survey programme.
6. What is induced sterility?
7. Is integrated control of tsetse flies with a SIT component a possible/feasible option (in your own country's situation)?

C. Future Seminar

An FAO/IAEA Seminar for Africa on "Animal Trypanosomiasis: Tsetse Control, Diagnosis and Chemotherapy Using Nuclear Techniques" will be held on 11 - 15 February 1991 in Nairobi, Kenya.

The main focus of the Seminar will be on recent advancements in the use of nuclear techniques for the control of tsetse-transmitted animal trypanosomiasis, with special regard to improved diagnosis, the mode of action and efficacy of currently available trypanocidal drugs and vector control techniques including the use of insecticide-treated attractive devices and the Sterile Insect Technique.

The Seminar provides a forum whereby scientists from various disciplines will review and report on tsetse control strategies, diagnosis and disease treatment.

The Seminar will include papers from invited lecturers, papers from participants and panel discussions.

Papers related to the following topics will be considered for presentation at this Seminar:

a) Diagnosis and Treatment

   i) Development and application of the ELISA technique for the diagnosis and control of tsetse-transmitted animal trypanosomiasis.

ii) Use of radiolabelled drugs for screening of drug sensitivities of trypanosomes.

iii) Study of pharmacokinetics and residue levels of trypanocidal drugs in experimental animals.

iv) Development of methods of assay for trypanocidal drugs.

b) Vector Genetics, Biology, Ecology and Control

i) Studies on tsetse fly nutrition and reproductive physiology.

ii) Dynamics and behaviour of natural tsetse populations.

iii) Factors determining the susceptibility of tsetse species to trypanosome infections.

iv) Use of recombinant DNA probes in the detection of natural trypanosome infections in tsetse flies.

v) Applied research aimed at improving mass production of tsetse flies and the deployment of sterile flies in control programmes.

vi) Development and application of tsetse population suppression methods with emphasis on the use of improved formulations of insecticides on attractive devices.

The Seminar is mainly of interest to the following:

- Animal scientists/veterinarians/parasitologists with specialist research/development experience in diagnosis, trypanocidal drug efficacy and treatment of animal trypanosomiasis;

- Agrochemists/biochemists with active research experience in the use of insecticide formulations and their applications for tsetse fly control;

- Entomologists/ecologists with practical experience in integrated tsetse control programmes and the use of the Sterile Insect Technique.

In conjunction with the Seminar, it is planned to hold the Research Co-ordination Meeting of recently initiated Co-ordinated Research Programmes of the Joint FAO/IAEA Division's Insect and Pest Control Section and the Agrochemicals and Residues Section.

Therefore, in addition to lead scientists involved in the FAO/IAEA/Netherlands Government Co-ordinated Research Network on "Improving the Diagnosis and Control of Trypanosomiasis and other Vector-Borne Diseases of African Livestock Using Immunoassay Methods", research contract and agreement holders of the programmes on "Development of Practicec for Area-wide Tsetse Eradication or Control with Emphasis on the SIT" and "Development of Controlled-release Formulations of Insecticides: Component Tsetse Control" will be invited to participate in the Seminar.

V. SPECIAL REPORTS

A. Function of the Entomology Unit, IAEA Seibersdorf Laboratory

The Entomology Unit of the IAEA Laboratory Division was established at Seibersdorf, Austria, in 1964 to provide in-house support for the Agriculture Programme of the International Atomic Energy Agency (IAEA). As such it is unique, as are also the IAEA Laboratories at Trieste and Monaco, in that the Agency is the only UN Organization that operates its own laboratories. By doing so the Agency is able to achieve much more direct and co-ordinated support for its field programmes.

The mandate of the Entomology Unit is to assist the Insect and Pest Control Section (IPCS) of the Joint FAO/IAEA Division in providing services to Member States using nuclear and related biotechnology to solve insect problems. This programme is funded and operated jointly by the IAEA and the FAO. Assistance is provided by (1) conducting research and development, (2) training nationals from primarily less developed countries, (3) supplying materials and equipment to maintain the operational infrastructure of local programmes, and (4) serving as experts or consultants in the planning and conduct of national or regional pest control programmes.

Although administratively separate, the Laboratory Unit is technically closely bound to the IPCS and provides input into the Co-ordinated Research Programmes and Technical Co-operation Projects directed by the Section. Together the two groups provide an international focal point for the application of isotopes and radiation techniques in entomology.

The Laboratory Unit has earned international recognition for its activities in applying the sterile insect technique (SIT) for the control or eradication of selected economically important insect pests. Currently the tsetse fly and the Mediterranean fruit fly are targets. In the past programmes have also been directed toward the olive fly and codling moth. In recent years the Unit has provided direct support for two successfully completed field programmes using the SIT.

The tsetse fly is the vector of the causative agents of trypanosomiasis in Africa. One species, Glossina palpalis palpalis, was eradicated from a large area in Nigeria during a programme completed in 1986. Rearing technology for the target insect was developed at Seibersdorf and transferred to the project. Diet ingredients for the insect colonies were prepared at Seibersdorf and supplied, as was much equipment and other materials, to the project site. In addition a large back-up colony was maintained at Seibersdorf and the excess progeny were sent to Nigeria for sterilization and release into the eradication area. Also, approximately 32 man months of training were provided at Seibersdorf to project staff members.

The Unit also supported a field project in which the SIT was integrated with other techniques to eradicate the Mediterranean fruit fly from Mexico and parts of Guatemala. During the first year of the project over 2,000 million medflies were provided to train project personnel in Central America in SIT techniques. Later the rearing technology, developed at Seibersdorf, was transferred to Mexico where it was adapted to produce about 500 million insects weekly for release in the infested area. Within 3 years after releases were begun the medfly was eradicated from Mexico. The programme continues with eradication activities now directed toward Guatemala. Over 20 man months of training at Seibersdorf were provided for project personnel between 1978 and 1989.

Anticipating further interest in applying the SIT, staff of the Unit are now concentrating their activities on making the technique more effective and efficient. Research and development are underway to automate the rearing systems and to find and develop lower cost ingredients and materials for mass rearing insects. Strains of medflies are being genetically developed and tested in which the females can be selectively eliminated so that only males are sterilized and released. Entomopathogens are being developed to replace the environmentally hazardous chemicals that are presently used to suppress wild insect populations before the release of sterile males. Techniques are being developed and equipment designed for transporting insects long distances so that a single large mass rearing facility can provide sterile insects to multiple projects in a region. These developments will support the IPCS toward the goals to reduce the cost of applying the SIT, to make it more environmentally acceptable and to make it more effective by attacking pest insects in large geographical areas.

As replacement staff are recruited for the Entomolgy Unit individuals are sought with knowledge and experience in molecular biology, biological control and other fields pertinent to modern trends in pest control. In this way the most advanced technology is made available to the less developed third world Member States.

B. How to Obtain Support for Entomology Projects in Developing Countries from the Joint FAO/IAEA Division

The Joint FAO/IAEA Division offers assistance to solving insect control problems in developing countries through research programmes, technical assistance and training. The following are some quidelines to obtaining this assistance.

1. Co-ordinated Research Programmes

Co-ordinated Research Programmes are developed around a defined topic on which from ten to twenty institutes from different countries are invited to collaborate. Research Contracts or Research Agreements are awarded on the basis of project proposals received from institutes. Research Co-ordination Meetings are usually held at intervals of 15 to 18 months. Research Contracts or Agreements are awarded to institutes for a period of one year and are renewable (subject to satisfactory progress) for up to three years or, in some cases, five years. Research Contracts provide modest financial support for a project on a cost-sharing basis (normally $3000 - $5000 per year), and priority for these is given to proposals from institutes in developing countries. On the other hand, Research Agreements are normally awarded to institutes in developed countries with expertise in the area of interest. Research Agreements do not provide financial support for a project, but the Agreement holder participates in exchange of information and the Principal Investigator is invited to attend the Research Co-ordination Meetings at Agency expense.

To apply for a Research Contract proposal use Form N-17; for a Research Agreement proposal use Form N-20. Both forms can be obtained either from the IAEA in Vienna or from the appropriate government authority (e.g. ministry, atomic energy commission) dealing with nuclear matters. In most countries, contract proposals require only the signatures of the Principal Investigator and the head of the institute before submission to the Agency. If supplies or equipment are to be procured through the IAEA, use Form N-16.

New participants cannot join a programme after the first Research Co-ordination Meeting.

2. Technical Co-operation Projects

The IAEA is actively involved in technical co-operation. Within the framework of its Technical Co-operation Programme, the Agency assists developing Member States in solving technical problems, at the same time providing the necessary know-how. Technical Co-operation Projects are carried out to increase the recipient institution's self-reliance. Technical Co-operation Projects differ from Research Contracts in a number of important respects:

a) Technical Co-operation Projects can provide expertise through scientists who are already well versed in particular techniques (Experts) and who visit institutions that are carrying out such projects in order to train, advise or otherwise assist local scientists in conducting the work plan of the project;

b) Technical Co-operation Projects can support the transfer of know-how through the training of scientists from developing countries in specific techniques (see below for IAEA training fellowships);

c) Provision can be made through Technical Co-operation Projects to supply more expensive items of equipment than is possible through a Research Contract.

By these means, Technical Co-operation Projects aim at building up the research capability of institutions in developing countries to the point where scientists are able to conduct such work more or less independently and without further substantial outside funding when the project terminates. Of course, the inputs and time required to achieve these ends will vary from institute to institute as well as with the nature of the problem(s) requiring investigation, and it is therefore impossible to give hard and fast guidelines as to the funds which could be provided in each case through this programme. Projects may extend over more than one calendar year, according to the case.

All applications for IAEA Technical Co-operation Projects must be made on Form TA-IE/REV.3, which can be obtained either from the IAEA in Vienna or from the government authority dealing with nuclear matters (e.g. ministry, atomic energy commission). The completed form must then be submitted to the IAEA through the appropriate official government channels. IAEA Technical Co-operation Project proposals may be submitted at any time, and are approved in two year cycles (1991-2, 1993-4 etc.). If appraisal is positive implementation may then start in the following cycle. FAO Technical Co-operation Projects are approved on an ad hoc basis, and implementation may start soon after approval if there is an urgent need. In general, however, planning and approval may take up to one year.

Application for a project under the FAO Technical Co-operation Programme must be submitted through the FAO Country Representative or Regional Office, or else to the FAO headquarters in Rome (Food and Agricultural Organization of the United Nations (FAO), Via delle Terme di Caracalla, 00100 Rome, Italy). There is no formal application form, but the request should be sufficiently descriptive, and must be endorsed (signed) by the government. The FAO offices will be helpful in advising how to do this.

3. Ordering Equipment and Reagents from the IAEA

An important service provided to holders of Research Contracts and to Technical Co-operation Projects is the handling of requests for equipment, chemicals, radioisotopes, etc., by the Agency's Procurement Section. To

ensure that the correct item is sent as quickly as possible to its proper destination, please observe the following simple rules:

a) Type all requests and send them either to the Area Officer concerned (for Technical Co-operation Projects) or to the Contracts Administration Section (for Research Contracts) in Vienna.

b) Don't ask for items that can be obtained easily or more cheaply in your own country. In many countries, common electrical goods are easily obtainable (e.g. refrigerators, freezers), and in some countries common chemicals, glassware, etc., are readily available from commercial firms. Instead of ordering such items through the Agency, therefore, you should first obtain a quotation from a local firm and send it to the IAEA for checking of whether a cheaper quotation is available elsewhere. Local purchase can be authorized and the funds can be provided by cheque payable to the supplier if the quotation that you provide proves cheaper than what is available from other sources.

c) For items ordered via Vienna, please provide as much information as possible. At the very least, this should include;

(i) quantity required (volume or weight),
(ii) specification of the items (e.g. capacity, temperature range, working voltage and frequency) and the need for power conditioning,
(iii) name of the manufacturer or of the supplier,
(iv) manufacturer's or supplier's catalogue number,
(v) approximate cost,
(vi) routing of material (e.g. direct or through the UNDP),
(vii) mode of shipment (e.g. air freight, ship etc.).

Arrange the list so that all articles from one firm are grouped together.

d) Ask for as many items as possible at the same time, within the limitations of the funds available, rather than sending several lists each consisting of a few items. Remember that packaging and shipping are expensive.

e) Ask for as many items as possible from as few suppliers as possible.

f) Don't expect the Agency to deliver items at a few days' notice. If you require radioisotopes on a certain date, let the Agency know at least one month in advance and the delivery date can then be met. For other items, allow one to three months for delivery from the time your request is received by the Agency.

g) It is important that the Chief Scientific Investigator submits the request for equipment or supplies promptly (and preferably at the time application is made for a contract or renewal of contract) so that funds can be used as foreseen early in the contract period. It is not advisable to try to hold funds from one year and add them to a renewal award in order to purchase more expensive items.

4. Training

a) Fellowships

The IAEA offers fellowships to suitably qualified personnel from developing Member States for training in the application of nuclear and related techniques.

Qualifications for fellowships

As a general rule, an applicant must be currently working in the area in which further training is requested. Applicants requiring training in insect control should have a basic degree related to the subject and be involved in a research programme. Fellowships are, however, sometimes offered to technicians for basic technical training, particularly relating to the operation and maintenance of instruments used in isotope or irradiation studies.

Duration and conditions of a fellowship

The length of award of an IAEA fellowship is normally between three and twelve months and all expenses related to the training are borne either by the IAEA, the FAO, the UNDP or a donor country. In exceptional cases, fellowships of longer duration may be awarded. It is not the objective of the IAEA fellowship programme to support training which leads directly to a higher degree, although degrees are sometimes earned while completing fellowship training. The following limitations apply to fellowship awards by the IAEA or the FAO:

(i) Applicants must be from a Member State of the Agency;
(ii) Applications must be endorsed by the government agency responsible for nuclear matters. Without this endorsement the fellowship application cannot be considered.
(iii) Applicants must be employed by a government, ministry, research institute, university or similar body, and there must be assurance of employment upon completion of the fellowship.
(iv) In general, awards for training are not made if suitable facilities for the requested training are already available in the applicant's own country.
(v) The submission of an endorsed application does not constitute a guarantee that an award will be made. All applicants are evaluated by the IAEA and the selection is made on merit.
(vi) Age limits for applicants are normally 18 - 45 years.

Applications for IAEA fellowships should be submitted on an Application for Fellowship and Scientific Visit Form No. TA-2ES or TA-2EF, obtainable from the Fellowship and Training Section of the IAEA through the applicant's national atomic energy commission or the ministry responsible for nuclear matters. This government body must endorse the application before it is forwarded to the IAEA for consideration.

For FAO fellowships complete a Fellowship Application Form AGO 25/E, or a Study Tour Form AGO 23 obtainable from the office of the FAO representative, the UNDP Office or from the Fellowship Group, FAO, Rome. Forward the application to the FAO, through the Government, duly endorsed (signed).

b) Training Courses

A further feature of the Agency's training programme is the organization of regional and inter-regional training courses. These are usually of short duration (four to six weeks) and can be attended by up to 20 participants from developing countries, depending on the facilities of the host institute. Details of such courses are announced in the Section's Newsletter and are sent to appropriate organizations in Member States. The qualifications required and the application procedures are the same as those for training fellowships, except that Form TA-3E, Nomination for Training Course/Study Tour, should be completed and sent to the IAEA in Vienna through the appropriate official channels.

5. Sabbatical or Study Leave

It is possible to apply for a sabbatical or study leave position post in the Insect and Pest Control Section or the Entomology Unit at Seibersdorf. Travel support plus a supplementary financial grant to partly cover costs of living are provided by the Agency. An applicant for a sabbatical or study leave post must be in receipt of at least a base salary from his or her home institute.

VI. NEW TECHNIQUES FOR INSECT CONTROL

F-1 sterility is a very promising approach for control of the diamondback moth (Plutella xylostella L.) which is a major world-wide pest of crucifers. This insect has developed resistance to most insecticides, particularly in Southeast Asia.

During October and November Dr. Anthony Shelton, Cornell University, travelled to Indonesia and Malaysia as an IAEA expert on the diamondback moth. Dr. B. Butt served as an expert in SIT and F-1 Sterility in Indonesia in June and July.

An area-wide diamondback moth control programme using F-1 sterility is being planned in the Cameron Highlands of Malaysia. A National Training Course was given on 11 - 22 June in preparation for the programme. See section II regarding past and future meetings and training courses.

VII. PUBLICATIONS AND ABSTRACTS

A. Proceedings

1. Genetic Sexing of the Mediterranean Fruit Fly

The Proceedings summarize the research and development findings of the Agency's co-operators in the co-ordinated research programme to develop a genetic sexing method for the medfly. Great progress has been made in many aspects of medfly genetics, including the development of a number of genetic sexing strains. However, none of these meets all the requirements for the ideal genetic sexing strain of the medfly, and therefore research and development need to be continued.

2. Sterile Insect Technique for Tsetse Control and Eradication

The Proceedings include the final reports of scientists co-operating in the 5 year Co-ordinated Research Programme entitled Application of the Sterile Insect Technique for Tsetse Eradication or Control. The work of these scientist contributed directly to the success of the field programmes utilizing SIT for tsetse fly eradication.

B. Publications from the Entomology Unit and the Insect and Pest Control Section, 1989 - 90

Bruzzone, N.D., Economopoulos, A.P. and Hua-song Wang. Mass-rearing Ceratitis capitata: reuse of the finisher larval diet, Entomol. Exp. Appl. (in press).

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Busch-Petersen, E. Male recombination in a genetic sexing strain of the Mediterranean fruit fly, Ceratitis capitata (Diptera: Tephritidae) and its impact on stability, Ann. Entomol. Soc. Am., 82 (1989) 778-784.

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Economopoulos, A.P. Use of traps based on colour and/or shape, World Crop Pests, Volume 3B, Fruit Flies, their Biology, Natural Enemies and Control (A.S. Robinson and G.H.S. Hooper (eds.)): Elsevier Science Publishers, Amterdam (1989) 315-327.

Economopoulos, A.P. Larval diet with starter for mass-rearing the Mediterranean fruit fly (Diptera: Tephritidae): low cost ingredients, synthesis optimization, J. Econ. Entomol. (in press).

Economopoulos, A.P. Evaluation of a white female pupa genetic sexing strain of the Mediterranean fruit fly under selection procedures, In: Genetic Sexing of the Mediterranean Fruit Fly, Ceratitis capitata (Wied.). Proceedings of the Final Research Co-ordination Meeting, Colymbari, Crete, 3-7 September 1988 (1990) 129-136.

Economopoulos, A.P. Progress in the sterile insect technique against fruit flies. In: Pesticides and Alternatives. (Proc. Int. Symp., Colymbari, Crete, 4-8 September 1989, J. Casida (ed.), Elsevier, Amsterdam): (1990) 143-148.

Economopoulos, A.P. and Bruzzone, N.D. Mass-rearing of the Mediterranean fruit fly (Diptera: Tephritidae): Continuous light in the adult stage, J. Econ. Entomol., (1989) 82(5) 1482-1489.

Economopoulos, A.P., Bruzzone, N.D. and Judt, S. Effect of continuous light and oviposition hole size on the egg production of Mediterranean fruit flies mass-reared for sterile insect technique programmes. In: Regulation of Insect Reproduction IV (Proc. Symp., Zinkovy, 1987), Academia Publishing House, Czechoslovak Academy of Sciences, Praha (1989) 193-195.

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B. Abstracts Received

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BIOLOGICAL SIGNIFICANCE OF GENETIC INJURY INDUCED BY GAMMA RADIATION IN TOBACCO CATERPILLAR MOTH

Proc. V ICEM - Symposium on Genetic Toxicology in Developing Countries, Guadalajara, Mexico (July 20-23,1989)

Considering the dominant defects such as lethality, teratogenicity, distorted sex ratio, infecundity and sterility, that appeared in the offsprings following γ-irradiation of our test insect, tobacco-caterpiller moth, it was imperative to know its most vulnerable stage in the life cycle and a minimum radiation dose that would exaggerate certain such effects and abbreviate others, so that the results could judiciously be applied in its management program. Different physiological stages of the test moth were assessed against various radiation doses; the induced genetic hazards were adequately determined in P-1 and F-1 generations. The sensitivity to the radiation was appreciably dependent on the age of the insect. For example, the sterilizing dose ranged from 2-4 krad for eggs, 3-6 krad for larvae, 7-21 krad for pupae and 17-25 krad for adults. However, significantly more somatic defects surfaced in F-1 progeny of the moths administered with substerile doses. A gamma dose of ca.25 krad, for example, produced 90-100% control of reproduction in P-1 adults while a similar target in F-1 generation was attained by irradiation of

the male parent at 16 krad. Radiation has been used in conjunction with several other factors (chemical or biological) to attain better effects in pest control. Use of hypoxia or other treatments, that protect against the induction by radiation of chromosomal damage, was suggested by Hollaender and others for reducing the genetic hazard of radiation in man. However, an investigation as an antithesis of this belief is being undertaken for an effective control of this pest.

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Development of Tribolium castaneum (Herbst) Larvae after Gamma Irradiation of Eggs.

J. Nuclear Agric. Biol., 19 (1990)

ABSTRACT

Development of Rust-red flour beetle. Tribolium castaneum larvae, after gamma irradiation of eggs of two different age groups was studied. Results indicated that, if 2 to 3 day old eggs were irradiated with 6 Krad, the development of larvae emerging from such eggs is completely arrested at the end of 18 days after hatching. In case of comparatively older eggs (3 to 4 day old), 8 Krad dose of gamma radiation was required to produce the similar results. However, treatment with 10 Krad resulted in 100 per cent egg mortality in both the age groups. The studies thus reveal that survival of the larvae depended not only on the radiation dose and the time period elapsed after irradiation but also on the age of eggs at the time of exposure.

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Suppression of potato tuber moth population build-up through release of an egg parasite, Trichogramma brasiliensis and its possible augmentation by sterile host female release under field conditions

Knipling (1966[1], 1979[2]) suggested that use of an egg parasite such as Trichogramma, combined with sterile insects of the target species in an IPM program would be complementary in that the sterile females would provide large number of

infertile eggs for the development of the parasite. However, though theoretical aspects of such combined approach have been discussed, validity of the same has not been tested under field conditions. Feasibility of this approach was, therefore, tested for the suppression of field population build-up of potato tuber moth (PTM), Phthorimaea operculella Zeller through release of Trichogramma brasiliensis, an egg parasite of several lepidopterous pest species and its possible augmentation by release of sterile PTM females.

Inundative release of the parasite to coincide with the host egg laying in an artificially infested potato crop was made. Also at appropriate times, i.e. expected parasite emergence, radiation sterilized (0.3 KGy) females of PTM were released to augment sustenance of the parasite. Parasite activity was monitored by placing Ephestia (Laboratory host) egg cards on randomly selected plants on every alternate day and retrieved to check parasitization.

Results have indicated that population build-up of PTM was fairly reduced in the parasite release plot as compared to control plot. This was evident from (1) reduced number of F_1 generation PTM males trapped and (2) lower infestation level in post-harvest sampled potatoes. By employing release recapture method using genetic marker PTM males, it was estimated that during peak emergence period the moth population was about 5-6 times more in control than parasite release plot. Further, recovery of parasites through Ephestia eggs during consecutive parasite generations indicated that sustenance of the parasite was augmented through sterile PTM female release.

This approach, thus, appears to have good potential for the biocontrol of PTM and other pests of economic importance.

1. Knipling, E.F. Bull. Entomol. Soc. Am. 12, 7(1966)

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Effect of X-irradiation on the ovary development in the red cotton bug, Dysdercus koenigii F.

Ovarian development in the red cotton bug, Dysdercus koenigii, following X-irradiation of preimaginal stages was studied. The X-ray doses ranged between 0.01 to 0.05 KGy. Feulgen stainability of the germarium was used as one of the criteria for determining damage besides the egg chamber formation and overall size of the ovary.

Doses 0.02 KGy and above greatly affected moulting and metamorphosis of earlier nymphal instars, while the treatment of later nymphal instars with doses 0.02 KGy and above greatly affected ovary development in the emerged adults as manifested by poor Feulgen stainability of the germarium indicating severe damage

to the germarial tissue. Reduction or absence of egg chambers resulted in overall reduction in the size of the ovary. However, at a dose of 0.01 KGy, there was apparently no change in the germarium but differentiation and development of oocytes was abnormal. These abnormalities included crowding of oocytes, differential development of individual ovarioles, change in their linearity, reduction in size and number of egg chambers etc.

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Effect of irradiation on mating behaviour and mating competitiveness of sterile males of red cotton bug, Dysdercus koenigii F.

In this insect sexual maturity of males was found to be decisive factor in mating success. Males attained sexual maturity only 36-48 hr after emergence whereas the females are receptive soon after emergence. Irradiation of males with a sterilizing dose of 0.07 KGy prior to attaining sexual maturity brought about delayed mating. But irradiation after attaining sexual maturity did not alter mating behaviour.

Mating competitiveness of sterile males was evaluated by confining a normal female with sterile and normal males in 1:1 or 2:1 ($S\delta$:Nδ) ratio and the type of matings were recorded. It was observed that mating competitiveness of males rendered sterile by irradiating prior to attaining maturity was greatly reduced even when the sterile males were aged for 72 hr as compared to normal males. Since more normal male matings occurred. However, when males were irradiated after attaining maturity, apparently they became more vigorous than normal males since mating pattern was reversed in favour of sterile males.

Irradiation during early 5th instar induced wing deformities. Such males having wing deformities failed to undergo copulation with normal females. But wing deformity among females did not prevent them from undergoing copulation with normal males.

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Degree of wing deformity as an indicator of radiosensitivity of nymphs of Dysdercus koenigii F. with acute and fractionated doses

When early 5th instar nymphs of D. koenigii were exposed to various doses X-rays, number of nymphs metamorphosing into adult stage was inversely proportional to the dose administered. Doses (7 krad) 0.07 KGy and above prevented adult emergence. At lower doses, adults that emerged exhibited varying levels of wing deformities depending on the dose particularly (3 krad) 0.03 KGy and above. An arbitrary scoring system based on the extent of wing coverage of the abdominal segments was used to measure radiosensitivity. A wing deformity (WD) score of O was considered normal wing pattern and a score of 3.5 indicated severe wing damage. Based on this system, it was found that hind wings were more sensitive than the forewings. While at a dose of (2 krad) 0.02 KGy an average WD score was only 0.55, it increased to

3.05 with (5 krad) 0.05 KGy dose in the case of hind wings. The corresponding figures for forewings for these two doses were 0.27 and 1.51 respectively. Similarly, males were more radiosensitive than females. At a given dose, damage to the male wings was more pronounced than female wings.

Fractionation of radiation dose brought about some amiliorative effect on adult emergence and the extent of wing damage but only at 0.02 KGy and 0.03 KGy. Doses higher than these were too severe for any recovery. Increase in interval between two fractions brought about further amilorative effect.

VIII. IAEA Publications

The IAEA publishes a Yearbook which provides descriptions of the IAEA's major programmes, with articles on particular projects and areas of activity, together with reports of particular current interest and general information about the IAEA. The Yearbook presents the work of the IAEA in the context of scientific, technical and economic developments worldwide.

The contents are a foreword by the Director General; the IAEA's Contribution to Sustainable Development; Part A - Transfer of Nuclear Technology; Part B - Applications of Nuclear Techniques; Part C - Nuclear Power and Fuel Cycle: Status and Trends; Part D - Nuclear Safety Review; Part E - IAEA Safeguards; Part F - The IAEA.
Parts A, B, C and D are also available separately.

The publication date for the 1989 IAEA Yearbook is August 1989 and may be purchased for 560 Austrian Schillings.

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