



# **JOINT FAO/IAEA DIVISION**

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



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

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**WAGRAMERSTRASSE 5, P.O. BOX 100, A-1400 VIENNA, AUSTRIA, TELEPHONE: (222) 2360-0 TELEX: 1-12645, CABLE: INATOM VIENNA**

**INSECT & PEST CONTROL SECTION**

**NEWSLETTER**

**AND**

**INFORMATION CIRCULAR**

**ON**

**RADIATION TECHNIQUES AND THEIR**

**APPLICATION TO INSECT PESTS**

**No. 39**

**July 1987**

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**TSETSE TRAINING COURSE : 1988**

**A 4-WEEK REGIONAL TRAINING COURSE ON INTEGRATED CONTROL OF TSETSE  
WITH EMPHASIS ON THE STERILE INSECT TECHNIQUE (SIT) IS PLANNED FOR  
MAY 1988.**

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

**VENUE: KADUNA (NIGERIA), TSETSE TRAINING SCHOOL.**

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July 1987

Dear Colleague,

Enclosed please find the 39th issue of the Information Circular on Radiation Techniques and their Application to Insect Pests. Please note also that we are presently compiling material for the 40th issue and would appreciate receiving contributions from you and/or your associates by 1 November 1987.

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

We wish to emphasize that the Circular contains items for your information only and that your contributions do not constitute quotable journal publications.

For your convenience and for printing purposes, we are enclosing with this issue the standard form on which we would appreciate receiving your contribution(s). If you require a supply of these forms, please let us know. Please use a separate form for each item and type your name and address, in capital letters, in the upper left block. The text should be no longer than one side of the standard form and double-spaced.

We look forward to receiving your contributions for the next issue and wish to thank all contributors to the 39th Information Circular and Newsletter.

Yours sincerely,



Evans J. Offori  
Insect & Pest Control Section

Encl.

The first part of the report is a general introduction to the subject of the study. It discusses the importance of the study and the objectives of the research. It also mentions the scope of the study and the limitations of the research.

The second part of the report is a detailed description of the methodology used in the study. It discusses the data collection methods, the sample size, and the statistical analysis techniques used. It also mentions the ethical considerations of the study.

The third part of the report is a discussion of the results of the study. It discusses the findings of the research and the implications of the results. It also mentions the limitations of the study and the need for further research.

The fourth part of the report is a conclusion and a summary of the findings. It discusses the overall results of the study and the implications of the findings. It also mentions the limitations of the study and the need for further research.

The fifth part of the report is a list of references. It lists the sources of information used in the study, including books, articles, and other documents.

The sixth part of the report is an appendix. It contains additional information related to the study, including data tables, figures, and other documents.

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I. INTRODUCTION

Publication Policy

The policy of the Joint FAO/IAEA Division in publishing the Information Circular is to emphasize the results of recent or on-going research on the use of radiation and radioisotopes in entomology. Therefore, emphasis is placed on unpublished data. For several reasons, we are unable to edit submitted contributions. These are reproduced by a photographic process, and therefore reflect faithfully, the author's care in preparing the material.

While emphasis is on unpublished data, we include, whenever possible, summaries of recently published papers. In that case, the material submitted should be no more than one page when typed double-spaced. (A form for submission of contributions is included in each distributed copy of the Information Circular; more can be provided on request).

The Newsletter is intended as a medium for informing our readers of "what is going on" and for providing an indication of "future plans". As far as possible, results or summaries of major activities during the preceding 6 months (e.g. field programmes, meetings, etc.) will be provided.

PLEASE NOTE

The summaries of unpublished work often represent preliminary reports of investigations in progress and, therefore, such findings are subject to possible revision at a later date. The abstracts in this Information Circular should not be published or referred to in articles for publication without first obtaining permission from the authors.

Introduction

Background

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Conclusion

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II. GENERAL INFORMATION

IN PROGRESS

## II. GENERAL INFORMATION

### A. Professional Staff - Insect & Pest Control Section

#### Headquarters

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

#### Seibersdorf Laboratory

R.E. Gingrich	Head, Entomology Unit; <u>B.t.</u> Investigations
A. Van der Vloedt	Tsetse Fly Investigations : Mass-Rearing
A. Economopoulos	Medfly Investigations : Rearing
J. Kabayo	Tsetse Investigations : Artificial Diets
E. Busch-Petersen	Genetic Sexing of Medflies
D. Bruzzone (FAO Associate Expert till 30 June 1987)	Medfly Rearing (Diets)
T. El-Abbassi (till 1 June 1987)	Medfly Investigations : <u>B.t.</u> Investigations

#### BICOT

M. Oladunmade	Project Leader and Officer-in-Charge, Field Operations
U. Feldmann (till 31 May 1987)	Technical Adviser (IAEA) and Team Leader, Laboratory Operations

### B. Entomology Laboratory

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

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

The main thrust of research in Seibersdorf involves development of the Sterile Insect Technique (SIT) for pest control or eradication. Because of the dependence of this technique on efficient production of the target insect, much of the research at the laboratory involves development and improvement of mass-rearing techniques. Other major areas of activity include (1) development of methods of radiation sterilization for producing quality insects (in terms of sexual competitiveness and longevity); (2) investigation of handling techniques for large numbers of insects; and (3) supplying insects for field programmes.

In general, research is undertaken to:

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

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

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

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

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

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

C. Programmes of the Insect & Pest Control Section

1. Medfly

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

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

2. Tsetse Fly

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

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

D. Co-ordinated Research Programmes

Currently the Section has responsibility for the following four programmes:

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

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

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

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

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

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

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

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

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

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

F. Experts and Consultants : January - June 1987

Name	Nationality	Location of Assignment	Dates and Task Performed
W. Takken	Netherlands	Uganda	12 - 23 January Review of tsetse eradication project on Buvuma Island.
L.C. Madubunyi	Nigeria	Ghana )	11 April - 16 May
K.D.S. Kathuria	India	Ghana )	Review of project
		)	"Eradication of Riverine Tsetse
		)	Using the Sterile Insect Technique".
A. Robinson	Netherlands	Vienna)	1 - 5 June
Y. Rössler	Israel	Vienna)	Review of medfly genetic sexing research in Seibersdorf.
		)	
		)	

G. Trainees in Entomology : January - June 1987

(a) Tsetse Group

Drabile Drani, C.F.	Uganda	87-01-21 to 87-05-20
Nsenga Chatar, P.C.	Uganda	87-01-21 to 87-05-20

(b) Medfly Group

Ahmed, E.	Egypt	86-01-22 to 86-08-31 & 86-11-01 to 87-01-21
El-Badan, N.	Egypt	86-01-22 to 86-08-31 & 86-11-01 to 87-01-21
Kafu, A.A.	Libya	86-10-09 to 87-10-08
Wang, H.	China	86-11-15 to 87-08-10
Al-Taweel, A.A.R.	Iraq	87-01-13 to 87-07-12
Khan, N.	Pakistan	87-01-21 to 87-06-22
Chiravathanapong (SV)	Thailand	87-01-26 to 87-01-30
Rahman, R.	Bangladesh	87-01-26 to 88-01-26
Papadopoulos, V.	Greece	87-05-02 to 87-06-12
Blak, M.	Libya	87-06-01 to 87-06-30
El-Ayan, S.	Libya	87-06-01 to 87-06-30
El-Zaidy, I.	Libya	87-09-01 to 87-09-30
Marnu, W.K. (cost-free)	Ghana	86-08-04 to 87-04-30
Gaggl, K. (cost-free)	Austria	87-05-20 to 88-05-19

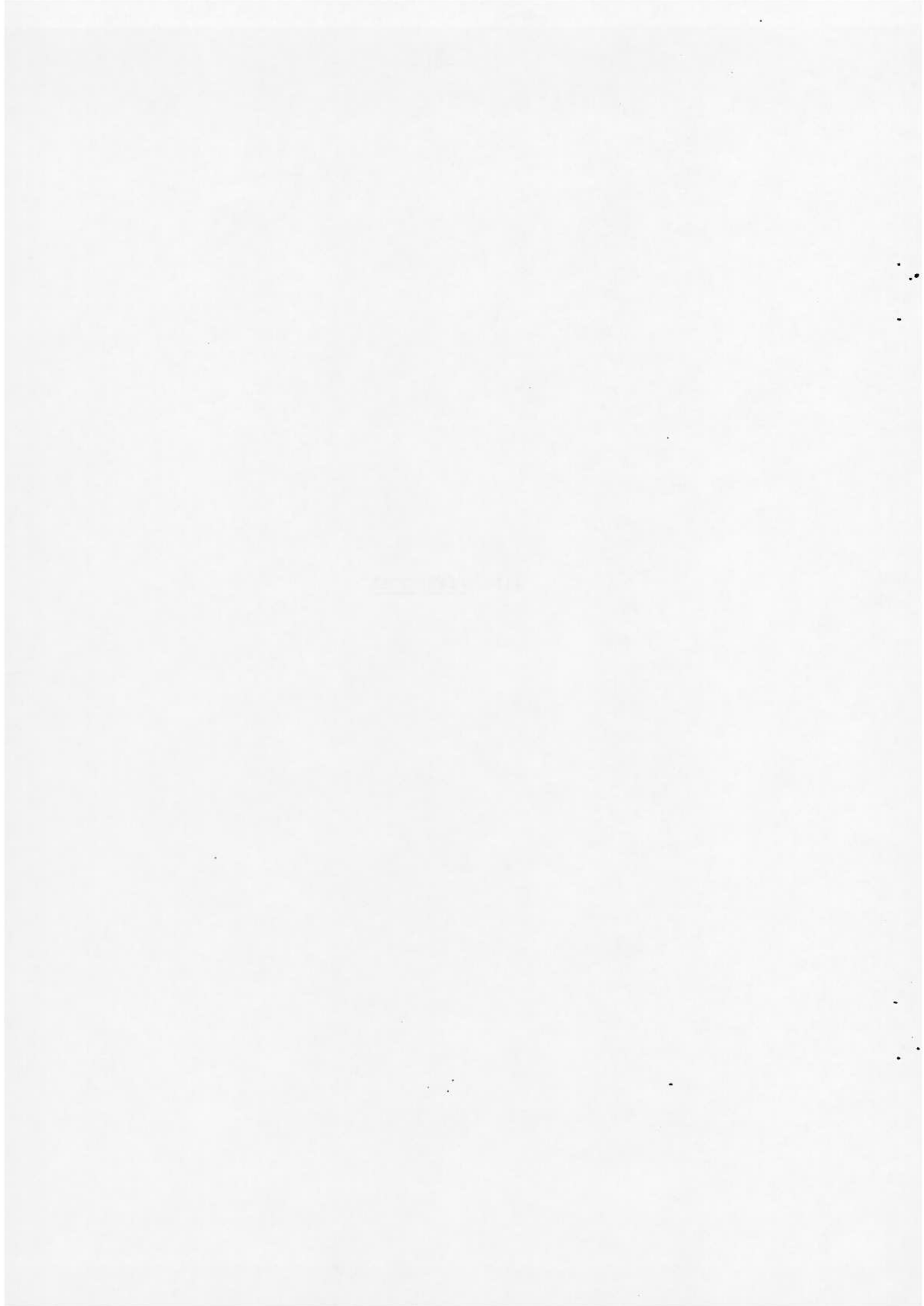
# 1. General Information

Name		Address		Phone	
Mr. J. H. Smith		123 Main St.		456-7890	
Mrs. A. B. Jones		456 Elm St.		789-0123	
Mr. C. D. Brown		789 Oak St.		012-3456	
Mrs. E. F. Green		012 Pine St.		345-6789	
Mr. G. H. White		345 Cedar St.		678-9012	
Mrs. I. J. Black		678 Birch St.		901-2345	
Mr. K. L. Gray		901 Walnut St.		234-5678	
Mrs. M. N. Hall		234 Spruce St.		567-8901	
Mr. O. P. Young		567 Ash St.		890-1234	
Mrs. Q. R. King		890 Hickory St.		123-4567	

# 2. Particulars of the Case

Date		Time		Place	
1912-12-15		10:00 AM		New York	
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1912-12-23		6:00 PM		New York	
1912-12-24		7:00 PM		New York	
1912-12-25		8:00 PM		New York	
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III. NEWSLETTER



### III. NEWSLETTER

#### A. Special Features and Comments

##### BICOT : A Successful Tsetse Eradication Project

by Evans D. Offori  
Technical Officer, Insect and Pest Control Section

The project "Biological Control of Tsetse by the Sterile Insect Technique (BICOT)" has come to a successful conclusion. At their 15th meeting on 13 May 1987, members of the BICOT Project Advisory Committee (PAC) heard detailed reports on project activities during the preceding 6 months. Data were presented on sterile male releases and trap catches of Glossina palpalis palpalis in the remaining zone of the project area. The committee concluded that the objective of eradicating the target species had been achieved.

The story of BICOT began in June 1977 when an agreement was signed between the International Atomic Energy Agency and the Federal Government of Nigeria "concerning co-operation on the development of the sterile male technique for control or eradication of the tsetse fly". The purpose of the project was to investigate the advantages, efficacy and economics of the sterile insect technique for controlling or eradicating riverine species of tsetse on a large scale under characteristic conditions. The immediate objective was to eradicate Glossina palpalis palpalis from a semi-savannah area of north-central Nigeria using the Sterile Insect Technique (SIT). The project also aimed to, eventually, develop appropriate procedures in order to incorporate the SIT into the regular tsetse control operations in Nigeria and other affected African countries.

The SIT is a biological control methodology, involving the rearing of large numbers of target species, sexual sterilization of mass-reared males by gamma radiation, and release of the sterile insects into the natural population. Females mating with sterile males fail to produce progeny. The procedure is therefore practically a birth control operation. Repeated release of sterile males thus causes the natural population to disappear within a predictable period of time.

BICOT became operational in 1979 when essential facilities, including an insectary and office buildings became available at the project headquarters in Vom. With the assignment of Nigerian staff, drawn from the Federal Department of Pest Control Services and the Nigerian Institute for Trypanosomiasis Research, and the recruitment of an expert by the IAEA, the rearing of the target species was initiated and ecological studies begun, in the same year, in potentially suitable areas for field release operations. The Federal Republic of Germany, Belgium, Sweden, the U.K. and Italy provided financial support through contributions to the IAEA.

### Laboratory Activities

Two insectaries, with a combined capacity for 100,000 flies, were constructed in 1979. By December 1980 two separate tsetse colonies were established, one maintained in vivo (fed on guinea-pigs) and the other in vitro, whereby flies ingested blood through a silicone membrane. A 50:50 mixture of bovine and pig blood was used for feeding flies in vitro.

Initially, the in vitro colony was maintained using freeze-dried blood prepared and packaged in the IAEA tsetse laboratory in Seibersdorf near Vienna and air-freighted to Nigeria. This was done because it was presumed that locally collected fresh blood contained trypanosomes that would infect colony flies. When it was found that irradiation with 0.5 kGy (50 Krad) gamma radiation, followed by slow freeze-thawing of blood inactivated the trypanosomes, it became possible to collect and utilize local blood routinely for fly feeding. From mid-February 1984 locally collected fresh heparinized bovine blood replaced imported blood from Vienna. With improved local conditions, including installation of a commercial pig slaughterhouse in Jos, a local source of pig blood also became available in June 1986.

Immediately upon collection, and before storage at  $-20^{\circ}\text{C}$  in a deep freezer, all freshly collected blood was treated with 0.50 kGy gamma radiation. Prior to feeding to flies, the 50:50 mixture of (thawed) bovine and pig blood was treated with 0.50 - 1.0 kGy gamma radiation to reduce bacterial contamination in the blood. These treatments did not adversely affect blood quality.

At the peak of production in 1986, the tsetse colony contained 180,000 female Glossina palpalis palpalis, over 70% of which were fed in vitro. On the average 10,000 to 12,000 surplus males were available for sterilization and release each week.

### Field Operations

The BICOT field project area is located approximately 200 km south of Vom and lies within the Lafia Agricultural Development Project area.

The field release area comprises  $1,500 \text{ km}^2$ . Beginning in 1979 and following demarcation and initial survey of the project area, biconical traps were used to sample fly populations in pre-determined grids. In later years attention was concentrated on identifying "hot spots" within the riverine forests on the tributaries of two major river systems (Akuni and Feferuwa) draining the project area. Tsetse population suppression activities were initiated in 1982/1983. Biconical traps and insecticide-impregnated (blue) screens were used extensively to reduce populations of G. p. palpalis by about 90% in the forest

patches as well as on the peripheries of the project area. In some cases reduction in fly population was achieved within 6 weeks of placing the screens and traps. Bioassay tests revealed that the insecticide used, Deltamethrin (used as 0.5% solution) remained effective on the screens for more than 3 months, even under rainy conditions. Trap monitoring at monthly intervals showed that screens were effective in reducing fly populations by between 85% and 95% within 8 weeks. Continued use of screens, however, failed to cause any further reduction in fly populations.

Male flies were sterilized by irradiating young adults with 120 Gy (12 Krad) gamma radiation in air. Irradiated males were fed two or three times in the laboratory before being transported by road to the release site.

Release of sterile males was done weekly. At a ratio of 10 sterile to one wild male, eradication of G. palpalis palpalis was achieved in mid-1987 as confirmed by the results of several months of trapping and monitoring. Altogether a total of 1.5 million sterile males were released.

#### Conclusion

Although the entire project area has been freed of the target tsetse species, release of sterile males will be continued through the rainy season, i.e. until October 1987 in order to consolidate what has been achieved. The borders of the project area are secured against fly re-invasion by placement of insecticide-impregnated screens to act as barriers in the boundary zones.

A major contribution to the success of BICOT was made by the Seibersdorf Laboratory of the FAO/IAEA Tsetse Programme. Not only was the Seibersdorf Laboratory involved in research and development activities to improve mass-rearing and quality control of mass-produced flies, but it also maintained a back-up colony of approximately 75,000 female G. palpalis palpalis which yielded excess puparia to support the BICOT fly colony as required. Other laboratories in Africa and elsewhere contributed through participation in a co-ordinated research programme to develop methodologies for applying the SIT for tsetse eradication or control.

With the successful completion of BICOT, the feasibility of the Sterile Insect Technique for tsetse eradication has again been demonstrated. Among the initial difficulties that faced the project was that of rearing the target species in large enough numbers to yield sufficient surplus males for release. Microbial contamination of blood caused high mortality in the in vitro colony on several occasions; however, the situation was remedied by irradiating the blood with gamma radiation and the

introduction of various quality control procedures. Growth of the in vivo colony was similarly affected because of high mortality in the guinea-pig host due to disease, and, on one occasion, to accidental contamination of guinea-pig food with insecticides. These difficulties notwithstanding, excellent progress was made, and the colony size of 180,000 female Glossina palpalis palpalis in 1986 was the largest ever raised of one species in Africa.

## B. Meetings

### 1. BICOT Project Advisory Committee (PAC)

The 15th PAC meeting held on 13 May 1987 in Vom, marked the successful conclusion of the project. Following discussions of administrative and financial matters, the Project Leader, Technical Adviser and the IAEA visiting expert reviewed BICOT laboratory and field operations covering January to May 1987. Results of trap monitoring following release of sterile males, indicated that the target species, Glossina p. palpalis had been eradicated from the entire project area.

The PAC Chairman congratulated the project staff, the Nigerian Government, the IAEA and donors, and urged the Project Leader and staff to continue efforts to consolidate the positive results achieved.

Future expansion of the project was discussed and the meeting was informed that the Nigerian Government had submitted a request through the UNDP to the IAEA for assistance in implementing BICOT II.

### 2. Consultants' Group on Genetic Sexing Mechanisms in Fruit Flies

A consultants' group was assembled in Vienna (1 - 5 June 1987) to assess progress made since the inception of the co-ordinated programme on medfly genetic sexing in 1981. Specifically, the group was to review and evaluate research undertaken, to date, at the Seibersdorf Laboratory and by individual contractors and agreement holders under the programme. The group was further required to provide guidelines for restructuring the programme when necessary.

#### Research in Progress:

- Medfly genetic sexing research at Seibersdorf involves investigation of temperature sensitive lethals (ts1) and pupal colour sexing.

- In other laboratories, programme participants have focused attention on segregation distortion genes (sd); genetic sexing using Adh (alcohol dehydrogenase) null mutants; assessment of various chemicals for their ability to select for resistance in medflies; quality control genetic studies in laboratory colonized medflies, e.g. effect of colonization on enzyme polymorphisms; and recently, developing genetic engineering techniques to effect medfly transformation.

Recommendations:

The group recommended continuation of current activities for two more years, i.e. till 1989 when a thorough review of the programme should be undertaken with a view to deciding on future direction.

The recently initiated work on medfly transformation (genetic engineering) and programmes on formal genetics of the medfly, including maintenance of genetic stocks at various centres, were specially recommended for continued support.

C. Field Programmes

1. Prospects for Tsetse Eradication from Lake Victoria Islands of Uganda

The tsetse and trypanosomiasis problem in Uganda has recently been brought into focus due, partly, to the mass exodus of people returning to their original homesteads following years of civil strife. In the northern shores region of Lake Victoria and the nearby islands, the problem reached alarming proportions recently because of increased livestock farming and fishing activities in an area inhabited by Glossina pallidipes and G. fuscipes, both of which are known vectors of animal trypanosomiasis and sleeping sickness.

In response to the Ugandan Government's request to the IAEA for assistance, a 2-man mission visited Uganda to review the tsetse and trypanosomiasis situation, specifically on the islands in the north-eastern corner of Lake Victoria and adjacent lake shore area and to advise on possible strategies for eradicating the tsetse species involved in trypanosomiasis transmission.

The civil strife of the 1970s and 1980s caused disruption of tsetse control operations in many parts of Uganda. As a result, several areas cleared of tsetse in the past became re-invaded.

There was clear evidence of such a situation on the northern lake shore area and Buvuma islands where Glossina fuscipes and G. pallidipes were encountered.

The Ugandan Government's priority objective in tackling the tsetse problem is to adopt an integrated approach to tsetse control/eradication using inexpensive but effective tsetse control devices including odour-baited and insecticide-impregnated traps, targets and screens, as well as the release of sterile males of the target species, wherever feasible. A recent workshop in Uganda focused attention on the problem.

For such a strategy to be effective, certain vital baseline data would be required. It was therefore recommended to:

- (i) determine accurately the distribution of tsetse on the islands and adjacent lake shore;
- (ii) determine the extent, if any, of fly movements between the islands and the lake shore;
- (iii) test and determine the effectiveness of various traps and targets in reducing populations of the tsetse species in the area;
- (iv) develop a mass-rearing system for the various species of tsetse involved (G. pallidipes and G. fuscipes and others).

In view of the need to protect the Lake (Victoria) and other water courses against pollution with insecticides, it seems obvious to adopt a tsetse control strategy that would preclude the use of aerial or ground spraying of insecticides. Therefore, the use of insecticides should be limited to application on screens or targets to ensure minimal contamination of the aquatic environment.

The special environment of Lake Victoria, the islands and the lake shore region would appear to favour the use of an integrated approach, including the SIT and limited use of insecticides, for eradicating tsetse on Buvuma islands and the lake shore area of Uganda.

## 2. Eradication of Riverine Tsetse in Northern Ghana

The widespread occurrence of two riverine species of tsetse flies, Glossina palpalis and G. tachinoides in northern Ghana and consequent incidence and prevalence of animal trypanosomiasis has long been recognized as a limiting factor in the development of the cattle industry in northern Ghana where 75% of the nation's cattle are located and where potential exists for increasing cattle production.

An IAEA-supported project initiated in 1983 aimed to explore the possibility of eradicating the two species using the Sterile Insect Technique (SIT) as part of an integrated programme to control animal trypanosomiasis.

With a view to identifying appropriate follow-up action in the immediate future, a 2-man team visited Ghana in April-May 1987 at the request of the Government to review project activities.

The team observed that since 1949 when a major tsetse control campaign in northern Ghana was concluded, no organized, large-scale tsetse control has been undertaken in any part of Ghana, primarily because the incidence of sleeping sickness (which prompted activities in the past) had become extremely low.

Considering that the country produces only 20% of its domestic meat requirements, and that the Ghanaian authorities consider tsetse eradication from vital areas of northern Ghana essential for increasing cattle production, and, given the available man-power and infrastructure within the country, the mission recommended expanding the existing project into a field programme to eradicate G. palpalis and G. tachinoides as an effective method of controlling animal trypanosomiasis in the cattle producing areas. The mission further recommended an integrated approach, with the SIT as a major component, and emphasized the need to locate the project within an on-going agricultural zone recently freed of onchocerciasis.

### D. What's on in Seibersdorf

Maintenance of Glossina palpalis palpalis as a back-up colony for BICOT was continued. The colony of 75,000 breeding females continues to thrive and during the last half of 1986 produced excess material for local research as well as 161,000 puparia that were sent to BICOT and other institutions.

In addition, colonies of G. tachinoides, G. austeni, G. f. fuscipes, G. pallidipes and G. brevipalpis were successfully established and maintained with an in vitro feeding system. These species broaden the training programme for African fellows and provide material for comparative studies on reproductive biology, nutrition and radiation sterilization.

Investigations were made to determine the effects of light cycles on the larviposition pattern of female G. p. palpalis. By controlling larviposition, it might be possible to better synchronize adult emergence and thereby prevent the overlapping of males and females in emergence cages. Results, however, showed that the larviposition pattern was quite consistent regardless of the length or even the absence of photoperiods. The colony is now being maintained in continuous darkness and will be monitored closely for any adverse effects.

In mating tests with G. p. palpalis it was reconfirmed that interrupted mating results in high losses of pregnancy during the first reproductive cycle. Remating increases reproduction, especially if remating is done when females are 9 days old (i.e. immediately before anticipated first ovulation).

Further refinements were made on the conditions affecting use of large cages for rearing G. p. palpalis. At present, 400 females are held in a cage, kept in continuous darkness (except during feeding) and fed 6 days a week on a mixture of equal parts of bovine and porcine blood.

Efforts to define and optimize the conditions for rearing G. pallidipes in vitro have resulted in a robust colony that is expanding rapidly. The insemination rate of females is greater than 90%, there is low female mortality, the puparia are normal sized and the emergence rate is high.

Nutritional studies were conducted with G. p. palpalis to determine the effects of freezing and thawing, dialysis and the ratio of component mixtures of porcine and bovine bloods on diet quality. The phagostimulation of various substances was compared and new formulations of ingredients were tested in adult synthetic diets.

Improvements in mass-rearing medflies resulted from investigations on treatments to decrease eggs from sticking on the oviposition net and on the effects of photoperiods on egg production.

Further refinements were made on the use in the medfly larval diet of ingredients from other countries.

Comparisons were made of several methods and materials for collecting mature medfly larvae when they leave the rearing medium. No material was clearly superior to all others in all categories of comparison.

Several isolates of the bacterium, Bacillus thuringiensis, that were pathogenic for adult medflies were examined further. Their active agents were characterized and compared for efficacy under laboratory conditions.

The selection programme for the induction and isolation of temperature-sensitive lethal factors in the medfly was continued. Six promising families have been isolated and are being further selected through single pair inbreeding until they become true breeding.

A new white pupa mutant strain of the medfly has been isolated and is being reared under large-scale conditions. After 13 generations the recombinant frequency has remained about 0.1%.

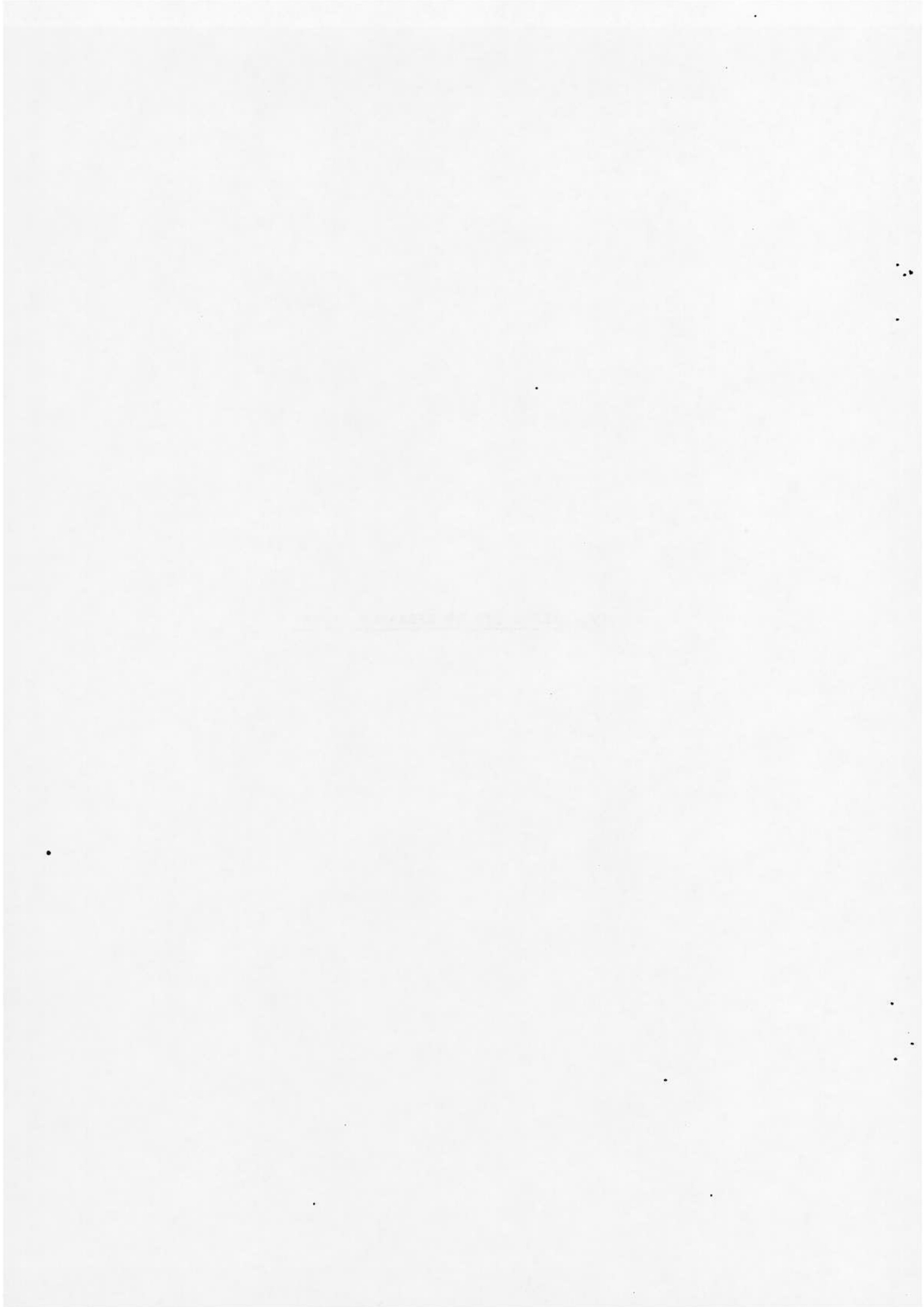
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IV. ABSTRACTS OF RESEARCH PAPERS



**A.**

PRAVAIT KAOCHAUNG  
BIOLOGICAL SCIENCE DIVISION  
OFFICE OF ATOMIC ENERGY FOR PEACE  
BANGKOK 10900, THAILAND

**1**

Effects of Gamma Radistion on Pupae of  
Fruit Flies, Dacus dorsalis Hendel and  
Dacus correctus (Bezzi)

The 1,3,6,8-day-old ( $\pm 4$  hr.) and 1,3,6,7-day-old ( $\pm 4$  hr.) pupae of Dacus dorsalis Hendel and Dacus correctus (Bezzi) were irradiated in air with gamma rays from Cobalt-60 source. The results showed that the LD<sub>50</sub> and LD<sub>95</sub> for 1,3,6, and 8-day-old ( $\pm 4$  hr.) D. dorsalis pupae were 18.6, 29.9, 311, 560.7 and 36.7, 72.9, 621.4, 884.6 Gray respectively. The LD<sub>50</sub> and LD<sub>95</sub> for 1,3,6 and 7-day-old ( $\pm 4$  hr.) D. correctus pupae were 8.88, 25.3, 226.6, 546.6 and 16, 75.2, 427.5, 958.4 Gray respectively. Radiation dose at 90.3 and 89.7 Gray sterilized 100% D. dorsalis and D. correctus males emerged from pupae 2 days before emergence respectively. In addition, both irradiated 60 Gray D. dorsalis and 40 Gray D. correctus females emerged from pupae were unable to lay eggs.

Nikola Genchev  
Institute for Plant Protection  
2230 Kostinbrod P.O.B.238 Sofia  
Bulgaria

**2**

Radiation sterilization of the greenhouse whitefly (*Trialeurodes vaporariorum* Westw., Homoptera; Aleyrodidae)  
I. Lethal radiation effects on puparia and imagoes  
Soil Science, Agrochemistry and Plant Protection, Vol.XXI, 1986, No 5, 125 - 133.

#### SUMMARY

The results are reported from radiobiological studies on the lethal effects of ionising radiation on puparia and imagoes of greenhouse whitefly. The irradiation was made by gamma rays ( $^{60}\text{Co}$ ) with dose rate of  $12 \pm 5$  % rad/s. On the basis of the dose - mortality curve, the main parameters of the lethal radiation effect for puparia were determined (LD, regression coefficients). It was found that in the irradiated populations existed susceptible and resistant fractions and a higher radioreistance of the females as well. The radiation sickness of whiteflies, emerged from irradiated puparia, reduced their longevity according to the applied dose. The direct irradiation of the adult insects caused the same effect but after application of higher doses.

Nikola Genchev  
Institute for Plant Protection  
2230 Kostinbrod P.O.B.238 Sofia  
Bulgaria

Radiation sterilization of the greenhouse whitefly (*Trialeurodes vaporariorum* Westw., Homoptera; Aleyrodidae)  
II. Sterilizing effect of radiation on puparia and imagoes  
Soil Science, Agrochemistry and Plant Protection, Vol.XXII, 1987, No I,  
108 - 115.

#### SUMMARY

The results are reported of studies on the sterilizing effect of ionizing radiation on puparia and imagoes of the greenhouse whitefly (*T. vaporariorum*). Irradiation was done with gamma rays ( $^{60}\text{Co}$ ) at the rate of  $12 \pm 5$  % rad/ s. The parameters of radiation induced sterility were determined separately for the two sexes. For males the sterilizing effect was expressed in arising of dominant lethal mutations in spermatozoa accompanied with partial sperm inactivation and/or partial aspermia. The absolute sterilizing doses for the two ontogenetic stages are 6 and 7 krad respectively. The radiation sterilization of the male parent resulted in a forced arrhenotoky in  $F_1$  which could be regarded as a transformation of the parthenogenesis from a necessary for the normal propagation of the insect process into a lethal to the population factor. Radiation-induced sterility in females was expressed in arising of dominant lethals in oocytes (the absolute sterilizing doses for puparia and imagoes were 5 and 6 krad respectively). Doses  $\geq 4$  krad caused partial infertility.

R.K. SETH AND S.S. SEHGAL  
Department of Zoology  
University of Delhi  
Delhi-110007  
INDIA

EFFECTS OF LARVAL IRRADIATION ON  
THE FECUNDITY AND FERTILITY OF  
SPODOPTERA LITURA (FABRICIUS)

J. Nuclear Agric. Biol., 15(3):  
156-161 (1986).

ABSTRACT

Gamma irradiation of S. litura larvae affected the fecundity and fertility of the ensuing moths when crossed in two different combinations -  $T\sigma \times NQ$  and  $T\sigma \times T\phi$ . The effect was more marked in the latter cross. The magnitude of sterility and reduction in the fecundity had a negative correlation with the age of the larvae at the time of irradiation. Also, the mating frequency of such adults showed deviation. The reduction in the life span of these moths was another manifest of larval treatment in different instars.

S.U. KHATTAK AND M. HAMED

CONTROL OF PULSE BEETLE,  
CALLOSOBRUCHUS CHINENSIS L. BY  
GAMMA RADIATION, IRRADIATED AS  
UNMATED ADULTS.  
Bangladesh J. Zoology, In press

Newly emerged unmated adults of Callosobruchus chinensis L. were exposed to gamma radiation at the age of  $24 \pm 6$  hour in a Cobalt-60 source. The doses given were 5, 10, 15, 20, 25, 50, 75, 100, 125, 150, 200, 250 and 300 krad. The insects after irradiation were provided mungbean in the glass jar and mortality data was recorded upto 21 days until all adults were dead. The results show that adult mortality was dose dependent. There was a quick response with an increased dose. A dose of 300 krad gave complete kill in 24 hours.

K.C.DEVARAJ URS  
AND  
P.N.KRISHNAMURTHY  
DEPARTMENT OF ENTOMOLOGY  
UNIVERSITY OF AGRICULTURAL  
SCIENCES, GKVK, BANGALORE-560065  
INDIA

CHEMICAL STERILIZATION  
OF *SPODOPTER LITURA* F.  
(LEPIDOPTERA : NOCTUIDAE)

**ABSTRACT:** Three chemosterilants viz. hempa, metapa and thiotepa were tested for inducing sterility in the tobacco cutworm, *Spodoptera litura*. Metapa caused 91% sterility, while hempa and thiotepa caused 100% sterility in the males at all concentrations (5  $\mu$ l, 10  $\mu$ l, & 15  $\mu$ l) tried. In general, adult longevity was reduced to 3-4 days as compared to control at the highest concentration (15  $\mu$ l) of each chemosterilant. However, sterile males were more competitive than normal males for mating.

K.C.DEVARAJ URS  
AND  
K. K. KUMAR  
DEPARTMENT OF ENTOMOLOGY  
UAS, GKVK, BANGALORE-560065  
INDIA.

COMPARISON OF SYNTHETIC  
PHEROMONE TRAP WITH VIRGIN  
FEMALE TRAPS FOR CAPTURING  
THE SPOTTED BOLLWORM, *EARIAS*  
*VITTELLA* (LEPIDOPTERA :  
NOCTUIDAE)

**ABSTRACT:** The effect of synthetic pheromone and virgin female traps was studied in the context of managing the cotton bollworm pest in Lady's finger (*Abelmoschus esculentus* L.). The traps baited with synthetic pheromone gave higher catches of moths than the virgin female traps.

Elena Gencheva  
Institute for Plant Protection  
2230 Kostinbrod P.O.B.238 Sofia  
Bulgaria

Labelling of Oriental fruit moth  
(*Grapholitha molesta* Busck) by  
radioactive isotopes  $^{32}\text{P}$  and  $^{14}\text{C}$   
Soil Science, Agrochemistry and Plant  
Protection (in press)

#### SUMMARY

In the present article are interpreted results of laboratory trials for radioactive labelling of *Grapholitha molesta* by  $^{32}\text{P}$  (introduced into the nutrient solution of moths in form of  $\text{KH}_2^{32}\text{PO}_4$ , specific activities of 2.5 and 5.0  $\mu\text{Ci/ml}$ ) and  $^{14}\text{C}$  (included as  $^{14}\text{C}$ -glucose in the semisynthetic larval diet, specific activities of 0.5, 0.75, 1.0 and 1.6  $\mu\text{Ci/g}$ ).

Decay parameters of the radioactive phosphorus determined for the labelled moths ( $T_{1/2, \text{eff}}$ ;  $T_{1/2, \text{biol}}$ ) show that their reliable radiometric identification needs an initial radioactivity ranging between 800  $\pm$  2200 imp/100 s depending on the sex.

As disadvantages of the methods using  $^{32}\text{P}$  might be pointed out the possible persence of some unlabelled individuals, the compulsory manipulations of moths with risk of causing them some damage and the considerable external body contamination when nutrient honey solution was used.

The introduction of  $^{14}\text{C}$ -glucose into the larval diet causes homogeneous labelling of developed larvae, pupae and imago of both sexes at level of sufficient radioactivity. A detectable marking of the sexual products of males and their identification in the reproduction system of females in crossing  $^{14}\text{C}\sigma \times \text{q}$  was established too.

The applied concentrations of  $^{14}\text{C}$  had not any negative effects on the vitality, sexual activity and fecundity of the insect. The reduction of egg hatching registered after utilization of the diets with specific activities of 1.0 and 1.6  $\mu\text{Ci/g}$  was due to a partially induced sterility in spermatosoa (crossing  $^{14}\text{C}\sigma \times \text{q}$ ).

Vladimír Mařha, Štěpán Lukeš,  
Jaroslav Weiser, Tomáš Soldán,  
Petr Švec and František Weyda

Institute of Entomology,<sup>+</sup>Institute of  
Parasitology, Czechoslovak Academy of  
Sciences, Branišovská 31, 370 05 České  
Budějovice, Czechoslovakia

B.

8

ANTIBODIES AGAINST GLOSSINA PALPALIS  
PALPALIS SALIVARY GLANDS HOMOGENATES  
IN RABBITS EXPOSED TO REPEATED FLY  
BITES: A DETECTION BY ELISA

Adult tsetse fly, *Glossina palpalis palpalis* (Rob.-Desv.), obtained as puparia from the Entomology Unit, Seibersdorf Biotechnology Laboratory, Joint FAO/IAEA Division, Vienna, Austria kept at  $26 \pm 1^{\circ}$  C and 80-85 % r.h. were fed on ears of rabbits fixed in holding cages for 30-60 min six days a week. Three rabbits of approximately same weight were exposed to two sucking cycles of flies of both sexes lasting for 15 days each. One sucking cycle comprised about 500-600 bites in total. The emerging antibodies against tsetse fly salivary gland homogenates were detected by ELISA (enzyme linked immunosorbent assay). Titres and persistence of antibodies is relatively low during the first sucking cycle. Antibodies appeared within 6 days and reached their maximal titres 19 days after the beginning of the experiment. After the first sucking cycle, titres of antibodies gradually decrease being only twice as high as those of control animals after 73 days. The second cycle of tsetse feeding of experimental rabbits was accompanied by approximately three times higher titres of antibodies than the first one which appeared 1-3 days earlier and persisted in the blood of experimental rabbits in higher titres as well. The correlation between titres of antibodies and the induction of "killing factor" in the blood of exposed rabbits causing total mortality of sucking flies in 11-15 days during the first and second cycle was not proved.

SYED S.H. QADRI  
TOXICOLOGY UNIT  
REGIONAL RESEARCH LABORATORY,  
HYDERABAD-500 007, A.P.,  
INDIA.

Behavioural and physiological  
approaches to control insect pests

Proceedings of the National Seminar on  
Behavioural and Physiological Approaches  
& Management of the Crop Pests,  
Tamil Nadu Agricultural University,  
Coimbatore-3, India, 1985, pp. 47-52.

#### Abstract

In a programme of research a large number of plant components and synthetic compounds have been evaluated for behavioural and physiological responses of insect pests. The bioactive components are anonaine from custard apple seed, azadirachtin from neem seed, diallyl disulfide from garlic clove, benzyl isoquinoline and barbarine from arrow root tuber, galangin, dioxy - flavanol from kachura rhizome possessing a camphoraceous odour and oleoresin (contains 14.8% pyrethrin-I and 15.2% pyrethrin-II) from chrysanthemum flowers. Diuresis was caused among test insects like last instar nymph of cockroach (Periplaneta americana) by custard apple. Growth inhibition among P. americana and rice weevil (Sitophilus oryzae) was caused by neem, garlic and custard apple. Neem for custard apple and garlic for oleoresin served as synergists against pulse beetle (Callosobruchus chinensis), lesser grain beetle (Rhizopertha dominica) and Musca domestica nebulosa. Arrow root (Maranta arundinacea) and kachura (Kaempferia galanga) repelled bed bug (Cimex lectularius), mosquito (Culex fatigans) and six different species of storage beetles. Kachura for DDT, arrow root for DDT and lindane served as synergists against M. d. nebulosa. Physiological and biochemical actions of indigenous pesticides in insects are discussed.

VLADIMIR H. BEREGOVY, AND  
KENNETH J. STARKS

METABOLISM & RADIATION RESEARCH LAB  
USDA/ARS  
FARGO, NORTH DAKOTA 58105

10  
ENZYME PATTERNS IN BIOTYPES OF THE GREENBUG,  
SCHIZAPHIS GRAMINUM (Rondani) (HOMOPTERA:  
APHIDIDAE).

J. Kansas Entomological Society 59: 517-523 (1986)

Laboratory clones of greenbug (Schizaphis graminum [Rondani]) biotypes B, C, and E and field-collected clones from 13 geographic locations in the central United States and cultures on barley (Hordeum vulgare L.), sorghum (Sorghum bicolor [L.] Moench), Piper sudangrass (S. bicolor var. sudanensis, Hitchc.) and Kentucky bluegrass (Poa pratensis L.) were tested for possible isozyme variations in 20 enzyme systems. The enzyme systems were: Acid phosphatase, Alkaline phosphatase, Esterase, Glutamate-oxaloacetate transaminase, Leucine amino peptidase, Aldolase, Malate dehydrogenase, Malic enzyme, Sorbitol dehydrogenase, Glucose-6-phosphate dehydrogenase, Galactose dehydrogenase, 6-phosphogluconate dehydrogenase, Octanol dehydrogenase,  $\alpha$ -Glycerophosphate dehydrogenase, Lactate dehydrogenase, Phosphoglucose isomerase, Tetrazolium oxidase, Triosephosphate isomerase, Phosphoglucomutase, and Hexokinase. The results did not indicate any differences in enzyme patterns among biotypes cultured on the same and different host plants or among fresh field-collected clones from different geographic locations.

LEO E. LACHANCE AND C. J. WHITTEN  
METABOLISM & RADIATION RESEARCH LAB  
USDA/ARS  
FARGO, NORTH DAKOTA 58105

CYTOGENETIC STUDIES OF SCREWORM (DIPTERA: **11**  
CALLIPHORIDAE) POPULATIONS FROM SOUTHERN MEXICO  
AND JAMAICA

Ann. Entomol. Soc. Am. 79: 792-798 (1986)

Karyotypes of 23 lines of screwworm, Cochliomyia hominivorax (Coquerel), flies originating as isofemale lines collected in the Mexican states of Colima, Michoacan, Oaxaca, Chiapas, Quintana Roo, and one line from the island of Jamaica were investigated. Detailed analysis of metaphase I meiotic chromosomes from male primary spermatocytes revealed differences between lines having the longest and shortest means for percentage of total chromosome length of the X and Y chromosomes, but no significant differences in the five autosomes. Comparison of mean arm ratios for the five autosomes among strains indicated no significant differences for autosomes II, III, IV, and VI. The F test for autosome V was significant. Analysis of karyotypes of 55 between-line hybrids to detect chromosome rearrangements showed that no isofemale lines possessed chromosome rearrangements. Results do not indicate existence of reproductive isolation between any of the lines, or differences indicative of more than intraspecific variation in karyotypes.

IN VITRO REARING OF GLOSSINA AUSTENI (NEWST.) WITH FRESH BOVINE BLOOD

M. K. Gao, N. E. Kivia and F. Makishe

Tsetse and Trypanosomiasis Research Institute, P.O. Box 1026, TANGA - TANZANIA

Abstract:

A self sustaining and flourishing laboratory colony of over 20,000 females Glossina austeni (Newst.) has been successfully established over a period of 15 months. Adults and puparia are kept at  $25 \pm 1^{\circ}\text{C}$  and  $75 \pm 5\%$  RH with a 12 h Scotophase starting at 19:00 hrs. Adults are fed 7 days a week on silicone membrane with defibrinated bovine blood collected from the local abattoir. Pupal weight, productivity and longevity have been very satisfactory. This is the first time that G. austeni has been reared on bovine blood alone.

