JOINT FAO/IAEA DIVISION

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

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

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INSECT AND PEST CONTROL

NEWSLETTER

No. 41

July 1988

NOTE: SUBMISSION OF ABSTRACTS

One of the functions of the NEWSLETTER is to serve as a medium for informing our readership of current research in the area of radiation and isotopes applied to entomology and pest control. For this purpose we have relied upon contributions by researchers in the field of entomology and related disciplines to provide abstracts for inclusion in the NEWSLETTER.

Contributions have declined considerably during the past 18 months. We may therefore be forced to discontinue the service if patronage does not improve.

Please send your abstract now for inclusion in the December 1988 issue of the NEWSLETTER.

CONTENTS

I. INTRODUCTION

A. To Our Readers

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

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

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

Please note that the summaries of unpublished work often represent preliminary reports of investigations in progress and, therefore, such findings are subject to possible revision at a later date.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

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

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

B. About the Insect & Pest Control Section

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

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

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

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

II. GENERAL INFORMATION

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A. Professional Staff : Insect & Pest Control Section

Headquarters

D.A. Lindquist	Head, Insect & Pest Control Section
E.D. Offori	Technical Officer (transferred to TCAC, 1 June 1988)
A. Van der Vloedt	Technical Officer

Seibersdorf Laboratory

R.E. Gingrich	Head, Entomology Unit; B.t. Investigations
A. Economopoulos	Medfly Investigations : Rearing and Quality Control
J. Kabayo	Tsetse Investigations (leave of absence, 1 July 1988 - 30 June 1989)
U. Feldmann	Tsetse Investigations
E. Busch-Petersen	Genetic Sexing of Medflies
P. Kerremans	FAO Associate Professional Officer, Genetic Sexing of Medflies
M. Vreysens	FAO Associate Professional Officer, Tsetse Investigations
R. Anouchinsky	FAO Junior Professional Officer, Tsetse Investigations
E. Lambremont	Sabbatical, Tsetse and Medfly Rearing

B. Entomology Unit, Seibersdorf

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

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

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

In general, research is undertaken to:

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

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

1. Mediterranean fruit fly, Ceratitis capitata (Wied.).
2. Tsetse fly, Glossina palpalis palpalis.
3. Tsetse fly, Glossina pallidipes.
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 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:

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

C. Programmes of the Insect & Pest Control Section

1. Medfly

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

(a) the development of less expensive larval and adult diets with particular emphasis on locally available ingredients (non-imported) from various parts of the world;
(b) the improvement of rearing systems;
(c) the development of laboratory and field quality control techniques;
(d) the improvement in handling techniques for large numbers (100s of millions) of flies;
(e) the development of genetic 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 SIT 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 sexing pupae.
(h) develop methods of shipping large numbers of pupae.

3. Nuclear Techniques and Biotechnology for Pest Population Suppression

The objective is to develop and assess F1 sterility and other genetic methods of insect control for application in integrated insect management programmes. Activities will involve development of genetic methods based on nuclear and genetic engineering techniques. Pest Lepidoptera and other species not readily amenable to control by the SIT will be the primary target. Research will emphasize development of:

(a) mass-rearing technology;
(b) area-wide control strategies;

(c) genetic engineering, with emphasis on gene transfer technology;
(d) isotope tagging for insect migration studies.

D. Co-ordinated Research Programmes

Currently the Section has responsibility for the following six programmes:

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

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

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

4. Title: "Development of Practices for Area-wide Tsetse Eradication or Control with Emphasis on the Sterile Insect Technique (new programme)".

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

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

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

(a) Medfly	(b) Tsetse	(c) Isotopes	(d) Others
Peru	Nigeria	Kenya	Pakistan
Guatemala	Zambia	Indonesia	Mauritius
Algeria	Ghana		
Libya	Tanzania		
Tunisia	Uganda		
Morocco	Zimbabwe		
	Kenya		

F. Experts and Consultants : January - June 1988

Name	Nationality	Location of Assignment	Dates and Task Performed
L.C. Madubunyi	Nigeria	Zanzibar) Tanzania)	May 1988 - April 1989. To undertake ecological studies of Glossina austeni and work out a strategy for its eradication by the sterile insect technique.
D.A. Anthony	U.S.A.	Vienna	31 May - 20 June 1988. Revise Technical Reports Series No. 61 "Laboratory Training Manual on the Use of Isotopes and Radiation in Entomology", 2nd Edition.
J. Tsitsipis	Greece	Libya	10 June - 20 August 1988. Review current Libyan medfly survey procedure and results and assist in planning and expansion of this survey in other parts of the country. Prepare recommendations for use by Libyan medfly team.
T. El-Abbassi	Egypt	Libya	17 June - 14 July. To assist in developing medfly mass-rearing techniques using Libyan ingredients.

G. Trainees in Entomology : January - June 1988

(a) Tsetse Group

Ahmed, A.B.	Nigeria	June to September 1988

(b) Medfly Group

Rahman, R.	Bangladesh	87-01-26 to 88-01-26
Kitwika, W.	Tanzania	88-01-04 to 88-04-03
Gaggl, K. (cost-free)	Austria	87-05-20 to 88-05-19
Kafu, A.A.	Libya	86-10-09 to 88-10-08

III. IN THE NEWS

III. NEWSLETTER

A. Special Features and Comments

1. The Co-ordinated Research Programme on "Application of the Sterile Insect Technique for Tsetse Fly Eradication or Control"

Summary Review by
Evans D. Offori*
Insect & Pest Control Section

For 21 years the Joint FAO/IAEA Division, through its Insect and Pest Control Section, has actively supported research on tsetse flies, aimed at developing and utilizing the SIT for their eradication or control.

The programme was initiated in 1967 as part of the Division's overall programme to apply nuclear techniques for increasing agricultural production and for controlling insect pests and disease vectors. Prior to the initiation of the programme, research on the biology, behaviour and nutrition of tsetse flies has been in progress at several locations within and outside Africa. In Europe, colonies of tsetse flies had been established at the Institute of Tropical Medicine, Lisbon, the Tsetse Research Laboratory, Langford, Bristol and the Institut d'Elevage et de Médecine Vétérinaire des Pays Tropicaux, Maisons-Alfort. These laboratories in fact, provided materials, at various times, for establishing tsetse colonies at the Joint Division's laboratory in Seibersdorf.

While the primary objectives of the laboratories in Lisbon and Bristol were to research the physiology, nutrition and disease transmission of tsetse flies, the programme in Vienna and Seibersdorf aimed to develop techniques and practices for utilizing sterile males in tsetse control/eradication programmes. Thus the research emphasis at Seibersdorf has been on development of tsetse mass-rearing technology, nutrition, irradiation and determination of sterility due to irradiation treatment.

The co-ordinated research programme which was initiated in 1968, was the result of deliberations of a panel of experts assembled in January 1967 to review current knowledge on the use of radiation, with emphasis on genetic aspects, to control animal insect pests. The panel recommended establishment of an international co-ordination of research by persons and institutions involved in developing the application of radiation for animal pest control.

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* Effective 4 July 1988, Evans Offori has left the Insect and Pest Control Section, to join the Africa Section of the Division of Technical Assistance and Co-operation.

The first co-ordinated research programme entitled "Control of Animal Insect Pests by the Sterile Male Technique" was initiated in August 1967. Under this all-embracing title, other insects than tsetse (e.g. Dermatobia, Hypoderma, Rhodnius) were researched by participating laboratories. Eight scientists including 5 cost-free agreement holders, participated in the programme which terminated in 1973. The inclusion of other blood-sucking arthropods in a tsetse programme was justified on the ground that nutritional and dietary requirements of tsetse could be elucidated from studies of other arthropods having similar feeding habits and dietary preferences.

In June 1971 a panel of experts was assembled in Paris, which included some of the participants of the on-going co-ordinated research programme. The mandate of the group was to discuss the possibilities and review conditions required for the successful application of the sterile insect release method for tsetse suppression. The 32-member panel identified five main areas requiring research emphasis for applying the sterility principle in tsetse eradication campaigns, notably:

(a) development of tsetse mass-rearing technology, including studies of tsetse nutrition and dietary requirements;

(b) irradiation studies and evaluation of sterility and radiation effects on fly competitiveness;

(c) development of surveillance methods for effective ecological studies as pre-requisite for sterile male release;

(d) development of population suppression techniques; and

(e) investigation of packaging, handling and transportation of sterile flies from the producing centre to the release point.

A new programme on "Tsetse Fly Control or Eradication by the Sterile Male Technique", initiated in 1974 was the direct outcome of the 1971 meeting in Paris. During the 10 years (1974-1984) that the programme was run, a total of 21 scientists at various times participated as research contractors and another 7 on a cost-free basis.

With a view to elucidating dietary requirements of tsetse and to study trypanosome transmission by sterile released males, especially in connection with the project BICOT, a programme on using isotopes to develop diets and study disease transmission was introduced in 1981 with 9 participants from 6 countries. A significant result of the

investigation was the discovery that sterile males were as effective as normal males in transmitting trypanosomes. Based on this finding, a strategy was developed, whereby sterile males were fed at least one blood-meal in the laboratory prior to release in the field. The procedure would minimize the chances of trypanosomes of the brucei group undergoing development in the gut of released flies.

The fourth programme which was initiated in 1984 and was concluded with a research co-ordination meeting in June 1988 was entitled "Development of Methodologies for the Application of the Sterile Insect Technique for Tsetse Eradication or Control". A total of 21 scientists from 13 countries participated in the programme at various times. Individual research covered subjects such as tsetse rearing, diets and nutrition, trypanosome transmission and vectorial capacity, genetics and tsetse ecology.

The four programmes are summarized in the table below.

The information accrued through research during the 21 years has increased our understanding of tsetse biology and behaviour under laboratory and field conditions and has enabled us to exploit these in preparing and executing field programmes. For this, we are indebted to all the 60 or more scientists who contributed to the programme since its inception in 1967.

Co-ordinated Research Programmes on Tsetse : 1967 - 1988

	Date	Title of Co-ordinated Research Programme	Number of Participants		
			Africa	Elsewhere	Total
1.	1967 - 1973	Control of Animal Insect Pests by the Sterile Male Technique	1	6	7
2.	1973 - 1984	Tsetse Fly Control or Eradication by the Sterile Male Technique	10	18	28
3.	1981 - 1984	Using Radiation and Isotopes to Develop Diets for Mass-Rearing Haematophagous Insects for Sterile Insect Release and to Study Disease Transmission by these Vectors	6	3	9
4.	1984 - 1988	Development of Methodologies for the Application of the Sterile Insect Technique for Tsetse Eradication or Control	8	8	16

2. The Screwworm Fly in Australia

First detected in Australia in 1979, the screwworm fly had evidently not posed a serious threat to the Australian livestock industry until recently. The discovery of Cochliomyia bezziana in northern Australia in May this year has underscored the need for strict quarantine as a measure against introduction of exotic pests into an otherwise free area. In the meantime, the Australian Department of Primary Industry proposes to control the pest using the SIT.

A mass-rearing plant and gamma irradiator on the island nation of Papua New Guinea will be used to mass produce the insect, and to sterilize the flies for release at vantage points in affected areas of northern Australia.

It is estimated that if unchecked, an outbreak of screwworm fly infestation could cost the Australian livestock industry over US$ 100 million annually.

B. Meeting Report

Research Co-ordination Meeting on "Development of Methodologies for the Application of the Sterile Insect Technique for Tsetse Eradication or Control", Vom, Nigeria, 6 - 10 June 1988

The co-ordinated research programme on developing methodologies for applying the SIT in anti-tsetse operations was started in March 1984, and aimed to provide research backing for on-going and future tsetse eradication projects in Africa.

The meeting was convened at the Nigerian Institute for Trypanosomiasis Research (NITR), Vom, to conclude the 4-year programme. Eleven of the 13 participating scientists attended.

Welcoming participants, the Acting Director of NITR, Dr. A.U. Kalu, noted the positive impact of research under the programme, on the operations at BICOT, and expressed the hope that results of the programme being concluded would be applied in many more African countries to eradicate tsetse and trypanosomiasis.

Papers presented are indicated by title below. The full papers will be published as an IAEA priced document. The FAO representative reviewed the FAO programme on tsetse and trypanosomiasis control in Africa.

The meeting was informed that a new programme would be initiated towards the end of 1988, which would emphasize area-wide (field) applications of the SIT. In discussing the proposal, the participants of the research co-ordination meeting, while agreeing with the proposed emphasis, stressed the need for continued research to improve tsetse mass-rearing and other laboratory activities that would increase the effectiveness and minimize the cost of applying the SIT in area-wide tsetse control/eradication operations.

Research Co-ordination Meeting Participants

Name	Title of Paper
T. Soldan (Czechoslovakia)	Study of mycetome and symbionts of tsetse flies kept on membrane feeding system and agents interfering with natural reproduction.
P.A. Langley (U.K.)	Towards an appropriate technology for tsetse control.
J. DeLoach (U.S.A)	Freeze-dried blood and development of an artificial diet for blood-feeding arthropods.
W.J. Kloft (F.R.G.)	Influence of different nutritional sources on haemolymph composition and vitellogenesis in haematophagous arthropods.
L.M. Ogwal (Uganda)	The population dynamics of Glossina fuscipes fuscipes on Buvuma Island, Lake Victoria, Uganda.
S.A. Ajayi (Nigeria)	Effects of nutritional quality of locally collected blood diets on the performance of Glossina palpalis palpalis fed in vitro.
G.O.C. Ekejindu (Nigeria)	Four years of trypanosomiasis surveillance in a selected area in Nigeria under intensive tsetse control by the sterile insect technique.
I. Maudlin (U.K.)	The effect of rearing diet on infection rates in flies released for control of tsetse populations by the sterile insect technique.
J.W. Hargrove (Zimbabwe)	Population estimation from mark-recapture data.
L.C. Madubunyi (Nigeria)	Ecology of Glossina species in the derived savannah zone of Anambra State, Nigeria, in relation to the sterile insect technique.
M. Clair (France)	EIVT activities in relation to tsetse control operations in Sideradougou, Burkina Faso using the sterile insect technique.
J.P. Kabayo (FAO/IAEA)	Artificial diets for tsetse rearing.
M. Oladunmade (BICOT)	Review of BICOT operations : 1980-1987.
E.D. Offori (FAO/IAEA)	Review of the co-ordinated research programme on the "Application of the Sterile Insect Technique for Tsetse Fly Eradication or Control".
B. Hursey (FAO, Rome)	FAO programme on tsetse and African animal trypanosomiasis.

C. Training Courses

1. Regional Training Course on "Integrated Control of Tsetse Flies with Emphasis on the Sterile Insect Technique", Vom, Plateau State, Nigeria, 23 May - 17 June 1988

The 4-week regional training course, jointly sponsored by the Federal Government of Nigeria, FAO and IAEA, took place at the Nigerian Institute for Trypanosomiasis Research (NITR), Vom, and the laboratories and field station of the Biological Control of Tsetse (BICOT), with visits to the headquarters and laboratories of the National Veterinary Research Institute (NVRI), Vom, which, originally, was to serve as the course venue.

The training course was officially opened by the Military Governor of Plateau State, Colonel Lawrence Onoja who thanked the FAO and IAEA for mounting the training course in Vom. He expressed the hope that the two international organizations would continue to support efforts at BICOT, Nigeria, and other locations to rid the African region of tsetse flies and trypanosomiasis.

Twenty out of 21 registered candidates from 12 African countries attended the course, including 56 from Nigeria, the host country. In addition to lectures, demonstrations, film shows, general seminars and discussions, the course included a 4-day visit to the BICOT project site, 200 km south of Vom, for practical field training.

Eleven invited lecturers including 8 from Nigeria, assisted the Course Director and participated fully in the discussions and seminars following their presentations. During a special session the role and involvement of FAO and UNDP in country projects such as BICOT, was explained.

In a 1-day session, trainees made oral presentations on tsetse/trypanosomiasis research and development and control activities in their various countries. Although all countries represented considered tsetse and trypanosomiasis a major constraint to livestock production, the priority accorded by governments to the solution of the problem varied widely.

The trainees also benefited from presentations by participants of the research co-ordination meeting on "Development of Methodologies for the Application of the Sterile Insect Technique for Tsetse Eradication or Control", held at the same venue during the third week of the training course, 6 - 10 June 1988.

During an open discussion in the final week, as well as through written answers to questionnaires, most of the trainees indicated that they considered the 4-week training course worthwhile and would like to see similar courses organized every two years at different locations in Africa.

The programme of the course included the following main subjects:

(a) Tsetse biology, ecology and behaviour.
(b) Mass-rearing and irradiation of tsetse flies.
(c) Application of the sterility principle for tsetse eradication.
(d) Tsetse population suppression techniques and practices.
(e) Strategies for area-wide control of tsetse/trypanosomiasis.
(f) Tsetse/trypanosomiasis control and rural development.
(g) Organization and management of tsetse eradication programmes involving the SIT.

2. FAO/IAEA Inter-regional Training Course on "Use of Isotopes and Radiation in Integrated Pest Management with Special Reference to the Sterile Insect Technique", Gainesville, Florida, U.S.A., 16 May - 24 June 1988

The Gainesville training course was sponsored by the University of Florida, U.S. Government, IAEA and FAO. Twenty participants were selected from 90 applicants from 50 countries. Nineteen of the selected participants attended the course, which lasted six weeks.
Dr. D.E. Weidhaas, the Course Director, restructured the course somewhat from previous Gainesville training courses. More emphasis was placed on the SIT and less emphasis on the use of isotopes. Whether we continue this type of course or revert back to more isotope work will depend to a large extent on the evaluation currently being conducted by Dr. Weidhaas and others who took part in the course.

The primary topics covered by the course were the use of radioisotopes in entomology, radiation biology, a rather extensive introduction to the use of computers and computer programmes in entomology, genetics as related to the SIT and F1 Sterility, and thorough reviews of on-going SIT programmes in many parts of the world.

From reports prepared by the students, the course was very useful and effective.

D. What's on in Seibersdorf

Blood dried at 45°C in a hot air oven was compared for quality to the fresh frozen-thawed blood used in diets for Glossina palpalis. Female flies fed on oven-dried blood lived as long and produced as many puparia of equivalent size as those fed on the normal blood diet.

It was found that like G. palpalis, G. tachinoides is also stimulated to engorge by ATP in its diet. A concentration of 1.3×10^{-8} M ATP induced 50% feeding. The ability of G. tachinoides to detect ATP is the highest recorded so far among insects.

A series of tests were set up to examine the influence of temperature and humidity on puparia and fly development in order to determine the possible detrimental effects of climatic fluctuations on puparia during transport. Puparia of six different ages were exposed for a 5-day experimental period to different humidities (from 35% to 95% r.h.) and different temperatures (from 11° to 31°C). The following parameters were measured: puparial weight fluctuations during puparial development, length of puparial period and fly emergence rate, fertility of the different experimental groups, and lipid fractions in puparia and flies.

A study has been initiated to analyze different aspects of cross-breeding between G. p. palpalis and G. p. gambiensis in order to examine the possibility of eradicating both target species by a release programme of sterile males of only one sub-species. The following preliminary tests were initiated:

(a) Interspecific crosses between G. p. palpalis and G. p. gambiensis and their hybrids to analyze the hybrid fertility-sterility.

(b) A morphological study of both sub-species and their hybrids with special emphasis on the external reproduction apparatus.

(c) An analysis of induced sterility in crosses between the two sub-species by means of gamma irradiated males.

(d) A series of competitiveness tests to analyze mating preference of both sub-species including gamma irradiated and non-treated males.

Investigations were conducted to develop techniques to rapidly mark large numbers of tsetse flies. U.V. fluorescent and inorganic pigments were dispersed in water by adding an organic resin (PVA or PA) with a weight ratio for pigment:resin:water of 10:15:75. Different colours were applied to flies by (1) spraying with an electric gun, (2) dipping flies in the solution, and (3) exposing flies to the coloured powder during emergence. Spraying provided the most easily detectable mark. All marked flies survived and mated as well as unmarked controls.

An ELISA procedure was developed to measure the amount of albumin in the gut of tsetse flies. This information can be used to quantify the rate of diet ingestion by flies.

Female medflies prefer sugar solutions containing ribonucleotides to sugar solutions alone; 5'GMP was the most stimulatory of the 13 ATP analogues tested. Because the content of specific nucleotides in the hydrolysate can be manipulated by the fermentation medium of the yeast, it may be possible to produce more cheaply the yeast hydrolysates used in medfly baits. Females sterilized by irradiation were less attracted to 5'GMP than non-irradiated females.

One or more isolates of Bacillus thuringiensis were recovered from 56 of the 195 soil samples received from Austria, Libya, Peru, Morocco, Spain, Egypt, Israel and Mexico. The samples had been collected from areas where medfly host plants were growing in an attempt to find strains of B. thuringiensis that were specifically pathogenic for adult medflies. In preliminary bioassays several of the isolates were highly active against medflies.

Comparative anatomical and cytogenetical observations were made on post-irradiated third instar larvae of the medfly to develop data on the use of irradiation as an effective quarantine treatment of agricultural commodities. It was found that the supraoesophageal ganglion was reduced 50% at doses of 30-40 Gy, whereas at 150 Gy a reduction of 65-74% was observed. Mitotic chromosomes appeared normal in all cells exposed to less than 50 Gy but they were diffuse or totally absent when exposed to 100 Gy.

The polytene chromosomes from male orbital bristle cells of two genetic sexing (GS) strains of the medfly were analyzed to determine the position of their respective translocation breakpoints. Both strains are based on a pupal colour dimorphism. Strain T:Y(wp^+)101 has a Y:A translocation which joins a piece of the Y-chromosome to chromosome 4 (map position 52C). Strain T:Y(wp^+)30C has a Y-linked translocation involving also chromosome 4 (map position 55C). This translocation breakpoint is situated in the immediate vicinity of the autosomal centromere. Strain T:Y(wp^+)30C has proved more stable under mass-rearing conditions than strain T:Y(wp^+)101. This may suggest that the white pupae gene lies close to the centromere.

The induction and isolation of recessive temperature-sensitive lethal (tsl) mutants was continued. More than 20 F3 families, containing tsl mutants, which were active in the early larval stage, were isolated. However, further inbreeding of these families in single pairs failed to produce true breeding lines despite up to five generations of further selection, and appeared to produce tsl mutants very similar in stability to the previously induced tsl mutants with activity in the egg stage. For this reason we will shortly initiate attempts to induce tsl mutations with soft X-rays rather than, as in the past, with EMS.

The new white female/brown male puparia medfly genetic sexing strain, T:Y(wp^+)30C, which was mass-reared for ten generations without showing signs of recombination, is now being used to assess the effects of contamination on the stability of this strain. Several frequencies of contamination with each sex of the wild type EgII strain were initiated in laboratory cages and the progression of aberrant phenotypes was determined each generation. The ultimate aim of this research is to produce sufficient data on factors affecting the rate of breakdown of genetic sexing strains. These data will then be placed in a computer model and will thus facilitate the taking of counteractive measures to reduce to a minimum the possibility of breakdown in genetic sexing strains.

E. Future Activities

A co-ordinated research programme on "Development of Genetic Sexing Mechanisms in Fruit Flies through Manipulation of Radiation-Induced Conditional Lethals and Other Genetic Measures" will terminate with a research co-ordination meeting in Colymbari, Crete, Greece from 3 - 7 September 1988. We anticipate that the papers prepared for this meeting will be published by the IAEA.

The revision of our laboratory training manual on isotopes and radiation in entomology is nearly complete. It will go to the editors and printers within the next couple of months.

The two new co-ordinated research programmes which are being initiated in 1988 ("Development of Practices for Area-wide Tsetse Eradication or Control with Emphasis on the Sterile Insect Technique" and "Laboratory and Field Evaluation of Genetically Altered Medflies for Use in Sterile Insect Technique Programmes") are open for project proposals. Qualified scientists who wish to participate in either of these programmes should contact the Section for additional information.

We have tentatively scheduled three research co-ordination meetings for 1989. These are:

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

2. "Radiation-Induced F1 Sterility in Lepidoptera for Area-Wide Control";

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

A seminar on the "Sterile Insect Technique for Fruit Fly Control or Eradication in Latin America" will be held in Guatemala City, Guatemala, 17 - 21 April 1989. We anticipate about 40 to 50 people participating in this seminar. In conjunction with the seminar, we anticipate holding a training course on the "Use of the Sterile Insect Technique for Medfly Control or Eradication". The exact dates of the training course have not been established, however, it probably will be the three weeks before or after the seminar, with the seminar itself being one week of the training course.

A second regional training course will be held at ICIPE, Nairobi, Kenya during 1989. This training course will emphasize the use of isotopes in entomological problems, both basic and applied, typical of Africa. Knowledge and experience on the use of isotopes has become so common in developed countries that it sometimes appears unrealistic to sponsor training courses on the use of isotopes in developing countries. However, in many developing countries the lack of expertise, as well as equipment, to utilize isotopes is hindering rapid development, thus regional training courses on the use of isotopes in entomology (as well as other agricultural topics) continue to be an effective means of transferring technology.

IV. ABSTRACTS OF RESEARCH PAPERS

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Induced suppression of genetic recombination in females of the Mediterranean fruit fly, Ceratitis capitata (Wied.), by translocation heterzygosity.
Genetica 72: 161-169 (1987)

Abstract

Chromosomal recombination suppressors (RS) were induced and studied as part of a programme to induce and isolate temperature-sensitive recessive lethal factors, for subsequent use in genetic sexing mechanisms in the medfly, Ceratitis capitata (Wied.).

The presence of induced RS factors was identified through the complete linkage of two morphological markers, ap and dc, located 18.25 recombination units apart. Adult +dc males were irradiated one day after emergence with 50 Gy in a cobalt-60 source. The irradiated males were mated to marked ap+ females and the F1 females were crossed to ap dc males. A total of 5 heterozygous RS factors was isolated from 570 irradiated and screened chromosomes. Suppression of female recombination in the heterozygous lines ranged from 77.6% in RS19 to 99.1% in RS30B. Chromosomal analysis showed all RS lines to contain a single reciprocal translocation involving in all cases chromosome 3 and one other autosome. It appears that recombination between the two morphological markers is suppressed either through lethality conferred upon the gametes, which results from recombinant events taking place in the interstitial segment between the centromere and the translocation breakpoints, or through interference by the translocation heterozygote with the initiation or maintenance of cross-over synapsis thus preventing the appearance of cross-over products.

All 5 translocations involved chromosome 3 and one of the other autosomes, providing the first evidence for a correlation between the ap-dc linkage group and chromosome 3.

E. Busch-Petersen, J. Ripfel, A. Pyrek and A. Kafu
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Isolation and mass rearing of a pupal genetic sexing strain of the Mediterranean fruit fly, Ceratitis capitata (Wied.)
IAEA-SM-301/35

Abstract

The induction and isolation of a multiple translocation strain in the Mediterranean fruit fly is described. Cytological analysis of this strain, T30C, showed the presence of a reciprocal autosomal translocation. In addition, a Y-autosome translocation, not involved in the reciprocal A-A translocation, was observed in meiotic chromosome preparations on a single occasion. Male viability of T30C was reduced both in the homozygous and in the heterozygous configuration when measured as egg hatch and as adult emergence, whereas a significant reduction in female viability was observed only in the egg hatch of the homozygous configuration, thus indicating the possible presence of chromosomal aberrations in male flies not present in female flies. T30C was backcrossed to the homozygous wp mutant, resulting in the genetic sexing strain T:Y(wp$^+$)30C, in which males emerge consistently from brown puparia and females from white. Laboratory scale rearing for 24 generations provided no indication of instability in this strain. Mass rearing for 10 generations resulted in the presence of 2.3% fertile females among the brown pupae, the first such females being observed in generation 4. A very low level of males emerging from white puparia was observed in almost every generation from the parental generation onwards. However, this level did not appear to increase. The possible cause of the observed low level of instability in T:Y(wp$^+$)30C when mass reared is discussed, and it is concluded that this was caused by the accidental introduction of foreign gene pools. The overall viability of the mass reared T:Y(wp$^+$)30C did not differ significantly from that of the standard mass reared "Sohag" strain. The stability and viability of T:Y(wp$^+$)30C thus renders this strain suitable for inclusion in SIT programmes dependent upon the release of only the male sex.

Dr. E. Busch-Petersen & A. Kafu
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Stability of two mass reared genetic sexing strains of the Mediterranean fruit fly, Ceratitis capitata (Wiedemann) (Diptera: Tephritidae), based on pupal colour dimorphisms.
Environmental Entomology (submitted)

Abstract

Two genetic sexing strains of the Mediterranean fruit fly, Ceratitis capitata, were mass reared. Both strains contain a Y-autosome translocation which links the wild-type brown allele of the white pupae (wp) gene to the male-determining Y chromosome. Continuous inbreeding of each strain results in the production of brown male and white female puparia, thus enabling the automated separation of the sexes prior to the release of sterilized males in sterile insect technique pest management control or eradication programmes against this pest. Past experience has shown such strains to be prone to break-down through a variety of mechanisms. The present experiments were designed to assess the stability of both strains under mass rearing conditions. Aberrant brown female pupae appeared in the T:Y(wp^+)101 strain in the first generation of mass rearing. By the fifth generation the reproducing component of these constituted 24.4% of the brown pupae. The corresponding level of aberrant phenotypes in the brown pupae of the T:Y(wp^+)30C strain was 2.3% by generation 10. The first reproducing aberrant females appeared in generation 4 of this strain. The frequency of reproducing, aberrant white male pupae in T:Y(wp^+)101 also increased with successive generations, reaching 12.4% in generation 5. No increase in aberrant white males was observed in T:Y(wp^+)30C. The results indicated that the break-down of the T:Y(wp^+)101 strain was caused by a low degree of male recombination combined with a high genetic load carried by the mutant wp allele. Whether or not the rate of break-down observed in this strain was accelerated by an accidental introduction of wild-type genotypes could not be conclusively determined. The slight break-down in T:Y(wp^+)30C was attributed solely to an introduction of wild-type material, and no indication of male recombination could be found. The overall viability of the latter strain was not significantly different from that of the standard, mass reared "Sohag" strain. It is concluded that T:Y(wp^+)30C is acceptable for mass rearing and that it shows excellent potential for utilization in SIT programmes relying and depending upon the release of genetically sexed sterile males.

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Quality control of a mass reared genetic sexing strain of the Mediterranean fruit fly, based on a pupal colour dimorphism. Entomologia experimentalis et applicata (in press)

Abstract

Quality control charts were employed to monitor the quality of several parameters during factory mass rearing of the T:Y(wp^+)30C strain of Ceratitis capitata (Wiedemann), in which male and female flies emerge from brown and white puparia, respectively. Egg hatch and pupal recovery in this genetic sexing strain were below that of the standard, wild-type "Sohag" strain, whereas pupal size, adult emergence and flight ability were higher. The overall recovery from eggs to adult flies capable of flight was similar in the two strains. The quality control charts showed an acceptable level of variation within sets of data but the level between data sets was occasionally out of control. This indicated the presence of uncontrolled conditions during the rearing process, probably arising from variations in the quality of the larval diet. It is concluded that the quality of T:Y(wp^+)30C renders this strain suitable for mass rearing in sterile insect technique (SIT) programmes relying and depending upon the elimination of the female flies prior to the release of sterilized males. The importance of optimal and standardized dietary conditions is discussed in relation to the quality of mass reared medflies.

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GAMMA IRRADIATION OF SPODOPTERA LITTORALIS EGGS AND NEONATE LARVAE TO ELIMINATE THE PEST ON FLOWERS FOR EXPORT

"HASSADEH", 68:710-711 (1988)

The effect of gamma irradiation on eggs and neonate larvae of Spodoptera littoralis was studied. Egg clusters aged 0-48 h irradiated by a gamma source of cobalt 60 were killed at the low dose of 5 krad. The dose of 50 krad killed eggs aged 72 h. Two-day old eggs laid on petals of Chrysanthemum sp. flowers did not hatch following a treatment with 25 krad.

A dose of 125 krad caused total mortality in neonate larvae and may be suitable for elimination of the pest in flowers for export.

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The Effects of Fast Electron Radiation on the Development of Trogoderma granarium (Everts) (Coleoptera: Dermestidae)

Effects of fast electrons radiation exposures (range from 0 to 1.00 kGy) on the developmental stages of Trogoderma granarium were studied. Adults were very sensitive to this kind of radiation and were sterilized when irradiated at 10 Gy or higher. Although treated females laid some eggs their viability was very low. Pupal development was stopped with 400 Gy and adults, that emerged from pupae treated by lower doses were sterile. Similar effect caused also the lowest apllied dose (5 Gy). Larvae did not develop after treating them by dose 50 Gy or high. Postradiation ovipositional behaviour of T.granarium was observed in two different conditional combinations. One group of treated adults was reared in cages with supply of food. The second group was after radiation kept in empty cages. Results show that food established an important ovipositional factor. Fast electrons established convenient and efficient method for reducing population of T.granarium.

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Sterile insect technique for control of the greenhouse whitefly: possibilities of use and problems involved
ESNA, XVIIIth Annual Meeting, 1987, Stara Zagora, Bulgaria

Abstract

The present report refers results of small scale experiments for population suppression of the greenhouse whitefly (Trialeurodes vaporariorum) on cucumber plants by releasing of radiation sterilized males and females (ratio 30+30 : 1+1). The sterile insects were intrduced in the native population in form of irradiated puparia. On the whole the effect could be considered as a conversion of the parthenogenesis (arrhenotoky) from a necessary for the normal reproduction of this insect process into a lethal for the population factor. The potentials of SIT for controling the whitefly after independent application or in integrated programmes are discussed

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Qualitative change in the laboratory-reared Oriental fruit fly, Dacus dorsalis Hendel

The deterioriation of the quality of the laboratory-reared Oriental fruit flies for use in the Sterile Insect Technique (SIT) is a major concern in the planned integrated control program of mango fruit fly in the Philippines.

This paper discusses the following aspects to evaluate the quality of fruit flies reared in the laboratory (L) over a hundred generations as compared with field (F) flies: 1) the size and weight of the puparia 2) the size of the ovaries 3) the ovipositional behavior and 4) the mating preference.

The studies conducted showed that:

1. the mean lengths and weights of the puparia of both strains did not differ markedly.
2. the ovarian measurements and ovariole counts indicated that the ovaries of the L-strain females developed earlier than those of F-strain
3. L-reared flies showed early and large amount of egg production than those of field strains
4. the pre-oviposition periods of L- and F- strains were 10 and 16 days respectively
5. L-strains mated readily with their respertive strains than with field flies; and field flies accordingly, mated less readily than the L-strains.

Although the early and large amount of egg production, hence, early sexual maturation in L-strain seem beneficial traits for mass-rearing, the noted change in the mating behavior will affect the success of SIT for the planned integrated program of fruit flies in the Philippines. Hence efforts are being directed to rpevent the development of inferior traits in the laboratory-reared flies.

RESEARCH COORDINATION MEETING

"DEVELOPMENT OF METHODOLOGIES FOR THE APPLICATION OF THE STERILE INSECT TECHNIQUE FOR TSETSE ERADICATION CONTROL"

Vom, Plateau State, Nigeria

6 to 10 june 1988

M. CLAIR

IEMVT - SUMMARY

The control operation against tsetse flies with sterile insect technique SIT in Burkina Faso by the CRTA (IEMVT/GTZ project) of Bobo-Dioulasso ended in 1984 with the eradication of the three tsetse species present in the area.

This control operation in the pastoral zone of Sideradougou which is more than 3 000 km2 large began in the 1983.

The elimination of *G.p. gambiensis* and of *G. tachinoides* and *G. morsitans submorsitans* has been achieved by the integration of two non polluting methods.

The CRTA first reduced the tsetse population by placing insecticide impregnated screens along the gallery forest during the 1983 dry season, followed by the release of steriles males of these species throughout the rainy season. The same pattern has been used next year placing so, nearly 12 000 screens and traps and releasing more than 900 000 steriles males. *G. morsitans submorsitans* only found in a little part of the south-east have been controled by several rows of traps. The zone was isolated by barriers on rivers with traps and screens (about 1 700) placed every 100 metres along several kilometers of riverine forest.

Since that campain the zone is free of tsetse. It is the first time a so large scale operation using the sterile insect technique (S I T) has been employed demonstrating the feasibility of this integrated method control.

From 1985 the only remaining operation have been maintenance of the barriers and monitoring of the zone by traps every two months.

Since 1983 the CRTA besides this conservatives measures engaged in research to increase the efficacy of the population suppression methods by working on the forms and the colours of traps and targets as well as the use of olfactory attractants for trapping ; mainly for *G. morsitans submorsitans*.

Numerous compounds sent by ODNRI have been tried on the field but without finding new ones as effective as acetone octenol. As riverine tsetse do not react to them one experiment has been carried out to know if these species are or not sensitive to odours attractants. The experiments made with animal hosts have demonstrated that *G. tachinoides* are attracted by odours and that it is possible to isolated them. Further research is presently carried out on those subjects.

And the tsetse mass rearing, which has exceeded more than 300 000 producind females durint he SIT campaign in 1984, have been strongly reduced keeping only six colonies of three species for further programme.

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W.J. Kloft, G.H. Hesse, H. Kirch & E. Platten

(Institute of Applied Zoology, University of Bonn / FRG)

Influence of different nutritional sources on hemolymph composition and vitellogenesis in hematophagous arthropods under special consideration of methods for the quantitative analysis of lipid components, protein and glucose content within hemolymph and eggs of the tick ORNITHODOROS MOUBATA (MURRAY, 1877 sensu WALTON, 1962 (IXODOIDEA: ARGASIDAE).

As early as 1981 for the soft tick Ornithodorus moubata could be demonstrated, that different blood-sources after in vitro feeding over a membrane feeding system have effects on the actual duration of feeding (feeding time) and body weight. For most of our experiments we have been working with two strains which have been fed over generations either on defibrinated bovine blood (RB-ticks, RB stands for Rinder-Blut) or pig blood (SB-ticks, SB stands for Schweine-Blut). The hemolymph volume of both strains was determined with the indirect ^{14}C-Inuline-dilution method. We used as further blood sources also human blood (MB stands for Menschen-Blut) and rabbit blood (KB stands for Kaninchen-Blut). In all cases feeding time, gain of body weight and hemolymph volume of the ticks was determined. We made quantitative determinations of triglycerides, glyceride-glycerin, total protein and glucose under use of enzymatic methods.
Additionally we used polyacrylamide-gel-electrophoresis for separation of proteins in the hemolymph as well as the eggs of the tick O. moubata. All tests have been carried out 2,4,6,8 and 10 days after feeding. For the females all analytic work has been done in relation to the deposition of eggs, so far the ovarial "cycles" have been considered. Female ticks always have higher amounts than males. The relation of triglyceride-glycerin to the sum of free glycerin, total glycerin and glycerid is increased in a distinct way, however follows constant fluctuations. The strain fed with bovine blood shows the highest accumulation of hemolymph proteins. We refer to the fact, that in insects the hemolymph proteins play a rôle for transportation of lipids, possibly these results could be transferred also to tick physiology. The glucose content within the eggs is increasing with the time after deposition and reaches at day 10 its highest values.

To find out if there occurs passage of undigested host serum proteins across the gut barrier, experiments have been conducted to analyse the hemolymph for the presence of meal proteins. The presence of meal proteins in the hemolymph immediately after feeding implies a rapid passage across the gut barrier which could be interpreted on the basis of changes in midgut structure. Immunoelectrophoretic analysis showed the occurence of this passage and could also be used for the demonstration of elimination of these proteins with the coxal fluid. After feeding on bovine blood, serum albumin, immunoglobulin G and transferrin were detected in the coxal fluid.

IAEA Research Agreement. Report of Activities at TRL since 1984

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Abstract

Research activities at the TRL are, in general, directed towards the control of the African trypanosomiases. The work can be broadly divided into two areas: 1) advancing our understanding of the behaviour and physiology of tsetse flies as vectors of the disease, with a view to exploiting such knowledge for the improvement of existing techniques and the development of new techniques for tsetse control or eradication; 2) elucidating the basis of infectibility of tsetse by trypanosomes and evaluation of one or more methods of applying genetic methods to the control of the spread of trypanosomiasis.

Laboratory and field analyses of responses of tsetse to a variety of visual, olfactory and sexually mediated stimuli are directed towards improvement of attractiveness and efficiency of traps and targets for sampling tsetse populations and for tsetse control. Replacement of insecticides with more environmentally acceptable and cost effective substances for use on targets or in traps for tsetse control is a further aim. Attention is focussed currently on the use of insect hormones to disrupt reproduction and therefore to act as chemical sterilants for tsetse.

The dynamics of blood meal digestion, lipid synthesis and utilisation, changes in body size and age structure of tsetse populations are being investigated. A service has been established to aid field workers by subjecting their field-caught samples to these analytical procedures.

A genetic basis for infectibility of tsetse with trypanosomes has been established and the biochemical basis of such infectibility is currently being investigated.

All research undertaken at TRL depends upon the continuous availability of tsetse. Colonies of *G. m. morsitans*, *G. p. palpalis*, *G. austeni* and *G. pallidipes* are maintained routinely to supply research material for workers at TRL and elsewhere.

The effect of rearing diet on infection rates in flies released for control of tsetse populations by sterile males

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Summary

In areas where sleeping sickness is endemic, it is the practice of SIT programmes to give sterilized males a bloodmeal before release into the wild to reduce the risk of these released flies acting as disease vectors. This strategy has been adopted because of experimental evidence which showed that it was essential to infect flies at their first feed to establish a T. b. gambiense or T. b. rhodesiense infection in tsetse. The aim of the present work was to test artificial tsetse diets produced at the Siebersdorf Laboratory to determine whether they were as effective as whole blood in inhibiting T. brucei s.l. infections in flies.

Seven artificial diets were tested with T. b. rhodesiense; G. m. morsitans males were fed one meal of the diet and then starved for three days before the infective feed. None of these diets significantly altered infection rates : the seven groups produced a mean midgut rate of 16% compared with 17% in control flies fed pig blood 17%. Flies infected as tenerals with the same trypanosome stock produced midgut rates of 61%.

Three of the diets were also tested with a T. congolense stock. There were no significant differences between artificial (mean midgut infection rate 15%) and whole blood fed flies (19%). G. m. morsitans infected as tenerals with this trypanosome stock produced midgut rates of 66%. As with T. brucei s.l. infections, teneral flies were far more likely to develop a T. congolense infection than fed flies; this result suggests that all tsetse flies used in SIT programmes should be fed before release to reduce the risk both to man and his livestock. Artificial diets are as effective as whole blood in inhibiting trypanosome infections.

The effect of bloodmeal on fly infection rates is discussed in relation to lectin production in fed flies.

June 1988, F. A. O. / I. A. E. A. Tsetse R. C. M. Report:

On the genetics of Glossina pallidipes and G. morsitans subspecies.

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Abstract

This report contains a review of published work and new data on tsetse genetics carried out as part of Research Agreement No. 4044/R1/CF.

Using polyacrylamide gel electrophoresis, Glossina pallidipes from I.C.I.P.E.'s Mbita Point colony were found to have 6 monomorphic loci and 6 polymorphic loci. Sex ratio distortion, resulting in production of an excess of females, in colonies of Glossina morsitans submorsitans was shown to be controlled by an X chromosome locus and a breeding program designed and undertaken to produce a colony having 50% males. Genetic variability in field and laboratory colonies of Glossina morsitans morsitans from Zimbabwe and Glossina morsitans centralis from Zambia have been estimated using polyacrylamide gel electrophoresis. Hybridization techniques were used to confirm that a tsetse colony maintained by the Zambian National Council for Scientific Research was G. m. centralis. The locus for tetrazolium oxidase has been mapped in linkage group I and further refinements to linkage group II have been carried out in G. m. morsitans. Field collected G. m. morsitans from Zimbabwe have been examined for linkage disequilibrium in linkage group II. Studies of the genetic basis of sterility in hybrid males, produced by crossing G. m. morsitans and G. m. centralis, have been continued and limitations to the proposed use of the maternally inherited sterility factors, as agents for genetic control of G. m. centralis, have been uncovered.

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Freeze-dried blood and development of an artificial diet for blood feeding arthropods.

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ABSTRACT

The goals of research at College Station were to determine biochemical differences in freeze-dried bovine and porcine blood relative to their nutritional value to Glossina palpalis palpalis and Stomoxys calcitrans and to develop an artificial diet for mass rearing these flies. Freeze-dried bovine and porcine blood differ in their amino acid content. Total lipids did not significantly differ but some notable exceptions were found for their fatty acid content. Both sonication and additon of fetal bovine serum to freeze-dried bovine blood improved its nutritional value to G. p. palpalis. A two component semidefined artificial diet was developed for both G. p. palpalis and S. calcitrans. The College Station diet consisted of lipid contaminated bovine hemoglobin and bovine serum albumin. To conduct dietary deletion tests, we developed a process for preparing large quantities of ultrapure lipid-free bovine hemoglobin (BHb). S. calcitrans fed on lipid-free BHb plus BSA had zero fecundity. Lipids were added back to the protein diet in 3 forms: 1) lipid contaminated BHb, 2) pure erythrocyte ghosts, and 3) pure lipids. It was found that membrane lipid from the erythrocyte is required by S. calcitrans. A defined artificial diet consisting of lipid free BHb, BSA, sphingomyelin, phosphatidyl ethanolamine, phosphatidyl serine, and cholesterol gave normal adult survival, nearly normal fecundity, and percentage of egg hatch for S. calcitrans. With the identity of lipids, it is now possible to prepare dietary formulations to obviate the dependency on blood proteins Hb and BSA.

*Deceased.

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Study of mycetome and symbionts of tsetse flies kept on membrane feeding system and agents interfering with natural reproduction

Tomas Soldan* Vladimir Matha and Frantisek Weyda

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footnote

*) Principal investigator of scientific contract No. 3969/RB

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Abtract. Mycetomes from male and female adult and puparia of Glossina palpalis palpalis were dissected from specimens obtained from Seibersdorf Biotechnology Laboratory, IAEA, Vienna. The structure and ultrastructure of mycetocytes and endosymbionts and their quantitative changes are described and compared with some other species of tsetse fly. Pronounced degenerative morphological changes can be caused, among other factors, by starvation. On the contrary, irradiation by gamma rays showed only slight structural changes and non-significant quantitative changes of endosymbionts. When culturing in organ culture (Leibowitz medium) mycetomes of unfed females release spherical clusters of mycetocytes and lose their dense cover of microvilli. Ultrastructural changes of individual endosymbionts under these conditions are described in detail. The results of basic bioassays showing intensive DNA synthesis and in vitro production of several de novo synthesized proteins of molecular weights from 52-159 kD are discussed with respect to recent knowledge on production of essential substances. Some aspects of possible role of endosymbionts in reproduction and transmission to the offspring are discussed as well. While the necessity of a functional mycetome in females can be at least partially explained by the production of proteins necessary for reproduction, the role of mycetome in males remains still unclear. The function of tsetse mycetome is shown to be much more complex than it has been supposed earlier. Consequently, further detailed data on its reproductive function are needed.

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Abstract

The estimation of vital parameters of tsetse (Glossina) populations using mark recapture techniques.

J. W. Hargrove

Careful analysis of mark-recapture data produced during the four and a half year experiment (October 1979 - April 1984) on Antelope Island, Lake Kariba, Zimbabwe has indicated that the system of marking chosen for the bulk of the experiment was such that the normal Jolly-Seber (J-S) estimates of the vital parameters are clearly in error. The errors do not invalidate, in any way, the major practical conclusions regarding the efficacy of odour-baited targets to eradicate tsetse populations. However, better estimators are required if the full potential of the very extensive data set is to be exploited, particularly in the construction of a comprehensive population model. Research has concentrated on the production of such estimates, and various solutions are suggested. The theoretical solutions produced suggest ways in which the general methods of producing pooled estimates from mark-recapture data can be modified in such a way as to produce estimates of the vital parameters with smaller biases and variances than those presently in use.

It is demonstrated that, with the non-standard marking system used, the errors in the J-S estimates are a function of the survival probability, and the probability of capture, of the flies. Results for Antelope Island are quoted for male G. morsitans. The marked population and the fraction of the population which is marked are both always underestimated by the J-S solutions, sometimes by as much as 50%. The total population, as a consequence, may be underestimated or overestimated, depending on the balance between the errors in the previous two estimates. In the case of male G. morsitans the population is overestimated, generally by between 4 and 12%. The probability of survival is itself overestimated, by between 5 and 20%; the estimate is worst for low survival probabilities, but the relationship is not as marked as in the case of the marked population. The number of births, which always shows the greatest variation anyway in J-S estimation, does not show a consistent error, it is suggested that this is due in part to a cancellation of errors in the other estimates used to calculate the number of births.

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DEVELOPMENT OF SYNTHETIC DIETS AND THEIR USE IN STUDIES ON TSETSE NUTRITION

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SUMMARY

Synthetic diets recently developed for tsetse flies are being used to gain further understanding of dietary requirements of blood-feeding arthropods.

Being simple and relatively determinate in composition compared to whole blood, synthetic diets can be altered specifically in composition and the effects of such treatments on the nutritional quality can be unambiguously related to particular components of the diet.

THE POPULATION DYNAMICS OF GLOSSINA, FUSCIPES FUSCIPES. Newst ON BUVUMA ISLAND, LAKE VICTORIA, UGANDA

BY

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Abstract

The survey to establish the incidence, distribution and population dynamics of tsetse flies showed that Glossina fuscipes fuscipes Newst was the most abundant species of Glossina on Buvuma Island. This species occured in the south east, western and the northern parts of the island. Although the vector is both riverine and peridomestic in its habits, the survey revealed that its population was concentrated mainly within a distance of about 2 km. from the lake shores around homesteads, in the banana plantations, forest edge and roadsides, fishing villages and ports of call, grazing grounds and water collection points.

Studies of the population dynamics revealed seasonal variations in the abundance of the species, with a peak during the main dry season, that is in the months of January and February. The breeding peak was reached/attained during the minor rainy season. Trap catches were highest in fishing villages and ports of call, followed in a decreasing order by catches at forest edge/roadside, locations, water collection points, houses, banana plantations and grazing grounds. It would therefore appear that the fishing villages and ports of call were areas of high fly activity and possibly the most suitable breeding grounds. The efficiency of the traps was reflected in the fact that G.f. fuscipes populations were reduced by up to 95% in Tome and 90% in Buliba/Walwanda and Lwenyanja villages. Many puparia were also found on the sandy beaches around fishing villages and ports of call. There was evidence of fly movement between the islands and the main land, indicating that although geographically isolated, Buvuma Island is not isolated from the mainland in terms of tsetse movement.

Ecology of *Glossina* species in the derived savanna zone of Anambra State, Nigeria, in relation to the sterile male technique.

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ABSTRACT

The unbaited blue biconical trap was used to sample populations of *Glossina* once a week from April 1984 to March 1988 in three peridomestic agroecosystems of the Nsukka area, Nigeria. Only *G. palpalis* and *G. tachinoides* were caught with the latter being more widespread and constituting 99.87% of all 16,862 tsetse caught. Serological analysis of 1,764 fly midgut contents revealed that these peridomestic *G. tachinoides* feed on reptiles, birds and mammals, the domestic pig accounting for 88.08% of 730 identifiable blood meals. The frequency distribution of flies in various stages of the trophic cycle revealed that males and females feed at 2.88±0.42 and 2.43±0.44-day intervals respectively. Of 10,208 flies examined for trypanosomes, approx. 1% were infected with only *Trypanosoma brucei*- and *T. congolense*-group trypanosomes, the latter accounting for 53% of all 111 mature infections encountered. The sex ratio in these peridomestic fly populations was variable, being 1 : 1 in one agroecosystem but departing significantly ($P<0.001$) from 1 : 1 in the others, and differed markedly between biotopes and seasons. Within an agroecosystem flies were caught in greater numbers in biotopes containing domestic pigs but even in such biotopes the presence of man depressed trap catches. The larger the pig population in an agroecosystem, the larger was its *G. tachinoides* population. However, reduction of the pig population to below 5 triggered the collapse of one of the *G. tachinoides* populations which eventually disappeared following complete removal of all pigs. The fly populations exhibited marked seasonal fluctuations in apparent density largely caused by routine agronomic practices which undermine recruitment of new adults into the population especially during the wet season.

It is suggested that in Nsukka peridomestic agroecosystems tsetse populations, already being kept at low density by routine agricultural procedures, could be further reduced effectively by combining insecticide-impregnated traps or targets with insect-proofing of piggeries; methods aimed at undermining the recruitment of young adults into tsetse populations, capitalising on naturally occuring sex ratio distortion as well as maintaining populations of preferred hosts of the tsetse at low levels should form part of integrated tsetse control packages; selection of sterile male release sites and numbers of sterile males to be released in them during SIT campaigns should take into account the sex ratio dynamics of target tsetse populations in time and space.

Effects of Nutritional Quality of Locally Obtained blood diets on the performance of *Glossina palpalis palpalis* fed *in vitro*.

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SUMMARY:

Three separate experiments to evaluate the effects of nutritional quality of locally obtained blood diets on the overall performance of *Glossina p. palpalis* fed *in vitro* were conducted.

In the first experiment, a batch of thirty teneral *G. palpalis* female flies were fed *in vitro* 6 days a week on protein-deficient bovine blood diet for 25 days. A second batch of thirty teneral female flies fed on normal bovine blood diet were used as control. The performance of the test and control groups in terms of survival rate, productivity and puparia weight were observed for 25 days post emergence and evaluated.

The mean pupal weight of the control flies was higher significantly at 0.05 level in comparison than with the value obtained in the test group. However, the survival rates and fecundity in both groups did not differ significantly.

In the second experiment, batches of female *Glossina palpalis* were similarly fed *in vitro* but on camel and cow blood diets for 25 days period. The survival rate, productivity and puparia weight produced of the two groups of flies maintained on camel and bovine blood diet were compared. More puparia of higher weight classes were produced by flies fed on the cow than camel blood.

In third and last experiment, six groups of teneral female flies with 50 in each group were maintained on blood diets with different cellular and plasma concentrations. The overall performance of the flies in each group in terms of survival rates, productivity and puparial weight observed over a period of 35 days were similarly evaluated.

Flies fed on diets with packed cell volume (PCV) between 20 and 36% performed better than those on diets with PCV 60% and above. The groups maintained on 100% plasma and 100% cell performed poorly.

FOUR YEARS OF TRYPANOSOMIASIS SURVEILLANCE IN A SELECTED AREA IN NIGERIA UNDER INTENSIVE TSETSE CONTROL BY THE STERILE INSECT TECHNIQUE.

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SUMMARY

Between March 1984 to March 1988 animal surveys for bovine trypanosomiasis were conducted periodically on resident herds in the Biological Control of Tsetse (BICOT) Project area in Lafia, Plateau State, Nigeria, using the standard detection methods. Over a specified period sentinel herds were also examined in selected locations within the project area. Fly trapping and dissection were similarly used for screening of both wild viable fertile flies, and sterile laboratory reared flies released in the area. Both in the resident and sentinel herds infections were detected consistently showing persistence of disease throughout the period of survey. Fly trapping and dissection revealed that the target species, Glossina p. palpalis was effectively eliminated from the control zone, or may be persisting only at an undetectable level. However, G. tachinoides seems to be present in most of these areas and may therefore have been responsible for the persistence of infection. Infection among resident herds could have also been due to migratory activities which took them to areas outside the control project zone and on return would have become infected.

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