

# Insect and Pest Control Newsletter



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

No. 44  
April 1990

ISSN 1011-274X

## CONTENTS

I.	GENERAL INFORMATION	
A.	Logo Contest .....	2
B.	The Staff .....	2
C.	What we want from you .....	4
D.	The Programme .....	4
II.	NEW WORLD SCREWORM .....	5
III.	MEDFLIES AND OTHER FRUIT FLIES	
A.	Meetings and Training Courses .....	7
B.	Fruit Flies at Seibersdorf .....	7
IV.	TSETSE FLIES	
A.	Meetings and Training Courses .....	10
B.	Tsetse Flies at Seibersdorf .....	10
V.	NEW TECHNIQUES FOR INSECT CONTROL	
A.	General Information .....	12
B.	Meetings and Training Courses .....	12
VI.	SPECIAL REPORTS	
A.	The Onion Fly	
M. Loosjes (De Groene Vlieg, The Netherlands) .....	13	
B.	Nuclear Strategies in Food and Agriculture - 25 Years of Progress, 1964-1989	
Björn Sigurbjörnsson, Director, Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture .....	14	
C.	The FAO Programme for the Control of African Animal Trypanosomiasis and Related Development	
B.S. Hursey, Animal Health Officer, FAO, Rome .....	16	
VII.	PUBLICATIONS AND ABSTRACTS	
A.	Publications from the Entomology Unit and the Insect and Pest Control Section, 1989 .....	21
B.	Publications of Interest .....	23
C.	Abstracts Received .....	24
VIII.	IAEA Publications .....	32

# I. GENERAL INFORMATION

## A. Logo Contest

There were a number of good logos submitted to the logo contest. The winning logo, which appears on the cover of this Newsletter, is by Dr. R.K. Seth, Department of Zoology, University of Delhi, Delhi, 110007, India.

We congratulate Dr. Seth and thank all who participated in the contest.

## B. 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.

<u>Name</u>	<u>Duties</u>
<u>Joint FAO/IAEA Division</u>	
Björn Sigurbjörnsson, Director	
L. LaChance, Deputy Director	
<u>Insect &amp; Pest Control Section</u>	
D.A. Lindquist (USA, 1980)	Section Head, fruit flies
A. Van der Vloedt (Belgium, 1974)	Tsetse flies
B. Butt (USA, 1988)	F-1 sterility
<u>Seibersdorf Laboratory</u>	
R. Gingrich (USA, 1980)	Head, Entomology Unit, microbiology
A. Economopoulos (Greece, 1985)	Head, medfly programme, medfly mass-rearing
U. Feldmann (FRG, 1988)	Head, tsetse programme, tsetse mass-rearing
R. Anouchinsky (Italy, 1987) (terminated 1 November 1989)	IAEA Junior Professional Officer, tsetse isozymes
M. Vreysen (Belgium, 1987)	FAO Associate Professional Officer, tsetse mass-rearing
E. Busch-Petersen (Denmark, 1982) (terminated 31 October 1989)	Medfly genetic sexing
P. Kerremans (Belgium, 1987)	FAO Associate Professional Officer, medfly genetics
G. Franz (FRG, commenced 11 November 1989)	Medfly genetics

Dr. Erik Busch-Petersen has taken a position with Immuno AG in Vienna after 7 years with the IAEA at the Seibersdorf Laboratory. His research on genetic sexing of medfly, first by pupal colour and more recently by temperature-sensitive lethals in the larval stage, is a major contribution to medfly control by the Sterile Insect Technique (SIT). We congratulate Erik on a job well done and wish him all the best in his new position.

Dr. Riccardo Anouchinsky has returned to Italy after 2 years at the Seibersdorf Laboratory working on tsetse isozymes.

Dr. Gerald Franz has joined the Seibersdorf Laboratory to continue work on genetic sexing. He has studied biology with a strong emphasis on biochemistry and genetics. After obtaining his PhD. in genetics at the University of Düsseldorf (FRG) he went to Cambridge (U.K.) to work in G.A. Dover's laboratory on the molecular characterization of rRNA genes in different *Drosophila* species. This line of research was continued at the Institute of Molecular Biology and Biotechnology in Crete (Greece) and led to the discovery of a new mobile element in *D. hydei*. During the last 2.5 years he worked in R.Z. Sung's laboratory at the University of California, Berkeley (USA) on the cloning and analysis of embryo-specific genes in *Daucus carota*.

Dr. Franz has prepared the following comments on his work at Seibersdorf:

Over the last few years the Entomology Unit has emphasized research on the development of genetic sexing medfly strains. The initial strain that allowed the separation of the sexes was based on the pupal colour marker *w<sup>p</sup>* (Rössler, 1979 and Robinson and Riva, 1983), and a Y-autosome translocation detected by Busch-Petersen and Southern (1987). This strain is now being field-tested in Israel. In parallel, Busch-Petersen has successfully screened for *ts1* mutants after EMS treatment. The goal was to improve the economical aspect of mass-rearing by removing the unwanted females during the early stages and thereby saving larval diet.

With this background I will concentrate my efforts on two main areas:

1. Testing of the new *ts1* mutant and the development of a genetic sexing strain that will discriminate between the sexes in early developmental stages by treatment with elevated temperature.  
Once this has been achieved this strain could replace the present one.
2. Application of molecular biology methods on medfly. Two main aims can be addressed with this programme. First, it is desirable to improve the knowledge of the strains or species that are used in a mass-rearing programme, and second, it should be possible to use molecular biology methods to construct new genetic sexing strains with improved characteristics compared to the existing ones.

To achieve these goals a close collaboration of all laboratories working with medflies is absolutely essential in order to avoid overlaps and to speed up progress.

Busch-Petersen, E. and Southern, D.I. Induced suppression of genetic recombination in females of the Mediterranean fruit fly, *Ceratitidis capitata* (Wied.) by translocation heterozygosity. *Genetica* 72 (1987), 161-169.

Robinson, A.S. and Riva, M.E. Male-linked translocations in *Ceratitidis capitata* for genetic sexing and irradiation. In: *Fruit Flies of Economic Importance*, Balkema, Rotterdam, The Netherlands, Cavalloro, R., ed., pp. 190-196.



Rössler, Y. The genetics of the Mediterranean fruit fly :  
A "white pupae" mutant, Ann. Entomol. Soc. Am. 72 (1979)  
583-585.

C. 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:

Dr. D.A. Lindquist  
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

D. 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".

A training course, "Use of Isotopes in Entomology", will take place from 13 May - 23 June 1990 in Gainesville, Florida, USA.

## II. NEW WORLD SCREWORM

The presence of the New World Screwworm (NWS), *Cochliomyia hominivorax*, in North Africa was reported in the previous Insect and Pest Control Section's Newsletter (No. 43, pages 4-9). As of 1 January 1990 the NWS is reported in about 20,000 km<sup>2</sup> in Libya. The pest has not been reported from other North African countries. Egypt, Tunisia and Algeria have very active surveillance programmes to detect the NWS if it occurs in these countries.

Libya has initiated an extensive surveillance and control programme involving more than 90 teams of workers. Each team consists of 3-5 individuals, a 4-wheel drive vehicle, spray equipment and insecticides. The teams are surveying and treating wounded and infested animals in the northern part of the country. In addition, all oases in the interior of the country have individuals who are inspecting animals for NWS. The Government of Libya has obligated more than US\$ 7 million for this programme.

FAO (the Food and Agriculture Organization of the United Nations), the UNDP (United Nations Development Programme) and IFAD (International Fund for Agricultural Development), are all making significant contributions to assist Libya and all countries with common borders with Libya in their NWS programmes. Training of individuals is receiving high priority. Equipment and supplies have been delivered and expert services provided.

The IAEA has provided a small technical assistance project to support the programme in Libya. In addition, the staff of the Insect and Pest Control Section and the Entomology Unit of the Seibersdorf Laboratory have:

1. obtained pupae of the NWS in Libya and transported these to the ARS Laboratory in Fargo, North Dakota. The Fargo scientists have demonstrated that the NWS from Libya and the strain being reared in Mexico are sexually compatible and the pheromone identical;
2. assisted FAO in the training course in Libya;
3. assisted FAO in designing the NWS eradication programme for North Africa; and
4. initiated tests to measure the effect of shipping sterile NWS pupae from Mexico to Vienna in preparation for large shipments to North Africa.

Plans are proceeding to initiate an eradication programme to eliminate the NWS from North Africa. This will be a rather costly undertaking, however, the benefits from eradication will far exceed the estimated costs. The eradication programme will include an intensification of surveillance, control and quarantine within Libya and the release of sterile flies which will be obtained from the Mexico-U.S. Screwworm Commission rearing facility in Tuxtla Gutierrez, Mexico. This facility is the only NWS rearing facility in the world.

As of mid January 1990 the estimated cost of eradication may exceed US\$ 75 million. About 70% of this cost is associated with the Sterile Insect Technique (SIT) and involves cost of the sterile flies from the Mexico facility, transport of these flies from Mexico to North Africa, and the aerial release of the sterile flies in North Africa.

If eradication is not successful, the African continent will be faced with an enormous problem, not only for livestock, but also for wildlife. Information from the Western Hemisphere indicates that a high percentage of new-born wildlife will die from NWS attack. Endangered species may thus become more endangered if the NWS is allowed to become established throughout Africa. The pest also will invade the Middle East and southern Europe unless a successful eradication programme is initiated very soon.

have very active surveillance programmes in these countries.

Libya has initiated an extensive surveillance and control programme involving more than 50 teams of workers. Each team consists of 3-5 individuals, a 4-wheel drive vehicle, spray equipment and insecticides. The teams are surveying and treating wounded and infested animals in the northern part of the country. In addition, all cases in the interior of the country have individuals who are inspecting animals for NWS. The Government of Libya has obligated more than US\$ 7 million for this programme.

FAO (the Food and Agriculture Organization of the United Nations), the UNDP (United Nations Development Programme) and IFAD (International Fund for Agricultural Development), are all making significant contributions to assist Libya and all countries with common borders with Libya in their NWS programmes. Training of individuals is receiving high priority. Equipment and supplies have been delivered and expert services provided.

The IAEA has provided a small technical assistance project to support the programme in Libya. In addition, the staff of the Insect and Pest Control Section and the Entomology Unit of the Helmholtz Laboratory have:

1. obtained pupae of the NWS in Libya and transported them to the ARS Laboratory in Fargo, North Dakota. The Fargo scientists have demonstrated that the NWS from Libya and the strain being tested in Mexico are sexually compatible and the phenotypes identical;
2. assisted FAO in the training course in Libya;
3. assisted FAO in designing the NWS eradication programme for North Africa;
4. initiated tests to measure the effect of shipping sterile NWS pupae from Mexico to Vienna in preparation for large shipments to North Africa.

Plans are proceeding to initiate an eradication programme to eliminate the NWS from North Africa. This will be a rather costly undertaking, however, the benefits from eradication will far exceed the estimated cost. The eradication programme will include an intensification of surveillance, control and quarantine within Libya and the release of sterile flies which will be obtained from the Mexico-U.S. Stereoworm Commission testing facility in Tuxtla Gutierrez, Mexico. This facility is the only NWS testing facility in the world.

As of mid January 1990 the estimated cost of eradication may exceed US\$ 75 million. About 70% of this cost is associated with the Stereoworm Technique (STT) and involves cost of the sterile flies from the Mexico facility, transport of these flies from Mexico to North Africa, and the serial release of the sterile flies in North Africa.



### III. MEDFLIES AND OTHER FRUIT FLIES

#### A. Meetings and Training Courses

##### 1. Past

In anticipation of a possible area-wide medfly SIT release programme in North Africa, a 2 week training course was offered by FAO/IAEA/ENEA. The course was attended by 9 selected participants from Morocco, Tunisia, Algeria and Libya. Co-ordination was by Prof. B. Donini and lectures were presented by E. Buyckx (FAO), A. Economopoulos (FAO/IAEA), G. Vita and U. Cirio (ENEA) and Italian scientists P. Fimiani, G. Del Rio, M. Cerasola and D. Ciraulo.

During the first week lectures were given at ENEA, Casaccia Centre in Rome. Practical exercises and demonstrations, including release and trapping of flies, were conducted during the second week on the Italian island of Pantelleria.

##### 2. Future

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

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

Third International Symposium on Fruit Flies, Antigua, Guatemala, October 1990.

#### B. Fruit Flies at Seibersdorf

The search was continued to find agents produced by the entomopathogen, *Bacillus thuringiensis*, that can be used in bait sprays to control fruit flies. Attention was focused on isolates of the bacterium that produced active exotoxins. Supernatants of submerged cultures were harvested after fermentation and fractionated by high pressure liquid chromatography (HPLC). Each fraction is bioassayed against adult medflies. Most of the active isolates examined so far have produced exotoxins that were indistinguishable by HPLC from the well-known  $\beta$ -exotoxin. Since this exotoxin is presently banned from use by regulatory agencies in many countries, interest is directed toward active fractions that have a retention time different from the one of  $\beta$ -exotoxin. Some have been found and are under further examination.

The search for a *tsl* mutation in medfly was conducted with two aims in mind. First, to detect a marker that can be used to discriminate between males and females and second to reduce mass-rearing costs by killing the females at a very early stage of development, ideally in the egg or very early larval stage.

One *tsl* mutation was obtained in this screen and was found to be located on a 5th chromosome also bearing a *wp* marker. The results of initial experiments to characterize the homozygous *wp<sup>-</sup>tsl<sup>-</sup>* strain are presented in Fig. 1. Eggs were treated for 24 hrs at different temperatures and at two different times. Four days after

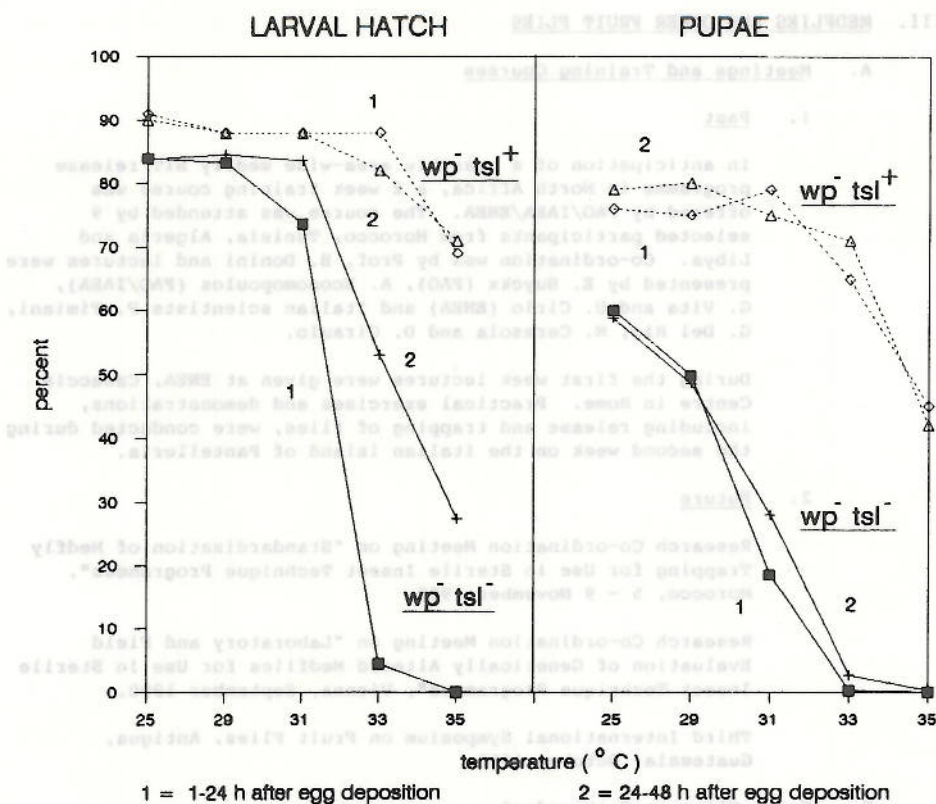


Fig. 1

egg deposition the numbers of hatched eggs were counted. In addition, the number of pupae developing from each set was recorded.

It is apparent that a temperature of around 33°C applied during the first 24 hrs after egg deposition prevents the majority of larvae from hatching while the same treatment has only marginal effects on the  $wp^+tsl^+$  control strain, e.g. neither larval hatch nor the number of resulting pupae are reduced significantly.

In the next step, a genetic sexing strain will be developed utilizing the Y-autosome translocation chromosome (T:Y( $wp^+tsl^+$ )) 30C which has been used previously in GS strains based on the pupal colour.

The white female pupae genetic sexing strain was field-tested in Israel. Each week since the beginning of May 1989 two million sterile male pupae were shipped from Seibersdorf to Tel Aviv. The Rehovot laboratory of Citrus Agrotechnical Service transported the pupae by car 150 km to Gvullot where the flies were released on a kibbutz at 400 sites in 22 hectares containing about 3,000 mango and 5,000 citrus trees.



By November the strain had reached the 23rd generation and strain breakdown (females from brown pupae) reached 14%. Although no insecticide was applied, the medfly was kept at a very low, economically acceptable level and the kibbutz and Citrus Agrotechnical Service authorities were very pleased with the results. Normally aerial spraying of groves takes place weekly with malathion bait sprays from September to December. The test will be repeated in 1990.

From 23 - 24 October Dr. John Cook of AgriSense (joint venture of Phillips Petroleum Company and Dow Corning Corporation), Fresno, California, visited the Seibersdorf laboratory and discussed medfly trapping with Dr. A.P. Economopoulos. AgriSense contributed twice (1988-89) trimmedlure plugs (male attractant) and respective plastic baskets for the research co-ordinated programme on medfly trapping in Egypt, Greece, Guatemala, Libya, Mexico, Morocco, Spain and Turkey.

Future co-operation was discussed. AgriSense undertook to investigate whether trimmedlure could be combined with the killing agent (e.g. DDVP) in the same plug. If this proves possible, AgriSense indicated that they could provide the co-ordinated programme with the above combined plugs free of charge. Dr. Cook also expressed interest in providing the programme with an improved dry-trap for use with the attractant killing agent plug.

1. Testes morphology, reproductive biology, laboratory colonisation and mass-rearing.
  2. Testes flies as vectors of trypanosomiasis: parasite-vector relationships.
  3. Testes ecology: population structures and dynamics. Monitoring procedures and detection techniques. Data recording and analysis.
  4. The sterility principle: radiation-induced sterility in insects and methods of determining the impact of release of sterile testis fly males on natural populations.
  5. Release and demarcation of release sites, isolation and maintenance of testis.
  6. Organisation, planning, management, monitoring and evaluation, including costing, of testis SIT programmes.
  7. Preparation of testis SIT project documents and reports.
- Participants will have the opportunity to work in groups and present reports on specific topics and areas of interest. They will each be given the chance to make a 10-minute presentation on testis/trypanosomiasis control activities or plans in their respective countries.

8. Testis flies at Seibersdorf.
- The maintenance of seven species of testis flies (see Fig. 1, Insect and Pest Control Section's Newsletter, No. 43, August 1989)

#### IV. TSETSE FLIES

##### A. Meetings and Training Courses

###### Future

Regional FAO/IAEA Training Course on "Tsetse Control with the Sterile Insect Technique", will be held in Ghana from 7 May - 1 June 1990.

The objective of the course is to provide intensive training for African professional and senior technical staff actively engaged in tsetse eradication/control work. The aim is to expose participants to the basic principles of the application of the SIT for tsetse eradication projects involving the use of the SIT.

The course will last for 4 weeks and deal with techniques available for integrated tsetse control with emphasis on basic requirements for practical application of the SIT. Through lectures, demonstrations and field trips, the course will expose participants to the use of tsetse population suppression devices (visual and olfactory attractive devices/traps, insecticide-treated screens and animals) and their integration with the release of sterile males in area-wide tsetse eradication programmes.

Lectures and discussions will include the following:

1. Tsetse morphology, reproductive biology, laboratory colonization and mass-rearing.
2. Tsetse flies as vectors of trypanosomiasis: parasite-vector relationships.
3. Tsetse ecology: population structures and dynamics. Monitoring procedures and dissection techniques. Data recording and analysis.
4. The sterility principle: radiation-induced sterility in insects and methods of determining the impact of releases of sterile tsetse fly males on natural populations.
5. Selection and demarcation of release sites, isolation and maintenance of barriers.
6. Organization, planning, management, monitoring and evaluation, including costing, of tsetse SIT programmes.
7. Preparation of tsetse SIT project documents and reports.

Participants will have the opportunity to work in groups and present reports on specific topics and areas of interest. They will each be given the chance to make a 20-minute presentation on tsetse/trypanosomiasis control activities or plans in their respective countries.

##### B. Tsetse Flies at Seibersdorf

The maintenance of seven species of tsetse flies (see Fig. 1, Insect and Pest Control Section's Newsletter, No. 43, August 1989)

was continued to provide material for in-house research and distribution to outside institutes. The colony of Glossina fuscipes has been fully adapted to mass-rearing conditions and is presently kept at a size of 5,000 mated females. All tsetse flies at Seibersdorf are exclusively fed in vitro using quality-tested frozen-stored fresh blood.

Incubation experiments on tsetse fly pupae are being pursued with the aim of regulating the pupal period and to facilitate the sexing of adults upon emergence.

The search for sex-related differences among third instar larvae or pupae among the Glossina spp. colonies is being pursued. The aim is to reduce labour and time presently required for manually sexing adult flies and to enable shipment of only male pupae from a centrally located tsetse breeding centre to recipient projects which apply the sterile insect technique.

Experiments on the mating-receptivity of G. brevipalpis females in relation to their age and hunger stage were initiated.

A sex ratio distortion (only 24.2% males among emerged adults) and salivary gland hyperplasia (associated with sterility in males) was detected in the G. m. submorsitans colony. In order to gain more information on these findings, the performance of individual males and females was analysed. There is indication of a maternal inheritance of enlarged salivary glands. Whether there are other ways of transfer, e.g. during mating, still has to be confirmed.

Dr. Wayne Wolf (USA) visited the Seibersdorf Laboratory as a consultant on automation of tsetse fly rearing.



## V. NEW TECHNIQUES FOR INSECT CONTROL

### A. General Information

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.

An area-wide diamondback moth control programme using F-1 sterility is being planned in the Cameron Highlands of Malaysia.

### B. Meetings and Training Courses

#### 1. Past

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 is in preparation and will be available in March 1990.

#### 2. Future

A national workshop/training course on "Nuclear Techniques in Entomology" will be held in Malaysia in June 1990.

## VI. SPECIAL REPORTS

### A. The Onion Fly - M. Loosjes (De Groene Vlieg, The Netherlands)

This paper describes the origin, practical application, problems in application and prospects of control of the onion fly, *Delia antiqua* (Diptera: Anthomyiidae), in the Netherlands by the Sterile Insect Technique (SIT).

The larva of the onion fly is a severe pest in onions in temperate regions. Development of resistance of the onion fly against insecticides caused research on the SIT to be started by the Dutch Government in 1965. This research was on mass-rearing, long-term storage of pupae, sterilization, and release and ratio assessment techniques. By 1979 sufficient information had been collected to enable practical application, which was then turned over to any interested private company. In the case of the onion fly the SIT can be applied like a control treatment instead of chemical control to individual onion fields. This is due to the limited dispersal activity of the flies and the scattered distribution of onion fields in the Netherlands, with 5 - 10% of the onion growing areas planted with onions.

In 1980 we started a private company for application of the SIT for onion fly control.

During September - May onion flies are mass-reared at over 150 million flies per year. Pupae are stored at 3°C for up to one year. New strains are regularly collected in the field. Their offspring are released some years later as 5th to 9th laboratory generations. In the winter we make contracts with the onion growers.

Onion fly pupae are sterilized shortly before fly emergence with 3 Krad gamma radiation from a  $^{60}\text{Co}$  source in Wageningen. Next, the pupae are mixed with daylight fluorescent powder. All emerging flies are covered with powder. Later, they clean themselves but the dye is retained in the retracted ptilinum. As soon as the flies can fly their positive phototaxis is used to move them into a cold room where they are put into gauze screen release containers by weight. These are sets of two. The flies are transported to the onion fields by car and released by emptying the required number of containers while walking along the edges of the onion fields.

At the same time, field trap contents are collected. At every field there is at least one group of three traps situated near a corner. These traps consist of a white plastic coffee cup, filled with water, polyethylene glycol and detergent and placed in a similar cup fixed to the soil surface by a bamboo stick. Trap contents are checked for onion flies. For all suspected onion flies the ptilinum is squeezed out and checked for presence of dye at 60x magnification and under UV light. Of the flies without dye, species determination is checked to exclude several very similar flies. The ratio of sterile to fertile flies should be about 20:1.

During the first six years of application most of the releases were made from aircraft, flying 20 m high at 180 km/h. This method has been abandoned both for logistic reasons and because we missed data on the distance between release and trapping sites, reducing the value of the information from trap catches.



Wild onion flies emerge from hibernating pupae in May and June. As their longevity is only a few weeks, sterile flies are released every 1 - 2 weeks during this period on each field. The data from the catches are used to adjust and optimize the distribution of the next batch of sterile flies. A second flight is in July and August, generally causing no damage. Sterile flies are also released against this generation to get a further population reduction and also to get a rough estimate of their offspring, the hibernating pupae. In the spring the flies redistribute themselves over the newly sown onion fields.

Apart from some growing pains in mass-rearing and release techniques, the main problems in application arose near fields where onion maggots were chemically controlled but the fly populations were not sufficiently reduced. This was due to use of an insufficient dose and/or use of non-effective insecticides. Sometimes no control was applied. Increased populations on such fields spread the next spring to surrounding fields of our customers. We excluded customers if advanced fly population estimates exceeded levels that we could afford to control by sterile flies. In cases where we were taken by surprise, sometimes some damage resulted when we could not, or not in time, achieve a sufficient over-flooding of sterile flies. In both cases, this impaired the reliability of the sterile insect technique in the farmer's view. Therefore, participation did not exceed about 60%. More importantly, the planned population reduction could only regionally or temporarily be achieved, so we missed the expected cost reduction. Thus, the acreage treated remained around 1,200 ha/year from 1983 up till now, 1989, and the method is still unprofitable.

From 1970 onwards, onion maggots were effectively controlled by trichloronate, however, its production was stopped a few years ago. Now some carbamates are used which are somewhat less effective. Moreover, some of these are rapidly broken down by soil bacteria after a few applications. If this should happen also to benfuracarb, which is now the only insecticide available for use against the onion fly for the majority of the Dutch onions, the SIT will be very seriously threatened. In areas where participation is well below 100%, onion fly populations will become too high. Our prices are at present lower than those of the chemical alternatives, but because we will have to raise them, a high level of participation does not seem probable.

Thus the prospects for use of sterile onion flies remain uncertain due to present and expected problems.

#### B. Nuclear Strategies in Food and Agriculture - 25 Years of Progress, 1964-1989

Björn Sigurbjörnsson, Director, Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture

Healthy and abundant food supplies is a goal for every nation in the world. Nuclear techniques have played a fundamental role in solving some of the obstacles to attaining this goal which existed in the 1960s. New trends and approaches in food and agricultural production have had a tangible impact on the quality of life of people worldwide.



Research, testing, analysis and experience in the peaceful applications of nuclear energy have helped solve many practical problems for farmers and industry alike.

Unfortunately, however, not all successful nuclear applications available to industrialized countries reach developing nations. To address this problem, in 1964, the International Atomic Energy Agency (IAEA) and the Food and Agriculture Organization (FAO) of the United Nations joined forces to create the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture.

Initially just a small unit seeking solutions to food and agriculture problems through nuclear techniques, the Joint Division, and the Agricultural Laboratory of the IAEA Seibersdorf Laboratories, have since grown to be an internationally respected research and development centre, a forum for global sharing of information and knowledge, and a conduit through which nuclear technology can be transferred to those countries which need it most.

The Joint FAO/IAEA Division today focuses on six major areas:

Insect and pest control nuclear techniques are used to control or eradicate harmful pests responsible for extreme losses in food production, as well as in human and animal life, through dangerous diseases.

Food preservation through irradiation has become a valuable tool in reducing post-harvest food losses, reducing the occurrence of food-borne disease, and extending the shelf life of agricultural commodities.

Animal production and health is an area where nuclear techniques have been used successfully to improve the health and productivity of ruminant animals.

Plant breeding and genetics is an approach where nuclear techniques are used to develop new strains of plants of higher quality, yields, and resistance to diseases. These techniques induce genetic variation.

Soil fertility, irrigation and crop production covers the important combinations of healthy, productive soils and an adequate supply of water necessary to achieve good quality crop production. Nuclear techniques are used to improve the efficiency of fertilizers, to understand their environmental effects, and to establish new ways to restrain their use.

Agrochemicals and residues are watched through radiotracer techniques as they travel through our environment. More effective applications of pesticides can be devised, as well as new approaches to understand and protect the ecological balance.

As the Joint FAO/IAEA Division completes its 25th year in operation, it is an opportune time to review some of the achievements of nuclear methods applied to food and agricultural production. Some of these are quite remarkable and have set valuable precedents in research, development, and applications for nuclear strategies and their role in solving food and agricultural problems in a practical, efficient manner.

C. The FAO Programme for the Control of African Animal Trypanosomiasis and Related Development  
B.S. Hursey, Animal Health Officer, FAO, Rome

Introduction

The FAO proposal for a long-term Programme for the Control of African Animal Trypanosomiasis and Related Development was presented to the World Food Conference in November 1974. A recommendation was adopted that the programme should be implemented as a matter of urgency and should receive high priority in the FAO programme of work and budget. Following recommendations of support by FAO statutory bodies the preparatory phase, which led to implementation of a large-scale programme, was launched in 1980.

1. Preparatory Phase (1975-1979)

The objectives of the preparatory phase were to:

- (a) establish the necessary technical and administrative structures at international, regional and national levels;
- (b) intensify the training of personnel at all levels;
- (c) conduct applied research, surveys and field trials in order to improve control techniques;
- (d) promote research into trypanotolerance and establish multiplication centres;
- (e) assess the socio-economic implications of trypanosomiasis and its control including land use after tsetse elimination; and
- (f) mobilize the funds and services required to fulfil the set objectives and formulate plans for control and development programmes.

The need to include land use planning and area development in tsetse and trypanosomiasis control programmes was recognized at an early stage as was the need for monitoring the impact on the environment.

To achieve the above objectives a number of activities were implemented, namely:

- Establishment of a Trypanosomiasis Control Unit at FAO Headquarters as well as administrative structures for the co-ordination and management of the programme.
- Convening of seven expert consultations to define a detailed work plan for the preparatory phase, to review the general problem of human and animal trypanosomiasis, to determine modalities for implementation of the programme, to secure the technical data bases concerning trypanotolerance and African animal trypanosomiasis including the economic aspects of control.
- Holding of three joint FAO/industry task force meetings to ensure reciprocal technical feedback.



- Fielding of consultancy missions in 27 of the 37 affected African countries to advise on the establishment of national control services and to assist in project formulation. The economic impact of trypanosomiasis on rural development was also studied in 16 countries.
- Implementation of control projects in Mozambique and Niger and a tsetse distribution survey in Côte d'Ivoire, in collaboration with GTZ.
- Initiation of a jointly sponsored tsetse and trypanosomiasis information service. Reviews of the current state of knowledge on insecticides, application equipment and the impact on the environment of tsetse control operations were also commissioned and published. A study of the status of trypanotolerant livestock breeds was carried out in collaboration with the International Livestock Centre for Africa and the United Nations Environmental Programme.
- Following a consultancy mission for the establishment of a regional training centre in Eastern Africa, a project was initiated in Zambia for training middle-level personnel. A total of five joint training seminars were conducted in which 142 personnel of leadership cadre from both anglophone and francophone countries participated.
- A total of US\$ 100,000 was allocated to seven African research institutes and three European based laboratories to promote and assist research into tsetse ecology, control by insecticides and the effect on the environment, arboricides for bush control, insect growth regulators, epizootiology of trypanosomiasis in bovines, ovines and camels, trypanosomiasis diagnostic techniques, trypanocide pharmacokinetics and trypanotolerance.
- Mobilization of resources and services by personal and consultancy visits to assistance agencies to secure co-operation and collaboration in programme implementation.

The Commission on African Animal Trypanosomiasis was established by the XXth Session of the FAO Conference in November 1979 and related technical and management services were consequently strengthened at Headquarters and in the Regional Office for Africa. To ensure co-ordination of activities within FAO an Inter-departmental Working Group on Ecological/Technical Aspects and two Panels of Experts on development issues of the programme were formed in 1980.

## 2. Programme Implementation

The XXth Session of the FAO Conference approved plans for the implementation of the programme which started in 1980 with multi-disciplinary preparatory assistance missions to assist governments in the formulation of development projects. FAO also provided assistance to countries in specific technical subjects, some with TCP support. In total 30 countries received support for project formulation or implementation.



Only 2 of the 37 infested countries did not avail themselves of this FAO service.

FAO assistance to date has mainly been concentrated on:

- meetings and reports of the Commission of African Animal Trypanosomiasis and Panels of Experts on development, ecological/technical and vector control aspects of the programme. Consultations on the environmental impact of tsetse and workshops on the breeding and use of trypanotolerant cattle have also been undertaken;
- publication in English and French of a 3 volume Training Manual on Tsetse Control and a Field Guide for Trypanosomiasis Control, 11 volumes of the Tsetse and Trypanosomiasis Information Quarterly, 8 technical documents and a number of consultants' reports on selected aspects of trypanosomiasis control and rural development. A manual for the use of trypanotolerant livestock is currently in preparation;
- training of middle and post-graduate level tsetse control personnel, bringing the total trained to approximately 500 and 70 respectively from 34 African countries. Short-term specific training courses or workshops have been implemented in 11 countries;
- research grants amounting to some US\$ 400,000 on a number of aspects of tsetse and trypanosomiasis control and related development, excluding those aimed at promotion of the Sterile Insect Technique; and
- execution of some 31 Project Advisory Groups and technical assistance missions. Over 40 field projects on tsetse/trypanosomiasis control and related development, including the rearing of trypanotolerant livestock, have been launched with the support of the UNDP and other UN institutions, trust funds, mainly with the Government of Italy, and the FAO/TCP, for a total of approximately US\$ 25 million. Eight projects amounting to some US\$ 9 million have had a regional coverage.

The first Sub-Regional Development Support Unit and a Regional Project for the Rearing of Trypanotolerant Livestock were established in 1983 in Burkina Faso. Both are being financed by the Government of Italy, through the FAO/Government Co-operative Programme.

Collaboration has been established with the International Institute for Applied Systems Analysis in Vienna in order to apply the models designed by the population supporting capacity and agro-ecological zones studies, for the identification of areas for large-scale and long-term programmes.

In spite of the progress made in implementation of the programme, some delays in resources flow have been observed. In general, the development of the programme has been seriously affected by changes in the international economic situation. The effects of the rise in oil prices and the

subsequent world economic recession of debt servicing have altered the needs and priorities of the African countries. The funding of field activities has also been affected by new problems such as drought and rinderpest, the immediate effects of which were more obvious and many African countries have given priority to emergency actions using funds earmarked for long-term development programmes.

### 3. Strategy Adjustments

The ultimate goal of effective large-scale tsetse and trypanosomiasis eradication can only be achieved over a long period of time. Consequently, it is essential to keep this subject under constant review, whilst preparing for large-scale activities through training, research and pilot trials.

Initially, the scope of the programme was pan-African, aimed at involving all the countries affected by trypanosomiasis. This was in line with the wishes of FAO Member Countries as expressed in recommendations by FAO governing bodies. Considering the funds actually available this proved too ambitious and it was agreed that the programme during the next few years should be revised to:

- focus on priority areas, with good prospects of attracting funds for integrated control and development programmes;
- promote simple and low-cost control techniques for areas where the prospects for limited funding are good;
- intensify training activities and allocate funds for research on subjects of immediate importance to the control programme; and
- co-operate with research institutes, concerned organizations and bilateral assistance agencies.

### 4. Approach to Vector and Disease Control

Trypanosomiasis control: Support will be given to research on selected subjects, strengthening of veterinary services and promotion of chemotherapy and chemoprophylaxis, the last mentioned through training in simple diagnostic techniques and the strategic use of trypanocides.

Trypanotolerant livestock: Promote the rearing of trypanotolerant livestock, and, where appropriate, wildlife.

Tsetse control by non-polluting techniques: Assist the development of insecticide-impregnated traps/screens and insecticide treated cattle, particularly for control of savannah tsetse species.

Training, information and research: Preference to be given to training of national personnel from countries where facilities and infrastructure exist so that full and immediate use can be made of the training received. Preparation of training material, publication of technical documents and dissemination of information will continue.



5. Co-ordination and Co-operation with other Institutions

In order to avoid duplication of efforts and to make better use of available funds and expertise, collaboration will be strengthened with organizations and research institutes such as WHO, UNEP, IAEA, ILRAD, ILCA, ICIPE, OAU/IBAR, Desert Locust Organization and the Onchocerciasis Control Programme.

6. Priority Areas for Integrated Large-scale Control and Development Programmes

On the basis of available information, the socio-economic importance and the prospects for funding, and considering the preliminary conclusions of the study on application of the agro-ecological zone data to tsetse infested areas, it is proposed that priority attention for integrated large-scale control and development programmes be given to:

- the Kagera River Basin (Burundi, Rwanda, Tanzania and Uganda) where there is considerable demographic pressure and need for better utilization of available land. A number of feasibility studies have been completed for integrated development and a preliminary project for tsetse and trypanosomiasis control has been formulated, with FAO technical assistance, and the preparatory phase implemented;
- the countries covered by the Sub-regional Development Support Unit in West Africa, with particular reference to the Onchocerciasis Control Programme areas;
- the common fly-belt in parts of Zambia, Zimbabwe, Malawi and Mozambique, particularly in respect of training for manpower requirements; and
- the common fly-belts along the boundaries between Kenya, Uganda and Tanzania in East Africa and the Niger River Basin in the west.

7. Preparatory Assistance Missions

Preparatory assistance missions will be continued as recommended by the Commission on African Animal Trypanosomiasis. Efforts will be made to carry out more detailed feasibility studies as well as an economic analysis of project proposals and to focus on specific areas scheduled for tsetse control rather than broad national issues.



## VII. PUBLICATIONS AND ABSTRACTS

### A. Publications from the Entomology Unit and the Insect and Pest Control Section, 1989

Bruzzzone, N.D., Economopoulos, A.P. and Hua-song Wang.

Mass-rearing Ceratitis capitata: reuse of the finisher larval diet, Entomol. Exp. Appl. (in press).

Busch-Petersen, E. and Kafu, A. Stability of two mass-rearing genetic sexing strains of the Mediterranean fruit fly, Ceratitis capitata (Wiedemann) (Diptera: Tephritidae), based on pupal colour dimorphisms, Environ. Entomol., 18 (1989) 315-322.

Busch-Petersen, E. and Kafu, A. Assessment of quality parameters during mass-rearing of a genetic sexing strain of the Mediterranean fruit fly, based on a pupal colour dimorphism, Entomol. Exp. Appl. 51 (1989) 241-248.

Busch-Petersen, E. Genetic sex separation in sterile insect technique pest management programmes, with special reference to the medfly, Ceratitis capitata (Wied.), Fruit Flies of Economic Importance (Proc. CEC/IOBC Int. Symp., Rome, Italy, 7 - 10 April 1987) (in press).

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.

Busch-Petersen, E. Temperature-sensitive lethal factors and puparial colour sex-separation mechanisms in Ceratitis capitata (Wied.). In: Genetics and genetic sexing of the medfly, Ceratitis capitata (Wied.): A publication of the Co-ordinated Research Programme on the Development of Sexing Mechanisms in Fruit Flies through Manipulation of Radiation-induced Conditional Lethals and Other Genetic Measures, IAEA, Vienna (in press).

Busch-Petersen, E. and Baumgartner, H. Simulation of instability in genetic sexing strains: Effects of male recombination in association with a range of genetic and biological parameters (submitted).

Butt, B.A. The future of plant protection, Proceedings of the Symposium on "Alternative Systems in Plant Protection", Cesena, Italy, 3 June 1989, Proceedings of AGRO-BIO-FRUT (in press).

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. Hooper (eds.)): 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, Final Research Co-ordination Meeting on Genetic Sexing of the Mediterranean Fruit Fly (Proc. Meeting, Colymbari, Greece, September 1988) (in press).

- Economopoulos, A.P. Progress in the sterile insect technique against fruit flies, Pesticides and Alternatives (Proc. Int. Symp., Colymbari, Crete, 4 - 8 September 1989, J. Casida (ed.) Elsevier, Amsterdam) (in press).
- 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, Regulation of Insect Reproduction IV (Proc. Symp., Zinkovy, 1987), Academia Publishing House, Czechoslovak Academy of Sciences, Praha (1989) 193-195.
- Economopoulos, A.P. and Judt, S. Artificial rearing of the Mediterranean fruit fly (Diptera: Tephritidae): Size of oviposition holes, J. Econ. Entomol., (1989) 82(2): 668-674.
- Fischer-Colbrie, P. and Busch-Petersen, E. Pest status: Temperate Europe and West Asia. In: World Crop Pests, Volume 3A, Fruit Flies - Biology, Natural Enemies and Control (A.S. Robinson and G.H.S. Hooper (eds.)), Elsevier Science Publishers, Amsterdam (in press).
- Galun, R. Phagostimulation of the Mediterranean fruit fly, Ceratitis capitata by ribonucleotides and related compounds, Entomol. Exp. Appl. 50 (1989) 133-139.
- Galun, R. and Kabayo, J.P. Gorging response of Glossina palpalis palpalis to ATP analogues, Physiol. Entomol., 13 (1989) 419-423.
- Gingrich, R.E. Status and potential of Bacillus thuringiensis for control of higher Diptera, Cyclorrhapha, Pesticides and Alternatives (Proc. Int. Symp., Colymbari, Crete, 4 - 8 September 1989, J. Casida (ed.), Elsevier, Amsterdam) (in press).
- Kapatsa, G.M., Kabayo, J.P., Spates, G.E., Sheffield, C.L. and Deloach, J.R. The nature of erythrocyte stroma lipid components required for normal reproduction in Stomoxys calcitrans (Diptera: Muscidae), J. Insect Physiol. 35 (1989) 205-208.
- Kerremans, Ph. and Busch-Petersen, E. Polytene chromosome analysis in relation to genetic sex-separation in the Mediterranean fruit fly, Ceratitis capitata (Wied.). In: Genetics and genetic sexing of the medfly, Ceratitis capitata (Wied.): A publication of the Co-ordinated Research Programme on the Development of Sexing Mechanisms in Fruit Flies through Manipulation of Radiation-induced Conditional Lethals and Other Genetic Measures, IAEA, Vienna (in press).
- Kerremans, Ph. and Busch-Petersen, E. Chromosomal and molecular analysis of the medfly, Ceratitis capitata, in relation to genetic sex-separation mechanisms to improve the sterile insect technique, Mededelingen Faculteit Landbouwwetenschappen, Rijksuniversiteit, Ghent, Belgium (1989) 759-766.
- Lindquist, D.A., Butt, B., Feldmann, U., Gingrich, R.E. and Economopoulos, A.P. Current status and future prospects for



genetic methods of insect control or eradication, Pesticides and Alternatives (Proc. Int. Symp., Colymbari, Crete, 1989, J. Casida (ed.), Elsevier, Amsterdam) (in press).

Makumyaviri, A.M. and Van der Vloedt, A.M.V. Trypanosoma congolense: Infection rates in Glossina palpalis palpalis from a laboratory-bred colony, Revue Méd. Vet. 140 (1989) 221-224.

Rahman, R., Rigney, C. and Busch-Petersen, E. Effects of radiation on the larvae of medfly, Ceratitis capitata (Wied). In: Regulation of Insect Reproduction IV (Proc. Int. Conf., Zinkovsky, Czechoslovakia, 1987), (1989) 361-364.

Rahman, R., Rigney, C. and Busch-Petersen, E. Irradiation as a quarantine treatment against Ceratitis capitata larvae following irradiation, J. Econ. Entomol. (submitted).

Stiles, J.K., Molyneux, D.H., Wallbanks, K.R. and Van der Vloedt, A.M.V. Effects of gamma irradiation on the midgut ultrastructure of Glossina palpalis sub-species, Radiation Research 118 (1989) 353-363.

#### B. Publications of Interest

Anisimov, A.I., Lazurkina, N.V. and Shvedov, A.N. Influence of radiation-induced genetic damage on the suppressive effect of inherited sterility in the codling moth (Lepidoptera: Tortricidae). Ann. Entomol. Soc. Am. 82 (1989) 769-777.



C. Abstracts Received

A.A. AL-TAWKEL, M.S.M. AHMED, H.J. NASSER, M.A. SHANKIT

INHERITED STERILITY AMONG Ephestia cautella LABORATORY POPULATION EXPOSED TO GAMMA RADIATION

Plant Protection Department  
P.O. Box 765  
Baghdad  
Iraq

Second Scientific Conference of  
I.A.E.C., Baghdad, Iraq (Nov.  
21-23, 1989).

ABSTRACT

Knipling [1] was the first to recognise the potential of inherited sterility over sterile insect technique. In his models comparing the two approaches he estimated that to achieve the same degree of suppression in a native population over three generations four times as many sterile insects would have to be released as compared with insects receiving a partially sterilizing dose. In addition, this technique offers significant advantages over classical sterile release methods through reducing the radiation dosage which minimizes somatic damage and increases the competitiveness of released individuals. Therefore, the present study designed to investigate the inherited sterility induced in the Ephestia cautella males of two strains (A & B) irradiated as 5-6 d old pupae.

The results show that the average fecundity of mated females & average number of spermatophore per mated female for both strains were not drastically affected, while, significant differences were observed in the percent eggs hatch for both strains. Furthermore, sex ratio of  $F_1$  progeny favored males and the deviation from the expected 1:1 ratios increased with dose. In addition, the investigation showed that  $F_1$  offspring were completely sterile if  $P_1$  male parent irradiated with 0.25 kGy, while, low fertility were observed if  $P_1$  male parent irradiated with 0.15 kGy & the effect was evidence in Baghdad (B) strain in comparison with American (A) strain where the reproductive potential for all lines that produced offspring were studied.

REFERENCES

- [1] Knipling, E.T. "The Basic Principle of Insect Population Suppression & Management". U.S. Dept. Agric. Handbook No. 512 Washington D.C. (1979).

AYAD A. AL-TAMEEL; MOHAMMED S.H. AHMED;  
SARAB S. Kadhumi; ASAAD A. HAMEED;  
MAJDOLIN J. NASSER.

Plant Protection Department  
P.O. Box 765  
Baghdad  
Iraq

INHERITED STERILITY IN DIFFERENT  
STRAINS OF Ephestia cautella  
(LEPIDOPTERA: PYRALIDAE)

Insect Science & Its Application  
(Accepted for publication).

SUMMARY

Partial sterility induced by gamma irradiation of Ephestia cautella adult males was studied in five laboratory strains A, B, C, D and E) which exhibit conspicuous genetic variation in the adult forewing pigmentation. Four of these strains had been reared in the laboratory for more than 80 generations, while the fifth strain has been reared for only 10 generations. When males irradiated with 0.2 kGy were crossed with untreated females, the percent egg hatch was reduced significantly as compared to the unirradiated control crosses. Strain C showed the highest reduction in the percent egg hatch followed by a gradual decrease in radiation sensitivity in strains A, E, D and B, respectively. Fecundity and mating frequency appeared not to be affected but the sex ratios were clearly distorted (about 2 males to 1 females) in all strains  $F_1$  progeny of all strains were either sterile when mated together (percent egg hatch = 0.0%), but semi sterile when  $F_1$  males were mated to normal females (percent egg hatch = 0.0-3.95%). Low fertility was observed when  $F_1$  females were mated with normal males (percent egg hatch = 1.30-15.04%). The cytogenetical investigations showed spermatogenesis to proceed normally in the  $F_1$  males, whose fathers had been irradiated (0.2 kGy). However, the primary spermatocyte cells carried multiple chromosomal translocations which were the main cause of the sterility in the  $F_1$  males.

M. A. SHAWKIT ; A. A. AL-TAWHEEL,  
M.J. NASSER ; M.S.H. ARMED

Plant Protection Department  
P.O. Box 765  
Baghdad  
Iraq

EFFECTS OF GAMMA RADIATION ON THE MATING ABILITY  
OF Ephesia cautella (Lepidoptera: Pyralidae).

Second Scientific Conference of  
I.A.E.C., Baghdad, Iraq (Nov.  
21-23, 1989).

#### ABSTRACT

The sterile insect technique appears very promising for controlling Lepidopteran pests [1], but requires high doses of gamma radiation to induce sterility or partial sterility. Such doses might inhibit sperm transfer & reduce mating competitiveness [2]. Therefore, the goal of this investigation designed to study the effect of two doses of gamma radiation on the ability of Ephesia cautella males irradiated as pupae 5-6 day old, to mate and transfer sperms.

The results show that Ephesia cautella males of different ages (24, 48 & 72h) were able to mate and transfer sperms if paired with virgin females singly or in groups, furthermore, within each age group the irradiated dose is not drastically affect the mating ability in spite of significant differences ( $P > 0.05$ ) were observed in the mean number of spermatophore per female. However, males of different ages were able to mate more than once if irradiated as pupae with 0.2 or 0.35 kGy.

Changes in the male fertility was taken as a measure of the success of these males to mate and transfer sperms & a little increase in male fertility occurred. This slightly regained fertility could be support the attitude of the differential intrinsic radiosensitivity of sperms.

#### REFERENCES

- [1] LaChance, L.E., In the Sterile-Insect Technique and Its Field Applications, IAEA, Vienna (1974).
- [2] LaChance, L.E.; Bell, R.A.; Richard, R.D., Environ. Ent. 2: 653-658 (1973) .



A.A.AL-TAWEEZ, M.S.H. AHMED;

Plant Protection Department  
P.O. Box 765  
Baghdad  
Iraq

MUTANTS INDUCTION IN Ephestia cautella AND  
ITS IMPORTANCE FOR GENETIC CONTROL

Second Scientific Conference of  
I.A.E.C., Baghdad, Iraq (Nov.  
21-23, 1989).

Non-chemical methods to control the major stored dates pest

Ephestia cautella were developed [1-3]. One of these genetical methods

depended on using inherited sterility through sterile insect release

technique and would be more beneficial when the female moths can be

eliminated systematically from the production line in a mass rearing

facility. To achieve such system we need to establish and maintain

genetically marked strains with good biological parameters. Therefore,

the theme of our study concentrated on the isolation of genetically

marked strains of E. cautella, such strain will be used in the induc-

tion and maintenance of lethal mutants with the idea that such muta-

tions could be useful in the development of autosexing strains or for

control purposes.

We succeeded in isolation and maintenance of two mutants with

good biological characteristics. Both of them are orange - eyed, but

one inherited as an autosomal recessive mutant and the other inherited

as a sex-linked recessive mutant. No significant differences ( $P < 0.05$ )

were observed in the mean number of eggs per females, mean number of

spermatophore per mated female and in the longevity of the adults

(males and females) if these mutants were compared with the wild types

strain (B). While, significant differences ( $P > 0.05$ ) were observed in

the percent eggs hatch of the sex-linked recessive mutant in comparison

with wild type strain (B) and autosomal recessive mutant. This could

be considered as a result of isolation of this sex-linked recessive

mutant as pure strain recently through many inevitable inbred crosses.

REFERENCES

- [1] AHMED, M.S.H; ET AL, J. Stored Prod. Res 20 (1984) 151.
- [2] AHMED, M.S.H., Modern Insect Control: Nuclear Techniques and  
Biotechnology. IAEA. 102-103 (1988).
- [3] AL-TAWEEZ, A.A., XVI Inter. Cong. of Genetics, Toronto/Canada,  
Abstract. (1988).

A.A. HAMEED, M.S.H. AHMED, A.A. AL-TAWEEZ

Plant Protection Department  
P.O. Box 765  
Baghdad  
Iraq

THE PHENOMENON OF CYTOPLASMIC INCOMPATIBILITY IN  
*Ephestia cautella* POPULATIONS IN IRAQ AND ITS  
POSSIBLE UTILIZATION IN GENETIC CONTROL.

Second Scientific Conference of  
I.A.E.C., Baghdad, Iraq (Nov.  
21-23, 1989).

#### ABSTRACT

The importance of the unidirectional cytoplasmic incompatibility in *Ephestia cautella* (Walker) in American (A) and Baghdad (B) strains was recognized [1,2]. Consequently this phenomenon was studied either to replace (B) strain by (A) strain or to suppress it by the reproductively incompatible (A) males [3,4]. Therefore, the goal of this investigation is to use the cytoplasmic incompatibility as a general method for controlling *E. cautella*.

The results show that, the release of a ratio of 40:1:1 (A males : B males: B females) + the release of 100 incompatible (A) males (IMs) every 2-3 d starting with the adult emergence in a simulated date store, the number of different live *E. cautella* (B strain) developmental stages infesting the dates was significantly reduced due to the high number of repeatedly released IMs. This was the most successful suppression effect so far caused by the cytoplasmic incompatibility phenomenon in one direction. The suppression effect lasted for 190 d thanks to the augmentation of the number of IMs initially released followed by the subsequent repeated releases where approximately 5600 IMs were used and thus keeping the infestation rate of the dates down for quite a long storage interval.

On testing the IMs of a new (D) strain of *Ephestia cautella*, the competitiveness of which against (B) males for (B) females proved to be inferior, a phenomenon that might be due to the inbreeding depression suffered by (D) strain on being reared for 15 years in the laboratory at a very limited numbers. However such genetic "weakness" can be improved by hybridization with other appropriate strains.

#### REFERENCES

- [1] Ahmed, M.S.H., I.A. Alhassany, S.B. Lamooza & N.A. Ouda (1974): Crossing experiments with two *Ephestia cautella* strains (unpublished). Cited by Brower, J. H. in potential for Genetic Control of stored-product Insect population. Proc. 1st. Intern. Working Conf. on stored - prod. Entomology. Savannah, Ga: 167-180 .
- [2] Ahmed, M.S.H., I.A. Alhassany, S.B. Lamooza, N.A. Ouda & A.A. Al-Taweel (1975a): Further hybridization experiments with different strains of *Ephestia cautella* (Walker). Proc. 1st Sci. Conf, Iraq Atomic Energy Commission, Baghdad: 108-111 .
- [3] Ahmed, M.S.H., A.A. Hameed, A.A. Kadhum (1985): Replacement of *Ephestia cautella* laboratory population of Baghdad crossing type by an imported strain, Abstract, 8th Sci. Convention, Iraqi Biological Soc., Erbil: 75 .
- [4] Brower, J.H. (1979): Suppression of laboratory populations of *Ephestia cautella* (Walker) (Lepidoptera: Pyralidae) by release of males with cytoplasmic incompatibility. J. stored Prod. Res. 15: 1-4 .



M.S.H. AHMED; A.A. AL-TAWEL;  
A.A. HAMEED

Plant Protection Department  
P.O. Box 765  
Baghdad  
Iraq

DISINFESTATION OF PACKED DATES BY GAMMA RADIATION  
USING A SUITABLE FOOD IRRADIATION FACILITY.

Second Scientific Conference of  
I.A.E.C., Baghdad, Iraq, (Nov.  
21-23, 1989).

ABSTRACT\*

In the previous studies [1], the treatment with a disinfesting gamma radiation dose (0.35 kGy) proved to be an adequate method of disinfestation of polyethylene-wrapped small date packages (carton lunch boxes: CBs), causing a complete inhibition of adult emergence in both *Ephestia cautella* & *Oryzaephilus surinamensis*. In this case, irradiation was carried out in Gamma cell-220 by placing every two CBs at a time in the irradiation chamber. The dose rate of the  $^{60}\text{Co}$  source was approximately 13.87 kGy h<sup>-1</sup> [2]. However, for almost semi-commercial trials, the recently upgraded irradiation facility type gammabeam-650 [3,4] has been used. This facility with its six round turntables made it possible to irradiate a big standard carton box (SCB) holding 40 CBs, by placing it in a limited position on one of the turntables. Therefore, the main objectives of the present study are as follows: (1) To measure the dose rate of gamma radiation emitted from gammabeam-650 using 15 Fricke dosimeters approximately equally distributed among 40 CBs placed in one SCB. (2) To disinfest SCB that contains 40 polyethylene wrapped CBs, which were deliberately infested with insect species, with appropriate "low" gamma radiation. (3) To study the effect of the treatment on the development of live insects found in CBs one day after irradiation, and to measure the effect of treatment on the longevity of last instar larvae.

The results showed that the practical treatment with irradiation for date disinfestation purposes, in gammabeam-650 irradiator,

is to use a dose of  $0.44 \pm 0.05$  kGy with a rotating turntable. This dose required that the exposure time should be for 29.57 min., where maximum & minimum limit were 0.51 & 0.35 kGy, respectively. Consequently, the dose uniformity ratio was 1.47, which perfectly lies within the accepted range provided that the limits, but not the overall average dose be considered. As a result of irradiating the packed date with above-mentioned dose, no live insects could be detected after storing for a period of 185 days. The live insects that were detected after one day posttreatment storage proved to be genetically sterile and died within a short period of time.

REFERENCES

- [1]. Ahmed, M.S.H.; A.A. AL-Tawel; A.A. Hameed & H. Auda (1988) "Combination of gamma radiation & elevated temperature as a quarantine treatment against two principal stored date insect species". Modern Insect Control: Nuclear Techniques and Biotechnology (Proc. Int. Symp. Vienna, 1987). IAEA, Vienna, pp. 357-367.
- [2]. ACEL. (1984) Certificate of Measurement, Gamma Cell-220 Source No. Gs-346, Quality Control, Commercial Products, Ottawa, Canada.
- [3]. ABCL. (1985) Certificate of Measurement, Gammabeam-650, No. 16, Quality Control, Commercial products, Ottawa, Canada.
- [4]. Ahmed, M.S.H.; A.A. Hameed & A.A. Kadhum (1986) Disinfestation of Commercially packed dates by combination treatment, Acta Aliment. 15:221-226.

\* This work is part of IAEA-Iraq Research Agreement No. 5159/CP.



R.M.SHUKLA\*, BALWINDER SINGH,\*\*

A.K. GARG AND G.R. SETHI

Nuclear Research Laboratory,  
Indian Agricultural Research  
Institute, New Delhi-110012  
(INDIA)

Penetration of  $^{14}\text{C}$ -labelled Methyl  
Parathion in Tribolium castaneum  
(Herbst)

J.Nuclear Agric. Biol., 18 (1989)

#### ABSTRACT

Studies on the rate of penetration of radioactive methyl parathion ( $^{14}\text{C}$ -ring labelled) were carried, under laboratory conditions, by applying 5 ng toxicant in 1  $\mu\text{l}$  acetone/insect on the thoracic sternum of rust red flour beetle, Tribolium castaneum (Herbst). Results revealed that the penetration of this toxicant was non-linear with two distinct phases. The earlier phase was faster and lasted upto 60 min from the time of application ( half-life:  $14 \pm 3$  min ) followed by a slower phase from 60 min to 24 hr with longer half-life ( $909 \pm 313$  min). It was further observed that at the end of the faster phase i.e., 1 hr after the treatment, nearly 68 per cent of the applied insecticide was absorbed by the beetle whereas the maximum quantity of the toxicant absorbed by the insect at the end of the experiment (24 hr after treatment) was 89 per cent.

\*\*\*\*\*

\* Central Insecticide Laboratory, Directorate of Plant Protection, Quarantine & Storage, NH IV, Faridabad- 121001

\*\* Department of Entomology, Punjab Agricultural University, Ludhiana- 141004

A.J. TAMHANKAR AND G.W. RAHALKAR  
Pest Control Section  
Bio-Chemical Group  
Bhabha Atomic Research Centre  
Trombay, Bombay-400085,  
India.

An artificial diet for rearing the spotted  
bollworm of Cotton, Earias vittella  
(Lepidoptera: Noctuidae)

More than 100 diets-formulated by using different permutations and combinations of easily available dietary ingredients - were evaluated for their suitability to support growth and development of the larvae of Earias vittella. Growth Index and Rearing Index values were calculated for the various diets. Based on the computations for 3 generations, a diet consisting of maize semolina (5.7%), wheat bran (4.7%), soy powder (2.6%), yeast (1.5%), Wesson's salt mixture (0.9%), agar (1.8%), water (80.5%), with additions of preservatives was found suitable for rearing of E. vittella larvae. The females developed from the diet laid normal complement of eggs (mean-263.6) and the egg viability was also normal (mean-83.3%). Adult longevity (mean- 17.3 days) was also comparable to the adults obtained from natural food source.

Joint FAO/IAEA Division of Nuclear Techniques  
in Food and Agriculture  
International Atomic Energy Agency  
Vienna, Austria  
Printed by the IAEA in Austria  
April 1980

#### 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.

Insect and Pest Control Newsletter  
Joint FAO/IAEA Division of Nuclear Techniques  
in Food and Agriculture  
International Atomic Energy Agency  
Wagramerstrasse 5, P.O. Box 100  
A-1400 Vienna, Austria

Printed by the IAEA in Austria  
April 1990

90-0176