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 & PEST CONTROL SECTION

NEWSLETTER

AND

INFORMATION CIRCULAR

ON

RADIATION TECHNIQUES AND THEIR

APPLICATION TO INSECT PESTS

No. 38

December 1986

SYMPOSIUM ANNOUNCEMENT

FAO/IAEA INTERNATIONAL SYMPOSIUM

ON

MODERN INSECT CONTROL: NUCLEAR TECHNIQUES AND BIOTECHNOLOGY

16 - 20 NOVEMBER 1987: VIENNA

FULL DETAILS ARE ENCLOSED IN THE CIRCULAR

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 FEBRUARY - MARCH 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.

December 1986

Dear Colleague,

Enclosed please find the 38th 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 39th issue and would appreciate receiving contributions from you and/or your associates by 1 June 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 38th Information Circular.

Yours sincerely,

Evans D. Offori
Insect & Pest Control Section

Encl.

CONTENTS

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.

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.

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
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
N. Bruzzone (FAO Associate Expert)	Medfly Rearing
T. El-Abbassi	Medfly Investigations : B.t. studies

BICOT

M. Oladunmade	Project Leader and Officer-in-Charge, Field Operations
U. Feldmann	Technical Advisor (IAEA) and Team Leader, Laboratory Operations

PERU-MED

R. Rhode Project Director

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.

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, Ceratitis capitata. Research undertaken on this pest aims to:

(a) develop less expensive larval and adult diets with particular emphasis on locally available ingredients (non-imported) from various parts of the world;
(b) improve systems of rearing;
(c) develop laboratory and field quality control techniques;
(d) improve handling techniques for large numbers (100's 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 sexing systems.

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, sterilized flies, study possible genetic and/or behavioural changes taking place during colonization and mass-rearing;
(h) conduct cross-breeding experiments with morphological mutants;
(i) develop laboratory and field quality control techniques.

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

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

E. Experts and Consultants: July - December 1986

Name	Nationality	Location of Assignment	Dates and Task Performed
L.C. Madubunyi	Nigeria	Zambia	Ecology of *Glossina m. centralis*

F. Trainees in Entomology: January - December 1986

Seibersdorf

(a) Tsetse Group

P.W. Mukiria	Kenya	85-09-16 to 86-01-13
O. Chalo	Tanzania	86-05-05 to 86-08-04
A. Pochet (cost-free)	Belgium	86-01-06 to 86-02-07
B. Bakuli	Tanzania	86-09-01 to 86-11-30
T.N. Kangwagye (S.V.)	Uganda	86-09-15 to 86-09-26
M.K. Gao (S.V.)	Tanzania	86-09-15 to 86-09-26

(b) Medfly Group

M.A. Ben Youssef	Libya	85-10-28 to 86-07-27
M.N. Elagal	Libya	85-10-28 to 86-08-27
E. Ahmed	Egypt	86-01-22 to 86-07-21
N. El-Badan	Egypt	86-01-22 to 86-07-21
A.A. Kafu	Libya	86-10-09 to 87-04-08
Huang-Song Wang	China	86-10- to 87-04

III. NEWSLETTER

A. Special Features and Comments

A Tsetse Factory for Sterile Insect Technique Programmes

by D.A. Lindquist

Head, Insect & Pest Control Section

In recent discussions among tsetse entomologists and researchers, the need for establishing regional tsetse mass-rearing facilities for Sterile Insect Technique (SIT) tsetse eradication projects has been pointed out. It has been suggested that consideration should be given to concentrating support on groups that have proven abilities to mass-rear tsetse. Laboratories in Bobo Dioulasso and Vom have been cited as recent examples. On the other hand, based on success at the Tsetse Research Laboratory, Langford, United Kingdom and the FAO/IAEA Tsetse Laboratory, Seibersdorf, Austria, proponents of the idea point out that there is a strong case for establishing a mass-rearing facility in Europe where tsetse cannot survive if they escape from the rearing facility, and that airplane connections to many African countries are better than among African countries, etc. Both a tsetse factory in Europe and one or more tsetse factories in Africa have considerable merit.

However, before arriving at the point where a large tsetse mass-rearing facility can efficiently serve as a source of tsetse flies for SIT programmes, a number of considerations must be taken into account and some problems solved. As an example, let us take the possibility that Bobo Dioulasso would supply, on a contract basis, 50,000 male Glossina tachinoides or G. p. palpalis per week for the proposed expanded programme in Nigeria (BICOT II) with headquarters in Vom, Plateau State, Nigeria. The following are some of the considerations/problems which must be addressed and solved before this could realistically be undertaken:

1. Strain of tsetse flies

   The usual procedure in SIT programmes, which have been conducted in Africa, is to collect wild flies from the target area and bring them into the laboratory for rearing. Within 6 to 18 months (depending upon the number of flies brought into the laboratory and colony size required), a good tsetse colony should be available for use. The question arises as to whether G. p. palpalis should be reared in Bobo since this sub-species does not occur in the Bobo area. All previous work at that location was on G. p. gambiensis. There is a G. p. gambiensis and G. p. palpalis transition zone in Burkina Faso.

If G. tachinoides were to be reared at Bobo for use in Nigeria, the stock from which the colony was started must come from the target area in Nigeria, unless it can be definitely proven that the Bobo strain of G. tachinoides is biologically (genetically) the same as the Nigerian strain.

2. Supply of flies

The rearing facility must be such that it can guarantee supply of the required number and quality of flies on the agreed upon schedule. In this regard, the Bobo Laboratory has apparently been more successful than the Laboratory in Vom, which has been plagued with several serious problems over the past several years in maintaining a constant production of the number of flies required. These problems appear to have now been solved at Vom.

3. Transport

Transport of tsetse fly pupae is more like transporting orchids than books. Transport most likely will be by air. Tsetse fly pupae are very susceptible to temperatures above 28°C. Experience has been that if transport takes more than about 48 hours, the eclosion rate is frequently drastically reduced. Thus, transport must be fast; customs clearances and other delays must be avoided. Methods of packing tsetse fly pupae for shipment have not been completely worked out. Large numbers of pupae have been shipped from Vienna to Nigeria during the past several months with variable results. Recently, good results have been obtained.

4. Radiation source

Flies are sterilized either as adults or 48 hours before they emerge as adults, thus precluding fly sterilization at the production facility. The receiving organization therefore must have a radiation source for sterilizing tsetse flies. Also the blood used to feed the flies before release must be sterilized with radiation or the flies are fed on live animals, which requires animal maintenance/breeding facilities.

5. Fly handling facilities

The receiving location must have termperature and humidity controlled rooms for emergence, feeding and handling of the adults. Emergence cages, chillers to handle the flies, etc. must be available. The sterile flies for release must be handled, packaged and transported carefully to prevent damage which would reduce their ability to compete with wild flies.

6. Quality

When one orders large numbers of paper pads, 1000 liters of 25% EC malathion, or 10 cu. meters of premixed concrete, specifications regarding the quality of the product are prepared. These include size, number per package, percent water content, chemical analysis, etc. While this has been extensively addressed in SIT programmes against the Mediterranean fruit fly and the screwworm fly, little work has been done on the tsetse fly. Thus, it is virtually impossible today to write quality specifications for tsetse flies which are mass-reared for use in SIT programmes.

Some of the quality control tests which have been developed for the Medfly, screwworm fly, etc. can probably be modified for application to the tsetse fly. This will greatly shorten the time required to fully develop the specifications (quality factors) needed for tsetse flies.

At first sight, the above list of concerns and problems seems formidable. However, they have all been addressed and solved for SIT programmes against other insect species, and if tsetse fly scientists utilize what has been learned from these other programmes, the solutions to these problems will come rather rapidly.

The primary reason for the above problems is that all tsetse SIT programmes to date have had the responsibility to prove that the SIT works; insufficient resources were available for other necessary R&D activities. There has been much money spent in repeatedly proving that the technology works, even though it had already been proven for numerous other insect species. However, many scientists and administrators without experience in SIT programmes were sceptical, and funding was not available unless the project was aimed at proving the efficacy of the technology. This has been accomplished for tsetse flies and we are prepared to make the next step, which is to improve efficiency and further, increase effectiveness by developing improved strategies for utilizing the sterile tsetse flies, developing improved mass-rearing systems, etc.

In conclusion, it should be emphasized that if there were sources of large numbers of high quality tsetse flies available at a reasonable price, there is no doubt that tsetse eradication projects based on the SIT would be routinely operational in many parts of Africa.

B. Meetings

1. Research Co-ordination Meeting on the Development of Methodologies for the Application of the Sterile Insect Technique (SIT) for Tsetse Eradication or Control

The meeting in Vienna (22 - 26 September 1986) was the second to be held under the new programme. Eleven research contractors and agreement holders from 10 countries participated, as did staff of the Seibersdorf Entomology Laboratory, a representative of FAO and two tsetse project leaders from Uganda and Tanzania who were on scientific visit to the IAEA. Papers presented covered a wide range of subjects relating to tsetse diets, nutrition and mass-rearing, tsetse ecology, physiology, genetics and trypanosome transmission. Participants identified areas of research that should be emphasized in the immediate future, especially in support of on-going and proposed integrated tsetse control programmes.

A full report has been issued. Abstracts of presented papers appear elsewhere in this Information Circular.

2. Research Co-ordination Meeting on the Development of Sexing Mechanisms in Fruit Flies through Manipulation of Radiation-Induced Conditional Lethals and Other Genetic Measures

The subject meeting was held in conjunction with the "Second International Symposium on Fruit Flies" at Colymbari, Crete, Greece (16 - 19 September 1986). Because of extended interest by many participants of the Symposium, participation at the RCM was open to all interested persons. The synthesis of genetic strains of the Mediterranean fruit fly, Ceratitis capitata, continues to be a worthwhile goal because of the potential for reducing the expenses of mass-production of sterile flies.

In addition to the 12 papers presented by programme participants, three main topics were discussed, namely:

i. Areas requiring research emphasis and funding;

ii. Updating the Medfly Genetic Information Circular;

and

iii. Establishing a Medfly Stock Centre.

Several recommendations were made including the need for the Joint FAO/IAEA Division to continue its support for research on developing a genetic sexing system for Medflies. Abstracts of papers are included in this issue of the Information Circular.

C. Field Programmes

MOSCAMED - PERU

The project in Peru, initiated in 1983, aims at eradicating the Medfly from relatively isolated valleys (Tacna, Moquegua and others) in southern Peru. Eradication would free important fruit-growing areas from this pest and reduce or eliminate emigration of the Medfly across the Peru - Chile border. Fly population dynamics were monitored through intensive trapping (Steiner traps) and the native population reduced through bait-spraying with malathion, prior to release of sterile flies.

Mass-rearing was undertaken in the laboratory at La Molina (Lima). Pupae were sterilized by gamma radiation and transported weekly, by air, to Tacna, where sterile flies were re-packaged for release in pre-determined areas. Approximately 80 million flies were released per week at the peak of operations.

Eradication was envisaged for selected areas of the Tacna Valley during the year, however, several difficulties made this impossible. Among these, was the decision of chili and olive growers to delay harvesting their crops, in anticipation of higher market prices at a later date. Secondly, olive fruit farmers were unco-operative in not allowing olive trees to be sprayed at the appropriate time. The result of these incidents was an unseasonal increase in fly populations. The situation was further aggravated by an influx of citrus and mango fruit from Medfly infested areas of neighbouring Bolivia.

Measures taken in recent months to solve the problem included an official proclamation (Ministry of Agriculture) requiring fruit farmers to harvest their crops promptly during specified dates each year. In further support of the project, plans have been initiated by the Ministry of Agriculture to establish quarantine stations in vantage points in the project area, in anticipation of resumption of fly release operations.

BICOT: THE 14TH PAC MEETING

The Project Advisory Committee (PAC) was set up at the commencement of BICOT, to advise on project management, project activities and plan of action, to review the annual budget and recommend measures for effecting improvement in project operations.

The Committee consists of 7 members, 3 representing the IAEA and 3 the Federal Nigerian Government, plus a Chairman appointed by the Nigerian Ministry of Agriculture. Since its inception, the PAC has met twice a year, as far as possible, in June and November.

At its 14th Meeting on 26 November 1986 reports were presented by the project leader and the technical adviser on field operations during this final phase of BICOT, including plans for post-eradication monitoring activities and institution of quarantine procedures aimed at protecting the areas freed of tsetse.

Already, the boundary zones to the east and west and areas adjacent to the 4 forest patches to the south, have been secured against possible re-invasion, using insecticide-impregnated blue screens. Occassionally, screens that have been in use for several months are checked, re-impregnated and re-installed. The possibility of utilizing sterile males as a biological quarantine is under consideration. Procedures are being worked out for monitoring trypanosome incidence in the tsetse-cleared project area, using trypanosome-free sentinel animals.

Current Research and Field Activities of the Tsetse and Trypanosomiasis Research Institute, Tanga, Tanzania

by M.K. Gao
Director, TTRI, Tanga

With the assistance of the International Atomic Energy Agency, IAEA, a project was initiated in 1983 to develop and apply the Sterile Insect Technique (SIT) in an integrated programme aimed at eradicating tsetse flies in affected parts of Tanzania.

For a start, Glossina austeni was selected and a colony set up with puparia collected from Zanzibar Island, which will serve as the initial tsetse eradication area. One advantage is that Zanzibar Island contains only one species of tsetse, G. austeni.

After several difficulties and failures in the early stages, the colony has become self-sustaining and has increased from 6,000 females in November 1985 to nearly 15,000 in June 1986. Both in vivo (rabbits and goats) and in vitro (membrane/bovine blood) feeding techniques are used.

Field studies on Zanzibar Island have shown that the classical biconical trap is inefficient in catching G. austeni. A recent study by an IAEA-sponsored expert indicates that electric targets and animal baits could be used to detect low populations of G. auteni. The study will be continued in the coming year, and will be followed by planning and demarcating areas on Zanzibar, where sterile male G. austeni will, eventually, be released.

Tsetse Programme and Control Activities in Uganda

by T.N. Kangwagye, Commissioner for Tsetse,
Department of Tsetse Control, P.O. Box 7033, Kampala, Uganda

The incidence of animal trypanosomiasis due to tsetse infestations and re-invasions continues to seriously restrict the raisng of productive livestock in Uganda. A tsetse reclamation programme has been drawn up for 10 schemes to reclaim 15,470 km^2 and consolidate on a farther 1,830 km^2 during the period 1986 - 1989. These are aimed, largely, at plans for developing the livestock industry.

The outbreaks in N.W. and S.E. Uganda of human trypanosomiasis are a threat to the rural communities. In S.E. Uganda alone 2,196 cases were recorded between January and June 1986 at treatment centres. Tsetse control activities in the past involved ground spraying (3% dieldrin emulsion), use of pyramidal traps impregnated with 1% delthamethrin, bush clearing, as well as planned land use for development of dairy farms, livestock ranches and human settlement.

The priority objective in the future is to adopt an integrated approach, using inexpensive, but effective tsetse control devices including odour-

baited and insecticide-impregnated traps, screens and targets and the release of sterile males, where feasible, of the target species, notably, Glossina pallidipes, G. fuscipes and G. m. brevipalpis.

It is proposed to start the eradication programme on Buvuma Islands of Lake Viktoria. Elsewhere in Uganda, the new techniques will complement ground spraying operations currently in progress against G. m. submorsitans, G. m. centralis, G. fusca and G. fuscipleuris. An IAEA-sponsored mission is expected soon in Uganda, to assist in identifying strategies to be adopted in eradicating the major tsetse species from Buvuma Islands and the Northern lakeshore regions.

D. What's on in Seiberdorf

Back-up colonies of Glossina palpalis palpalis were maintained to provide 60,000 puparia per month for BICOT. The colony in one insectary is being systematically reduced in size to enable developmental studies on large cages and to determine the effects of controlled fluctuations in temperature and relative humidity.

Rectangular plastic cages, 44 x 44 x 5 cm in size, have been designed and tested for holding 500 producing females. Performance of flies in such cages is equivalent to that of 30 flies in the previous standard round cages. By reducing holding temperatures to 21°C over weekends, feeding is no longer necessary with only a very slight increase to larval development time.

The colony of G. pallidipes continues to grow under in vitro conditions. Fed on a 50:50 mixture of frozen porcine and bovine blood, it is in full expansion with a monthly production of 1,500 puparia. Small colonies of G. austeni, G. brevipalpis and G. f. fuscipes are maintained for experimentation.

New formulations of artificial diets, containing porcine hemoglobin and serum albumin components, were improvements over previous formulations for rearing G. palpalis. The effect of dietary sucrose on the nutritional value of whole or synthetic diet mixture was found to depend on whether the diet in question had porcine or bovine blood component. While the nutritional value of porcine blood is unaffected by added sucrose, that of bovine blood is reduced. Freezing and thawing of fresh blood or hemolysis of the cell fraction had a beneficial effect on the nutritional value of porcine blood, but neither treatment affected the nutritional quality of bovine blood.

The need of tsetse flies for supplemental iron was investigated. Radio-labelled iron was used to determine that most of the iron ingested is expelled in the excreta and that none is stored. A small amount is taken by a intra-uterine larva. It is therefore, concluded that the flies need only trace amounts of dietary iron; the amount found in a usual blood diet is apparently in excess of this need.

Experiments were made with various substances to reduce the sticking of medfly eggs to the small-hole oviposition net that is now used on all adult cages. While more eggs are oviposited by flies through the small-hole net (0.1 mm^2), there is also greater sticking of eggs to the net. Sugar water applied to the net increased oviposition, but also sticking, whereas a dry lubricant release agent increased egg production and substantially reduced sticking.

Preliminary experiments to recycle spent larval medfly rearing medium were encouraging, especially when starter media were used. Supplemental yeast to the spent medium appeared to shorten the larval development time while sucrose promoted heavier pupae and a higher rate of recovery.

Approximately 100 isolates of the bacterium, Bacillus thuringiensis, were screened for pathogenicity to adult Medflies. Fourteen of the isolates produced agents with sufficient activity to qualify for further development. Active exotoxins and spores have already been identified among the agents while the search continues to identify other active agents.

Experiments were continued to induce and isolate temperature-sensitive lethal factors that can be used to separate the sexes of Medflies under mass-rearing conditions. The breeding scheme employed, utilizes a series of morphologically linked mutations, as well as previously induced strains showing absence of female recombination in specific chromosome regions. A number of potential candidate strains, showing various degrees of temperature sentivity, have been isolated. These strains will be further investigated when a sufficient number has been obtained, in order to determine the temperature sensitivity spectrum of each candidate strain.

Wang Yuying

Institute of Atomic Energy Improvement, Chinese Academy of Agricultural Sciences
P.O.Box 5109, Beijing

Studies on the synthetic diet and rearing technique of Carposina niponensis Wals.

Acta Phytophylacica Sinica 13(2):85-89 (1986)

Carposina niponensis Wals. has grown its 19th generation after two years experiment on synthetic diet and still keeping its normal biological charactristic. Through selecting experiments on 15 sorts of synthetic dietsit, has been found that No.1, No.2, No.3and No.4 diets are the better ones, amoung which No.4 diet is the best for its effects in comparison with the use of apple as food. Under the same conditions, the cost of synthetic diet is 12 times lower than using apple. In addition to the normal nutratious ingredients,the writers also creatively use stimulated compositions as banana and assence in order to get accordance with the response of the insect's behaviour,improvement has also been made by using semi-arc feeding peices. Areas of feeds antirot,ovum surface sterilizing and etc.have been involved in this experiment which has proved the compound effects of bactery-resistance made by My-del Phydroxybenzoate and sorbic acid, and ensured the antirot effect of sorbic acid with 130 mg as its best dosage. This experiment has worked out reliable for mass rearing of this insect.

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RADIATION STERILISATION OF THREE ANOPHELES SPECIES

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The response to radiation sterilisation of three species of Anopheles which are important malaria vectors in three continents was compared. Newly emerged males were irradiated with ^{60}Co gamma rays and mated to unirradiated virgin females. The logarithms of the hatchabilities of their eggs laid en masse declined approximately linearly with increasing radiation dose. At 10 krad the observed mean hatchabilities were 1.0% and 6.0% for two strains of An. gambiae, 2.7% for a strain of An. albimanus and 3.9 - 8.1% for strains of An. stephensi. The females were given a second blood meal and tubed for oviposition. The results for a dose of 8 krad were as follows:-

Anopheles species	Strain name/ origin	No. females oviposited	Egg hatchability from individual females: Geometric mean(%)	Range (%)	Heterogeneity between females χ^2
stephensi	ST MAL, Pakistan	5	5.6	3.4- 9.2	3.7 n.s.
stephensi	Kasur, Pakistan	5	3.8	1.4-11.4	13.9 **
stephensi	Lahore, Pakistan	5	5.8	3.1-10.1	6.3 n.s.
stephensi	BEECH, India	9	3.2	0-11.6	123.4 ***
gambiae	Kwale, Tanzania	6	2.4	0-11.4	23.5 ***
albimanus	PALB, Panama	13	0.75	0-16.2	122.5 ***

The significant heterogeneity between the results for individual females of the same strain could not be explained by variation in the dose within the space in which the males had been confined for irradiation. The distribution of hatchabilities from individual females was very skewed and warranted non-parametric statistics to compare strains and species. These showed no significant variation between the four An. stephensi strains and the strain of An. gambiae. However, the strain of An. albimanus showed significantly ($P<0.01$) lower hatchability than An. stephensi, apparently indicating a difference in radiation sensitivity.

3

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The effect of ^{60}Co gamma&ray irradiation on the esterase isozyme of Corn Borer

ABSTRACT

The expressions of esterase isozyme were compared between different sexes, different developmental stages and different parts of the corn borer (Ostrina furnacalis Guenee). The effects of ^{60}Co gamma & irradiation on the expression of esterase isozyme have also been studied. The patterns of esterase isozyme of different parts, at different developmental stages, and from different sexes were different. When the pupae at late stage were irradiated, the expressions of the enzyme bands in the order of 3, 4, 5, 6, 7, 8 on the electrophoresis gel were changed. The effect of irradiation on the isozyme is increased with increasing radiation doses.

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The effect of irradiation on the embryonic development and mating activities of peach borer

ABSTRACT

The eggs stage of the peach fruit borer (Carposina nipponensis) lasted about 144 hours at 25DEGC. The development of embryo was impeded seriously, delayed and some of which were abnormal when pupae were irradiated with 30 kR in the later period. After formation of blastula, 65.2—79.2% of eggs stagnated their development and died at last, so that no normal embryo with ocelli could be formed.

Adult may copulated many times (up to six times) inlife. Females copulated many times oviposit more eggs than those copulated once. The hatching rate of oviposited females copulated many times was related to radiation dose. The higher dose, the lower hatching rate was found. The fertility did not increase, when it copulated many times.

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Induction of sterility in Dysdercus koenigii Fabr. by exposing its different developmental stages to gamma irradiation

ABSTRACT

Dysdercus koenigii Fabr., the red cotton stainer subjected to gamma irradiation from a cobalt-60 source at the doses ranging from 0.5 to 16 krad during various immature stages exhibited sterility in the adult stage. Three types of crosses viz., Treated male X Normal female, Treated female X Normal male and Treated male X Treated female, were made. A marked decline in fecundity and fertility was noticed at 2 krad in adults that emerged from treated eggs, the second and the third instar nymphs. Over 85% sterility was achieved by irradiating the late fifth instar nymphs at 5 krad dose. A significant reduction in the fertility was observed when the adults were irradiated at dose levels of 4 to 10 krad.

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Multiple Mating of the Diamondback Moth, Plutella xylostella L. , and Recovering Fertility of Its Progeny After Irradiation

Application of Atomic Energy in Agriculture, 1986, (2),1.

The maximum multiple mating of the male diamondback moth (Plutella xylostella L.) was 30 times in its life, and the average were 16 times . The maximum multiple mating of the male moth irradiated with a substerilizing dose (35KR) was 14 times, and the average were 7.2 times. The maximum multiple mating of the female moth was 8 times, and the average were 4 times.

The rates of egg sterility in F1 and F2 were 57.5% and 99.1% respectivily when the normal female diamondback moths were mated with male moths irradiated with 35KR dose . However, the fertility was recovered in F3 as the rate of egg sterility was 0.7% .

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Development of Dysdercus koenigii Fabr. as modified by the gamma irradiation of embryonic and postembryonic stages

ABSTRACT

The radiosensitivity of embryonic and postembryonic stages of red cotton bug, Dysdercus koenigii Fabr. was studied at various doses of gamma irradiation. Significant effects of irradiation were observed on hatching, nymphal development, adult emergence and developmental time. It was seen that the efficiency of irradiated nymphs to reach the imaginal stage depended upon the age of the nymph at the time of treatment and on the level of gamma dose. At a dose of 1 krad, 40% eggs and 70% of the second instar nymphs became adults. However, at a dose level of 2 krad, a significant reduction to 16% and 34% respectively was observed. An exposure to 4 krad and above proved fatal and all the insects died before reaching the adult stage in both the cases. When the third instar nymphs were treated at the doses of 2 and 4 krad, the emergence of adults was 58% and 18% respectively. The radiosensitivity of the early and late fifth instar nymphs was also worked out. At a dose of 10 krad, only 12% of the early and 60% of the late fifth instar nymphs reached the adult stage. Further, irradiation caused serious malformations among the ensuing adults. Of the various types of malformations, the appearance of deformed wings was the most common. The other deleterious effect of gamma irradiation was the retardation in the developmental period of the insect exposed at different stages of development.

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Feasibility of egg-irradiation in 'Sterile Insect Release Method' for the management of Spodoptera litura (Fabr.)

Of the various developmental stages of an insect used in sterile insect release method (SIRM), the eggs appear to be the most meritorious because of their availability in abundance at a time. The limitations one confronts with the gamma irradiation of eggs are, however, discussed in the present context. Gamma radiation doses ranging from 1 to 4 krad administered during embryonic stage of Spodoptera litura at different time (1-,2-, and 3-day old eggs) caused about 50% egg-hatch with 45-50% reduction in growth index (GI) in the larvae. Consequently the adult emergence was evinced to the range of 35-40% at these doses. Sequentially a reduction in the fecundity to an extent of 22-45% was observed. Thus a sterility range as a result of irradiation was computed to an extent of 50-80%. The irradiation doses that caused 50% nonviability in eggs did not have much effect on the mating propensity and the magnitude of malformation. Such doses could be excluded for use in pest management considering their ill-effects on the life-span of this pest and mortality in the preimaginal stages. Further acquiring adults in large numbers from the eggs treated at high doses is fairly trying. This ultimately affects the reproductive competence of the treated population. The low gamma doses, if used with caution, in embryonic phase have relatively less detrimental effect of mutations (other than dominant mutations/lethals) on factors as fecundity, larval and adult mortality, distorted sex ratio and morphogenetic deformities in adults. Nevertheless at these low doses, the availability of a large number of adults ensuing from the irradiated eggs at a time might enhance the potentials of this treatment as a genetic control measure in the pest management program.

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Enhancement of Postirradiation Longevity and Mating of the Boll Weevil (Coleoptera: Curculionidae) by Regulation of Preirradiation Feeding

Journal of Economic Entomology (in press)

ABSTRACT Feeding newly emerged male boll weevils, Anthonomus grandis grandis Boheman, a standard laboratory diet for 2 consecutive days before treatment with a 10-krad dose of gamma radiation proved to be more detrimental to maintenance of postirradiation longevity than giving them just H_2O or a 5% sucrose solution. The postirradiation LT_{50} for weevils given the standard diet was 9 days compared with 11 days for groups given H_2O or sucrose before treatment and 12 days for those given 1% urea in a liquid diet. The mortality rate over a 14 day postirradiation period for the standard diet-fed group was significantly greater than weevils given only liquid diets. Mating propensity of male weevils given the various preirradiation diets did not differ from control mating at 5 days after irradiation. At 10 days after irradiation, reduced mating was exhibited by all treated groups and it ranged from 9% in standard diet-fed group to 42% in the urea/sucrose-fed group. Histological examination of the 14-day postirradiation, midgut pathology of weevils given the different diets revealed a greater survival of the regenerative cells and recovery of the midgut epithelium in groups given liquid diets containing urea. A range of 88-100% of the groups of weevils experiencing epithelial recovery also exhibited varying amounts of abnormal regeneration of the midgut nidi. Comparisons of the midguts of 3-day postemergent weevils given either the standard laboratory diet, H_2O or urea/H_2O for 2 days showed significantly less mitotic activity and regeneration occurring in the epithelium of weevils given the two liquid diets before irradiation. The study suggests that weevils bearing an inactive midgut epithelium are more able to withstand the debilitating effects of the radiation treatment.

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CONTROL OF POTATO TUBER WORM, PHTHORIMAEA OPERCULELLA (ZELLER) (LEPIDOPTERA: GELECHIIDAE) UNDER STORAGE CONDITION BY THE STERILITY APPROACH.

II. FIELD EVALUATION OF STERILE MALE RELEASE.

Potatoes procured from market were stored in two separate well ventilated insect proof storage structures erected under a shed. The proportion of infestation in this potatoes was not ascertained, but from a randomly collected sample of 100 potatoes, 16 adults emerged subsequently. Sterile males release in one structure was initiated coinciding with the adult emergence of the parent generation and was continued over a period of one week. The second sterile male release operation was initiated to coincide with adult emergence of the F_1 generation. As a consequence of the sterile male release operation, initial moth population multiplied 9 times as compared to 50 times in the control.

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CONTROL OF POTATO TUBER WORM, PHTHORIMAEA OPERCULELLA (ZELLER) (LEPIDOPTERA : GELECHIIDAE) UNDER STORAGE CONDITIONS BY THE STERILITY APPROACH.

I. RADIATION STERILIZATION.

Amongst the developmental stages evaluated, adult irradiation was found most ideal and near complete sterility (96.3 per cent) was induced when freshly emerged males were irradiated with a dose of 0.45 kGy. For females, a dose of 0.3 kGy was adequate to cause near complete sterility. Mating competitiveness of the sterile male was marginally reduced (0.82 by Fried's formula). Factors modifying biological radiation damage such as dose fractionation, temperature during and after irradiation, insects diurnal rhythm and gaseous environment during irradiation did not influence the level of sterility induced or bring about improvement in mating competitiveness of irradiated males.

Induced sterility was the result of induction of dominant lethal mutations in the sperm and was permanent. Irradiation with the sterilizing dose also did not appreciably alter mating periodicity and propensity. Under simulated storage conditions in the laboratory, release of sterile males alone was more effective than release of both the sexes together or sterile females alone.

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DEVELOPMENT OF TRICHOGRAMMA BRASILIENSIS (ASUMEAD) ON EGGS OF RADIATION STERILIZED FEMALES OF POTATO TUBER WORM, PHTHORIMAEA OPERCULELLA ZELL. (LEPIDOPTERA:GELECHIIDAE)

ENTAMOPHAGA:IN PRESS.

Surplus sterile females in a mass-rearing programme could be advantageously used to increase host egg density as a way of synchronizing population build-up of the host and its egg parasite since they would lay only non-viable eggs. Studies with Trichogramma brasiliensis, an egg parasite of several lepidopterous pests including potato tuberworm, revealed that there was no adverse effect on the incidence of parasitization, development of the parasite and the reproductive performance of the emerging adults when the parasites were provided with eggs oviposited by gamma radiation sterilized (0.30 kGy) females of Potato tuberworm. Even after rearing for over 10 generations on the sterilized eggs, the parasite was unable to discriminate between a sterile and a normal host egg.

9d

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INHERITANCE OF STERILITY IN POTATO TUBER WORM PHTHORIMAEA OPERCULELLA (ZELLER) (LEPIDOPTERA:GELECHIIDAE).

Irradiation of male adults of the potato tuber worm with a gamma radiation dose of 0.25 kGy induced 65 per cent sterility. When crossed with unirradiated females, there was 76.9 per cent preponderance of males in the F_1 progeny. F_1 males were more sterile than F_1 females. In the F_2 generation of F_1 male x F_1 female, males were completely fertile and sterility in female was of the order of 24 per cent.

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Chemosterilant activity and toxicity of thiourea against the mold mite, Tyrophagus putrescentiae (Schrank) (Acarina: Acaridae)

Thiourea (thiocarbamide) is know to exert a chemosterilant effect on insects, especially on certain Diptera. The effect seems to be confined to female flies only.

This report gives the effects of thiourea on the fecundity, fertility, and longevity of the mold mite, Tyrophagus putrescentiae (Schrank).

All females fed wheat germ with 0.25% thiourea were laying eggs, but their fecundity was lowered by 78% as compared to the control. About I2% females given a diet with 0.5% thiourea were unfecund and 52% females produced the eggs only during the first week of exposure to the chemosterilant, being unfecund thereafter. Only 36% pairs were laying eggs longer than one week. The mites treated with 0.5% thiourea laid 39.4% of all eggs during the first week, i.e., by ca. 20% more than the control mites. Of 25 pairs given a diet with 2.0% thiourea, only ten laid a few eggs (I-4). The higher the concentration of thiourea in wheat germ the higher the number of unfecund females and the lower the fecundity of mite pairs.

Mortality of eggs laid by mites fed a diet with thiourea was higher than mortality of the control eggs, but it never exceeded a value of 50%. Egg mortality was not stabile, and it somewhat decreased within the subsequent weeks of oviposition.

The chemosterilant at a 2.0% concentration affected significantly the longevity of mites. The males, however, lived longer than the females. Longevity of mites given thiourea at the lower doses was similar to the control.

High concentrations (I.0-2.0%) of the chemosterilant in the diet suppressed the postembryonic development of the mold mite. Of I00 protonymphs given a diet with 0.5% thiourea, only I4 mites completed the development. These mites were sexed, and five pairs were set up. All matings were sterile. Males lived somewhat longer (mean 4 weeks; range 2-6) than females (mean 3.2 weeks; range I-5). At the 0.25% concentration, thiourea affected slightly the development of the mold mite. Sex ratio of mites that emerged from the treated nymphs was close to a I:I ratio.

In the next experiment, the adults of T. putrescentiae were fed diets containing 0.25%, 0.5%, I.0%, and 2.0% thiourea for the first 7 days after eclosion, after which they were returned to an untreated food. Only a few pairs failed to produce eggs when were kept on a diet with 0.25-I.0% thiourea for 7 days, and then on an untreated diet. However, about 48% pairs fed a diet with 2.0% thiourea were infecund during the first week, but later, after the change of diets, most of them did start egg-laying.

Production of eggs by pairs given the chemosterilant for I week increased considerably, after the transfer of these mites on the untreated diet. Hatchability of eggs laid after the change of diets was slightly or not affected. As a consequence, the productivity of these mites was high (e.g., test with 0.5% thiourea - 65.5%), with the sex ratio in their progeny close to a I:I ratio (54.3% females).

Females and males exposed to 0.25%-I.0% thiourea for I week, and then given an untreated diet lived as long as the control mites. In the test involving a diet with 2.0% thiourea, the increased mortality of males have been seen after the tenth week. However, the longevity of these mites was higher than of mites fed a diet with thiourea for their whole life.

The results obtained indicate that the sterility and infecundity in T. putrescentiae induced by thiourea were incomplete and they were recovered to some extent after the return of mites to an untreated food.

This conclusion is supported also by the experiment, in which males exposed to 0.5-2.0% thiourea for 2 weeks were mated to untreated females. These pairs produced a similar number of eggs, but lower than the control mites. Decreased hatching success was observed only in the eggs laid during the first week by females mated to males which were treated with I-2% thiourea. Egg hatchability in the subsequent "egg-waves" was normal.

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Thiourea as a chemosterilant of the flour mite, Acarus siro L. (Acarina: Acaridae)

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Fecundity and viability of eggs of the flour mite, Acarus siro L., decreased with the increase of the concentration of thiourea in food. Antifecundity effect of thiourea was significant. Females fed a diet with 0.25% thiourea laid during the first week of oviposition about 27% of whole number of eggs, but those given food with 0.5% thiourea produced 45.3% of eggs. Mites fed wheat germ with I.0% thiourea ceased egg-laying after the first week of oviposition. It is evident that the higher the concentration of thiourea in a diet, the higher the number of eggs is produced during the early period of oviposition.

It is interesting to note that the sex ratio in progeny, which developed from eggs laid by 0.25% thiourea-treated females, was male biased. There were only 38.2% females ($X^2 > 3.84$, n=I) whereas the control mites exhibited a normal I:I sex ratio (53.5% females, $X^2 < 3.84$, n=I).

Mites fed wheat germ with 0.25% thiourea lived as long as the control mites, and the males lived longer than the females. At a 0.5% concentration, all females and males were dead after 5 and I0 weeks, respectively. The higher concentrations of the chemosterilant in diets caused the increased mortality of the mites: all males and females were dead after 3 weeks.

Mites fed 0.25% thiourea for one week, and after which given an untreated food, laid the similar number of eggs to the control mites. Mites fed diets with the high (0.5-2.0%) concentrations of the compound laid a very few eggs (2.3-5.3 eggs per ♀ on a diet with 0.5-I.0% thiourea) during the 7 days after eclosion. After the transfer to a normal food, they recovered partially their fecundity. However, the number of eggs laid by these females was lowered by 43.3% (0.5% thiourea) or by 69.2% (I.0% thiourea) as compared to the control. The productivity of these females was also significantly affected by the one-week exposure to thiourea: pairs exposed to 0.25% thiourea produced (avg.) I07 progeny, but those fed 0.5% thiourea gave only 38 progeny per pair.

Males of A. siro were exposed to 0.5-2.0% thiourea for one week, after which they were paired with untreated females. These males readily copulated with females and were able to fertilize them. Females laid eggs of normal hatchability. Larvae, which emerged from these eggs, completed the development. E.g., all females mated to males exposed to a 0.5% concentration of thiourea were laying the eggs, but their fecundity was significantly affected (avg. 29.6±I3.7 eggs per ♀). The hatchability of these eggs was very high (88%), and 76% offsprings developed to the adult stage. The results obtained indicate that the females were much more affected by the chemosterilant than the males.

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CYTOGENETICS OF BLATTELLA GERMANICA: COMPARISON OF AN INSECTICIDE RESISTANT AND A SUSCEPTIBLE FIELD STRAIN

Can. J. Genet. Cytol. (in press)
(1986)

Meiotic chromosomes of a cockroach field strain that is highly resistant to several insecticides were compared to those of a susceptible field strain. The resistant strain was characterized by the frequent occurrence of autosome/autosome associations, fragments, deletions, and insertion or attachment of segments in novel positions. Intra-individual variability indicated that most aberrations arose de novo within individuals, with the exception of a reciprocal translocation heterozygote. The aberrations are attributed to a single phenomenon, that is, an unusual tendency for fusion of constitutive heterochromatin. Karyotypic disruption in the resistant strain was almost certainly responsible for an abnormal distribution pattern of individual chiasma frequencies. Gross chromosome morphology, scarcity of chromosomal aberrations, and chiasma distribution distinguished the susceptible field strain from the resistant strain, but resembled closely properties of our standard susceptible laboratory strain (VPI).

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Distortion of sex ratio in the flour mite, Acarus siro L. (Acarina: Acaridae)

Pol. Pismo Entomol., in press

The single pair method was employed to study the variability of sex ratio among progeny of about 25 pairs of seven strains of the flour mite, Acarus siro L. It was found that the mean proportion of females in the progeny of the strains studied was about 50%. and the departures from an expected I:I ratio were not statistically significant. A Chi-square test for heterogeneity between the strains sampled showed that there were no significant differences between the strains of mites with respect to the sex ratio. However, the strains exhibited different extent of the trait variability.

Between-family variation of the sex ratio in the strain A8 was studied in details. Sex ratio was determined in 45 families of this strain. Totally, I6I3 females and I706 males were obtained, and results of the Chi-square goodness-of-fit test for a relative proportion of 0.500 are χ^2=2.6I, n=I, P 0.05. The departure from an expected I:I ratio was not statistically significant. The distribution of sex ratio between families is heterogenous with a mean sex ratio of 47.2% females. Among the progeny of some pairs, cases of a significant distortion of the sex ratio were found. A measurable excess of females over males or the opposite situation has been observed in some families.

A preponderance of females was highest in the family No.5, and this family was chosen for selection for the sex ratio distortion. Offspring of this family was allowed (July I985) to inbred for 2-3 generations, and the substrain No. 5 was established. Then, about 60 pairs of the substrain were set up and the sex ratios within their progeny were determined (August I985). Totally, progeny consisted of 2745 females and I538 males, indicating factors which cause a departure from "normal" I:I ratio. The distribution of the sex ratio between families is highly heterogenous with a mean sex ratio of 64.I% ♀♀. Within this distribution there is an indication of two modes, one at 40-60% ♀, the other at 60-I00% ♀. It seems that the distribution is equally divided into "normal or slightly distorted" and "distorted" families, with the line of demarcation at approximately 60% ♀.

Progeny of pairs No. II, I7, 30, and 32 of the substrain 5, yielding more than 70% females were inbred further and the respective lines were set up. After 2-3 months, the sex ratio of their descendants was recorded again, and the results obtained show that the selection process brought about a further increase of the frequency of females. The increase was more evident in the lines No. I7 and 32 than in the lines No. II and 30. The mean frequency of females in families of the line No. I7 was as high as 83.2% ♀. Note that not only frequency of females in the strain, but also the proportion of families with the female-biased sex ratios can be radically increased in relatively few inbred generations through the use of single-pair selection for high distortion. Only II.9% pairs producing offspring with the female-biased sex ratios were in the strain A8 whereas all families of the line No. I7 yielded female-biased progeny.

The sex ratio in progeny from any particular mating is constant, as shown by data from the subsequent "egg-waves". The proportion of one sex among progeny that developed from eggs laid during the first week of ovipositional period is biased to the same extent as among progeny that developed from eggs produced in the next successive weeks.

These facts suggest that the sex ratio distortion in the flour mite, A. siro, is inherited. The mode of inheritance and type of gene action controlling sex ratio distortion cannot be determined from this study. However, the rapid early response to selection of the strain A8 indicates that a simple genetic factor(s) is underlying the distortion of the normal (I:I) sex ratio.

Reciprocal crosses between the "normal" strain and strain exhibiting sex ratio distortion are in progress to determine the genetic basis of the abnormal sex ratios in A. siro.

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COMPARISON OF EFFICIENCIES OF CHALLIER's BICONICAL TRAP AND MONOCONICAL SCREEN TRAPS IN SAMPLING TSETSE FLIES, GLOSSINA PALLIDIPES AUSTENI

TPRI MISC. REPORT NO 1027 (1985)

ABSTRACT

An attempt was made to reduce cost of construction of Challier's biconical trap by replacing its lower cone with a single screen. Four types of monoconical traps were constructed and their efficiencies in sampling Glossina pallidipes in Northern Tanzania were compared with that of the biconical trap. The monoconical screen trap type 1 (MSc 1) was cheaper by 25% and also 2 to 5 times more efficient in sampling G. pallidipes than the dark blue biconical trap (BBD). Apparently, higher number of G. swynnertoni were caught in MSc 1 (but not significantly so) than in dark blue biconical trap.

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Insecticidal activity of RPR-series

The 6th International Congress of Pesticide Chemistry (1986), Ottawa, Ontario, Canada, August 10-17

Abstract

Substituted organophosphates of crotonic acid were synthesised by the shortest route and coded as RPR-series of compounds. Insecticidal action of technical grades of RPR-series of compounds was tested against target and non-target organisms. Against target organisms, by contact activity trials, RPR-II (E) was most active against Musca domestica nebulo. Almost all the compounds were more toxic to female M. d. nebulo than male except RPR-V. Similarly, RPR-II (E) was most active against Tribolium castaneum followed by RPR-V. However, RPR-V was most active against Sitophilus oryzae followed by RPR-II. In systemic toxicity RPR-V was most effective against male Dysdercus cingulatus followed by RPR-V (E), RPR-II, RPR-VI and RPR-II (E).

Against non-target organisms in contact toxicity trials, except RPR-II (E), other compounds like RPR-I, RPR-II (E+Z) and RPR-V were less toxic than azodrin to Apis cerena indica. But, RPR-II, RPR-V and RPR-I were more toxic than azodrin to Tilapia mossambica. In dermal toxicity RPR-II and RPR-V were less toxic to Rattus norvagicus albinicus than azodrin. In oral toxicity RPR-II and RPR-VI were less toxic to Columba livia; RPR-I, RPR-II and RPR-V were less toxic to Mus musculus and RPR-I, RPR-II and RPR-V to R. n. albinicus than azodrin.

It can be concluded here that out of the 6 RPR-series of compounds 5 compounds exhibited more pronounced systemic action than the commercially known systemic insecticide azodrin. Whereas, contact action of RPR-series of compounds varied with the insect pest species. As regards the toxicity to non-target organisms the majority of compounds were safer than azodrin to honey bee, pigeon, mouse and rat except fish, based on data included in the present communication.

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In vitro metabolism of a newly synthesised azodrin analogue in albino rat (*Rattus narvegicus albinicus*)

IV International Congress of Toxicology (IUTOX) (1986), Tokyo, Japan, July 21-25.

Abstract

Substituted organophosphates of crotonic acid were synthesised and coded as RPRP-series of compounds. RPR-I an analogue of azodrin - a conventional systemic insecticide has shown insecticidal activity against target insects (Qadri *et al*., 1986). The *in vivo* metabolism of RPR-I was carried out by giving 300 mg/kg body weight of insecticide to rats orally. Feces collected during the period and 24 hours after treatment. The animals were extirpated to remove liver, kidney and lung to homogenise each separately in phosphate buffer (M/15, pH 7.2). The metabolites eluted in benzene and ethyl acetate were subjected to analytical TLC. On the basis of R_f values individual metabolite was collected. The mass peaks and the fragmentation pattern was useful in assigning the structures of metabolites; they are O-desethyl phosphate of 3-hydroxy-N-methyl cis crotonamide (M^+ 223) in liver, kidney and lung; O-O diethyl thiophosphate of 3-hydroxy-N-hydroxy methyl cis crotonamide (M^+ 283) in liver; monoethyl phosphoric acid (M^+ 126) and O-desethyl phosphate of isopropene (M^+ 168) in kidney of rat. The *in vivo* metabolism of RPR-I is indidicative of oxidative desulfurisation, O-desethylation, cleavage of P-O alkyl linkage, deamination and oxidative-N-hydroxy methylation as metabolic fates in liver, kidney, lung and feces.

Reference

Qadri, S.S.H., Mustafa, M., Grover, P., Purohit, P., Rahman, M.F., Parvathi, Neelakantan, Rani, R. and Bhalerao, U.T. (1986). Insecticidal Activity of RPR-series. 6th International Congress of Pesticide Chemistry, Canada, August 10-17.

RESEARCH CO-ORDINATION MEETING

Joint FAO/IAEA Division of Isotope and Radiation Applications of Atomic Energy for Food and Agricultural Development

Co-ordinated Research Programme on the Development of Methodologies for the Application of the SIT for Tsetse Eradication or Control

Vienna, Austria

22-26 September 1986

AUTHOR(S): L. CHUKA MADUBUNYI

ORGANIZATION: UNIVERSITY OF NIGERIA, NSUKKA, NIGERIA

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TITLE OF WORKING PAPER: The dynamics of Glossina palpalis inhabiting rural peridomestic agroecosystems in the Nsukka area in relation to the sterile male technique.

SUMMARY

G. tachinoides was the most abundant and widely distributed tsetse in the Nsukka peridomestic agroecosystems. It was most abundant where the domestic pig also was most numerous. However, the number of flies caught daily did not seem to be linearly related to the levels of pig abundance in the three locations studied. Although size of their mature egg differed significantly with location ($P<0.05$; $F = 4.45$ df 2; 345), it varied in a manner indicating that inspite of the relatively high pig population at one location, the tsetse there were not necessarily better nourished than at the other locations harbouring fewer pigs.

The G. tachinoides populations displayed variable sex ratios, conforming to 1:1 (52% ♀) in one location and departing significantly from it in favour of males (46% ♀) at a second location ($P<0.001$; $X^2 = 18.28$) and in favour of females (65% ♀) at the third location ($P<0.025$; $X^2 = 5.57$). However, within each location, sex composition changed with time depending on position of traps relative to that of the domestic pig. The populations also exhibited seasonal fluctuations in apparent density characterized by minima during the wet season and maxima during the dry season inspite of comparable temperatures, age-structure and evenly high pregnancy rate during both seasons. This unconventional trend in seasonal apparent density and other findings are discussed in relation to certain peculiarities of agroecosystems and to tsetse control with particular reference to the sterile male technique.

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AUTHOR(S): L.H. Otieno, R.S. Ochieng' and H. Banda

ORGANIZATION: The International Centre of Insect Physiology and Ecology (ICIPE)

TITLE OF WORKING PAPER: Rearing of G. pallidipes at the ICIPE Mbita Point Field Stat

SUMMARY

A self supporting colony of G. pallidipes has been established at the ICIPE Mbita Point Field Station. This colony is maintained on live animals (rabbits) although steps are being taken to gradually introduce in vitro feeding approach. The recording systems of the colony is based on the standard procedure recommended by the International Atomic Energy Agency (IAEA) Siebersdorf Laboratory, Vienna.

The performance of the colony determined from the survival of adult females, puparia production, pupal weights and emergence and female mortality rates will be discussed. The data obtained between June 1985 and 1986 show that there was a general increase from 1480 females in June 1985 to 2980 in December 1985. During the same period the number of producing females increased from 1150 to 2100 and the total number of pupae produced increased from 2700 to 5300. Over 80% of the pupae produced weighed 30 mg and above.

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AUTHOR(S): I. Maudlin

ORGANIZATION: Tsetse Research Laboratory

TITLE OF WORKING PAPER: Current research at the Tsetse Research Laboratory relevant to the application of the Sterile Insect Technique for tsetse control

SUMMARY

Research at the Tsetse Research Laboratory relating directly to SIT currently centres on two programmes.

Firstly, traps are being tested which will attract, sterilize and release tsetse; such autosterilizing devices offer a simple method for the production and release of sterile males.

Secondly, the TRL is collaborating with IAEA scientists in research relating to the effect of rearing diet on subsequent infection rates in tsetse. This work is designed to reduce the risks associated with the release of potential vectors when tsetse are used in SIT. To reduce this risk flies are usually fed prior to release on the assumption that only the first feed is capable of producing a T. brucei infection in tsetse. Work at TRL (Dukes & Maudlin, in preparation) has, however, shown that older flies are capable of infection with T. brucei spp. trypanosomes. The aim of the current research is to test artificial diets produced at IAEA for their ability to inhibit infections developing from subsequent infective feeds. Five diets have been tested using G. m. morsitans and T. brucei; results obtained so far indicate that certain artificial diets are superior to whole blood in preventing flies developing infections at sequential feeds.

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AUTHOR(S): R. H. GOODING

ORGANIZATION: University of Alberta, Edmonton Canada

TITLE OF WORKING PAPER: Tsetse Genetics.

SUMMARY

Formal and Transmission Genetics of Tsetse.

1. The loci for eye colour (*tan*) and testicular esterase (*Est.1*) in *G. p. palpalis* are located on the X chromosome and are shown to be separated by 23.9 ± 5.1 recombination units.
2. Breeding experiments have established a) that the loci *Est.2* and *Mdh* are on different autosomes in *G. m. submorsitans* (as they are in *G. m. morsitans*), and b) that sex ratio distortion in *G. m. submorsitans* (from Burkina Fasu and Nigeria) is due to factors on the X chromosome. A colony of *G. m. submorsitans* from Burkina Fasu having a 1:1 sex ratio is being established.

Genetic basis of sterility in hybrid males.

Using *G. m. morsitans* and *G m. centralis*, carrying marker genes on each chromosome, all possible combinations of crosses and backcrosses have been completed. The results indicate that a) sterility occurs in hybrid males having an X chromosome from one taxon and a Y chromosome from another, b) fertility of hybrid males is influenced by factors on the autosomes, and c) hybrid males descending from *G. m. morsitans* females can fertilize *G. m. morsitans* but not *G. m. centralis*.

Genetic diversity in field and colony G. m. morsitans.

Electrophoretic determination of allele frequencies at 13 loci (4 on X chromosome, 7 in linkage group II, 1 in linkage group III and 1 unmapped) indicate that *G. m. morsitans* from TRL colony have the same amount of genetic variability as those collected at Rekometje, Zimbabwe. Although there were differences in occurrence of rare alleles at some loci, only one locus (*Alkph*, midgut alkaline phosphatase) was significantly different in the two populations. Reciprocal crosses of field and colony flies produced progeny which were fully fertile.

AUTHOR(S): J. R. DeLoach, G. E. Spates, G. Kapatsa 21

ORGANIZATION: United States Department of Agriculture, ARS, Veterinary Toxicology & Entomology Research Lab., College Station, TX

TITLE OF WORKING PAPER: "The importance of lipids in the artificial blood diet"

SUMMARY

Stomoxys calcitrans and Glossina palpalis palpalis have been successfully reared on an artificial diet consisting of bovine hemoglobin, albumin and their associated lipids. Recent tests with lipid-free hemoglobin (LFHb) have demonstrated the importance of erythrocyte lipids in the nutrition of tsetse and stable flies. When flies were fed on LFHb and albumin in place of lipid contaminated Hb and albumin, fecundity was markedly reduced. These data suggest that an essential component of the artificial diet is the lipids associated with both hemoglobin and albumin. Future dietary studies will focus on the identification of these yet unidentified components.

AUTHOR(S): L. CHUKA MADUBUNYI 22

ORGANIZATION: UNIVERSITY OF NIGERIA, NSUKKA, NIGERIA

TITLE OF WORKING PAPER: Epidemiological importance of Glossina species inhabiting rural peridomestic agroecosystems of the Nsukka area, Nigeria.

SUMMARY

Only 0.65% of 4620 G. tachinoides and none of 17 G. palpalis dissected were found with maturing/mature trypanosoma infections. Of these, 20% were due to T. brucei group, 40% due to T. congolense group and 40% due to a mixture of T. brucei and T. congolense groups. Mature infection rates differed significantly with location ($P<0.01$; $F = 5.31$). An apparent difference was observed in the frequency with which female and male G. tachinoides were infected by the various trypanosome species. Also the variety of trypanosome species in the flies differed with location. In infective flies, while the salivary gland, labrum and midgut were scantily to very heavily infected, their hypopharynx was never heavily infected.

Dependence of G. tachinoides on domestic pigs as the major source of blood meals, commercial activities in the Nsukka area, inherently limited vectorial capacity of palpalis group tsetse and most flies apparently obtaining their first blood meal when 2-4 days old were identified as some of the factors responsible for the observed infection rates. The epidemiological and epizootiological implications of these findings are discussed.

AUTHOR(S): CLAIR Michel

23

ORGANIZATION: Institut d'Elevage et de Médecine Vétérinaire des Pays Tropicaux
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TITLE OF WORKING PAPER: Activités du C. R. T. A.

SUMMARY

Après un rappel des opérations de lutte anti-tsé-tsé sur la zone de Sidéradougou, qui a été éradiquée par des milliers de mâles stériles relachés après la pose d'écrans et de pièges, la situation actuelle de la région est précisée et le coût de la méthode est évoquée. En raison du nombre de paramètres à prendre en compte le coût d'une mouche varie énormément.

L'évolution des élevages au cours de ces dernières années ainsi que les perfectionnements réalisés sont résumés. L'avenir incertain de cette unité de production est rappelé et en absence de projet-relais une solution d'attente doit être recherchée.

Après quelques commentaires sur les problèmes posés par un élevage de masse, les travaux de recherches sur le terrain visant à détruire les populations de glossines sont exposés. Ils ont surtout porté sur l'amélioration du taux de capture par les attractifs olfactifs comme l'association acétone octénal, par les couleurs des leurres en comparant le noir, le bleu et en les combinant, et enfin par la forme en joignant des panneaux de moustiquaire aux écrans.

AUTHOR(S): Peter Einyu

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ORGANIZATION: Uganda Trypanosomiasis Research Organization
P.O. Box 96, Tororo, Uganda

TITLE OF WORKING PAPER: MASS REARING OF GLOSSINA PALLIDIPES AUSTEN AT UTRO: A REVIEW

SUMMARY

A colony of Glossina pallidipes Aust. was started at UTRO (formerly EATRO) in 1967 (Rogers and Kenyanjui) with pupae collected from the field. The colony which was fed on live oxen rapidly increased and became a closed colony by the year 1970.

The International Atomic Energy Agency supported the colony under the Sterile Insect Technique programme as from 1982. During that year, the colony increased steadily from 1727 females in January to 1985 in December but the number of puparia deposited remained more or less the same. Further increase in the number of females from 2206 to 3394 was noticed from January to December in 1983. The number of puparia also increased from 3125 to 5920 during the same period. In 1984, the colony decreased from 3755 females in January to 2528 in December. The number of puparia also decreased considerably during the same period. During the year 1985, the colony remained at an average of 2500 female flies except in the middle of the year when the colony size dropped considerably, but the number of pupae produced increased steadily during this period. In 1986, the colony size increased in the first half of the year but reverted to the 1985 size during the second half. The probable causes of these fluctuations in the colony size and its productibility are discussed in this paper.

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AUTHOR(S): Gordian O.C. Ekejindu, Y.S. Kayit, W. Takken**

ORGANIZATION: N.I.T.R., & BICOT**, Vom, Plateau State, NIGERIA

TITLE OF WORKING PAPER: Effect of Migration of Herds on the Prevalence of Trypanosomiasis in BICOT Project Area, Nigeria.

SUMMARY

Movement of herds from areas of high fly challenge into the BICOT project zone where there are intensive tsetse control activities has been identified as one persistent source of infection in this area. Herdsmen roam about freely into and out of the project zone and this can result in transport of tsetse and trypanosomiasis through the zone. In the last one year between March 1985 and March 1986 there has been intensive relocation of some of the herdsmen that previously resided within the project zone. Similarly other groups have moved into the project to settle briefly. This definitely constitutes a destabilizing factor in the eradication programme as clean herds leaving the project for other areas get re-infected and infected herds from area of high challenge are randomly present in the project zone and may constitute source of transmission by sterile flies.

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AUTHOR(S): Kloft, W.J. & H. Kirch

ORGANIZATION: Institute of Applied Zoology, University of Bonn
An der Immenburg 1, 5300 Bonn

TITLE OF WORKING PAPER: Passage of undigested host serum proteins across the gut barrier in the tick Ornithodoros moubata (Ixodoidea: Argasidae).

SUMMARY

The uptake of host serum proteins, such as antibodies or albumin, from the intestinal lumen into the hemocoel without being digested, has been reported from several hematophagous arthropods, insects as well as acarina. Nevertheless, neither the mechanism of crossing the gut wall, nor the influence of host proteins on hemolymphe metabolism or on vitellogenesis have been throughoutly studied.

The purpose of this preliminary investigation is to confirm the passage of intact host serum proteins through the gut barrier in the argasid tick Ornithodoros moubata, and if an uptake does exist, to specify the time resorption takes. For all experiments four to six weeks old female ticks - age after final moult - were fed through a parafilm membran on mechanically defibrinated bovine blood.

As early as 2 hours after engorgement the presence of bovine serum albumin in the hemolymphe of all ticks examined is indicated by quantitative rocket immunoelectrophoresis. Thereafter a decrease in concentration within 48 hours is observed. 2 days after repletion, albumin can not be recorded in the hemolymphe of most of the ticks. Single ticks retain trace amounts of albumin up to 4 days after the blood meal. Albumin is not found in the hemolymphe of unfed, freshly moulted or starved ticks. Crabar-Williams immunoelectrophoresis of coxal fluid, which is excreted via the coxal organs within the first hour after repletion to eliminate the surplus water imbibed with the blood meal, reveals in addition to albumin the serum proteins IgG and transferrin.

The presence of host serum proteins in the coxal fluid implies a rapid passage across the gut barrier, which is interpreted as intercellular transport not associated with the phagocytotic activity of digesting gut cells. Moreover, it is assumed, that due to the highly stretched epithelium imperfections of the midgut cell junctions within the first hours after repletion cause a temporary, paracellular flux of small quantities of blood components into the hemocoel.

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AUTHOR(S): T. Soldán, V. Maťha, F. Weyda, P. Švec and Blanka Bennettová

ORGANIZATION: Institute of Entomology, Czechoslovak Academy of Sciences

TITLE OF WORKING PAPER: An establishment of the tsetse fly mycetome tissue culture

SUMMARY

Adult tsetse fly, Glossina palpalis palpalis (Rob.-Desv.) from the stock colony (Nigerian origin) were obtained as puparia from the Entomology Unit of the Joint FAO/IAEA Division in Vienna, Austria. One- and 2-day-old unfed, teneral females were decapitated and superficially sterilized. Dissected isolated mycetomes with the respective gut portion were incubated for 5 min in sterile physiological saline (Ringer) with 500 U ml^{-1} penicillin and 50 ug ml^{-1} streptomycin. Then the mycetomes were cut into pieces and placed into the Leibowitz (L-15) tissue culture medium modified after Maramorosh for tissue cultures of Diptera. Cultivation of tsetse mycetomes with or without presence of several antibiotics exerts no effects to tissue culture mycetome cells.

Behaviour and structural changes of the whole tissue, mycetocytes and individual symbiotic bacterioinds were observed in vitro under in verted and scanning electron microscope as processed gold-coated preparations. In general, these cultures can be easily kept for 1-2 weeks or more. After about 1 day cultivation in the medium the mycetomes release clusters of individual cells (mycetocytes) at first apparent as small bulb-like structures on the mycetome surface. Later (after several days) free spherical clusters of mycetocytes occur in cultivation medium. Also free endosymbionts of quite unusual shape (gram-negative rods several times longer and very narrow, newer occurring on squashes of fresh mycetomes) were observed on semithin sections of cultured mycetome tissue. No substantial changes of the mycetome adjacent mesenteron cells were observed on semithin sections after two weeks cultivation.

Establishment of tsetse fly mycetome tissue culture represents a basic step in the study of the effects of mycetocyte metabolites on the fly's fertility. If conditioned by the mycetome cultivation for 1-2 weeks, the medium can be used in bioassays on the effects of various substances on some tissues, especially reproductive organs. According to preliminary results, the tissue culture media condicioned in such a way are suitable for keeping the ovarian follicle in early stage of embryogenesis, salivary glands, some fat body cells etc.

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AUTHOR(S): J.W. Hargrove, G.A. Vale & G.F. Cockbill

ORGANIZATION: Branch of Tsetse & Trypanosomiasis Control, Government of Zimbabwe

TITLE OF WORKING PAPER: Tsetse : The Limits to Growth

SHORT SUMMARY OF PAPER

1. The growth rates of theoretical tsetse populations were estimated by way of calculating the dominant eigenvalue of an appropriate Leslie matrix.
2. For purposes of comparison the growth rate was always expressed as the log (base 10) of the number present after the end of one year divided by the number present at the beginning, i.e. $R = \log_{10} N_{365}/No$.
3. Estimates were made for values of four parameters - adult survival (PA), pupal survival (PP), pupal duration (K1) and fecundity (F) - over, and somewhat beyond, the entire range likely to occur in nature.
4. Relationships were examined between R and each of the four parameters taken singly, with the other three held constant. Under these circumstances R varied as follows:
   (a) Approximately linearly with PA and PP.
   (b) Approximately linearly with the log of F and K1.
5. A change of 1% in the daily death rate produces a change of an order of magnitude in R.
6. To produce this change in R the fecundity must change by more than 30%.
7. An increase of 20% in the total pupal mortality is equivalent to about a 0.5% per day increase in the daily adult mortality.
8. For expanding populations an increase in the pupal duration causes a decrease in the growth rate; in a decreasing population the same change causes a decrease in the rate of decline. For equilibrium populations R is independent of the pupal duration.
9. A linear function using the four independent variables mentioned above, and their first order interactions, explains 99.8% of the variance in R.
10. This function can be solved for the equilibrium loci and the entire situation can be encapsulated in a two-dimensional graph.
11. The implications for tsetse control are discussed.

28a

AUTHOR(S): S. Ajayi[1] and J.A. Onah[2]

ORGANIZATION: National Veterinary Research Institute, Vom, Nigeria (1)
Biological Control of Tsetse by the Sterile Insect Technique, Vom, Nigeria

TITLE OF WORKING PAPER: Preliminary studies on the comparative performance of Glossina palpalis palpalis (R-D) fed in vitro on fresh frozen camel and cow blood diets.

SUMMARY

Fresh frozen cow and camel were blood were fed in vitro to different batches of female Glossina palpalis palpalis (R-D) for 25 days and the performance of the female flies were evaluated at the end of the period. There were no significant differences in the survival rates, puparia per initial female (ppf) and the production values between flies fed in vitro on camel and cow blood. However, the mean puparia weight produced by flies fed on cow blood was significantly higher (P 0.05) than that on camel blood diet. On the whole, more puparia of higher weight classes were produced by flies fed on cow blood than those on camel blood. The importance of the results in relation to the results of analysis of blood of both animals and for the future in vitro rearing of Glossina on locally collected blood are discussed.

28b

AUTHOR(S): Clair Michel

ORGANIZATION: Institut d'Elevage et de Médecine Vétérinaire des Pays Tropicaux, 10, rue Pierre Curie, 94704 Maisons-Alfort, Cédex

TITLE OF WORKING PAPER: Considérations pratiques sur l'utilisation des lachers de males stériles dans la lutte anti-tsetse suite à la campagne d'éradication réalisée par le CRTA au Burkina Faso.

RESUME

Pour assainir une zone infestée de mouches tsétsé, devant servir à un projet de développement de l'élevage dans le Sud du Burkina Faso, la technique de lutte par des lachers de males stérilisés dans le cadre d'une campagne intégrée a été utilisée de 1982 à 1984 par le CRTA de Bobo-Dioulasso (Projet IEMVT-GTZ).

Après un rappel des différentes phases de l'opération et des moyens utilisés pour conserver l'acquis, l'évolution de la situation depuis l'éradication est exposée.

A partir de ce net succès, les conditions de production de masse sont étudiées et les différentes contraintes et obstacles passées en revue. Quelques perspectives d'utilisation de la méthode en Afrique de l'Ouest et Centrale sont exposées.

RESEARCH CO-ORDINATION MEETING

Joint FAO/IAEA Division of Isotope and Radiation Applications
of Atomic Energy for Food and Agricultural Development

Co-ordinated Research Programme on the
Development of Sexing Mechanisms in Fruit Flies through
Manipulation of Radiation-induced Lethals and other Genetic Measures

Crete, Greece

16-21 September 1986

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DEVELOPMENT OF INDUCED SEX-SEPARATION MECHANISMS IN CERATITIS CAPITATA (WIED.): EMS TOLERANCE AND SUPPRESSION OF FEMALE RECOMBINATION

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Abstract

Two essential prerequisites for the induction and isolation of recessive mutants, namely mutagen tolerance and suppression of recombination, were investigated in the medfly, Ceratitis capitata. Procedures were investigated for the application of the chemical mutagen, EMS, to developmental stages from eggs to 2-day old adult males. Treatment of adult males with EMS, mixed in a 10% solution of sugar in the drinking water supply, was found to be the optimal procedure. This treatment produced dominant lethality in sperm in direct correlation to the concentration of EMS, without being toxic to the treated adults. None of the other procedures was equally effective.

A series of female recombination suppressors (RS) was induced through gamma irradiation of pupae and isolated through appropriate breeding schemes. Earlier chromosomal analysis had confirmed the presence of reciprocal autosomal translations in all RS lines. It is suggested that recombination between the ap and dc genes is being suppressed in the interstitial segment between the centromere and the translocation breakpoint. The degree of recombination suppression in RS 30/55 was 98.1%. Viability, when measured as mean egg hatch in the heterozygous and homozygous configurations, was 53.4% and 79.0%, respectively.

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EXCESS MALE PRODUCTION IN LINES OF THE MEDITERRANEAN FRUIT FLY, *CERATITIS CAPITATA* (WIED.) ISOLATED AFTER X-IRRADIATION FOLLOWED BY OUTCROSSING

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Abstract

The descendants of X-irradiated males of *Ceratitis capitata*, after two generations of outcrossing to unirradiated females, were investigated for sex ratio in the progenies of single pair matings. Some progenies were found to show a significant excess of males, others a significant excess of females but most were normal. A programme, of single pair mating within excess male progenies, with selection for the most extreme distortion observed, led to the production of excess male producing lines. Such lines, which appear to be chromosomally normal, consistently show an excess of males without selection. The degree of sex ratio distortion is however variable, the maximum distortion observed in large samples (n>750) being about 20 :80 . Research has been directed towards determining the basis of this variability and whether the phenomenon is postzygotic or prezygotic in origin. Progress in these studies is reported.

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CURRENT RESEARCH RELEVANT TO GENETIC SEXING AT THE INSECTS AFFECTING MAN AND ANIMALS LABORATORY

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ABSTRACT

A genetic sexing strain of *Anopheles quadrimaculatus* Say Species A was synthesized by the induction of a male-linked translocation to create pseudolinkage between malathion resistance (mal^R), a dominant trait, and sex. The translocation, *T(Y;3R)1*, breakpoint and the mal^R locus are within a small, naturally-occurring, paracentric inversion, which effectively prevents genetic recombination in the strain. In other research on pesticide resistance, two dominant DDT-resistance loci, on separate autosomes, were identified in *A. quadrimaculatus* Species A. These two genes are also suitable for genetic sexing of this species.

In research aimed at the identification of transposable elements in *A. quadrimaculatus*, we have observed DNA sequences which show homology with P-element of Drosophila. We are actively investigating whether the DNA sequences which show homology with P-element are actually transposable elements.

BEHAVIOUR OF A GENETIC SEXING STRAIN OF MEDITERRANEAN FRUIT FLY, *CERATITIS CAPITATA*, DURING LARGE SCALE REARING

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Abstract

The availability of strains of the Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann) which enable sexing of mass-reared populations to be carried out has great significance for suppression/eradication programmes for this pest. Using a white pupal colour mutant and a male-linked translocation a line was produced in which males emerged from brown pupae and females from white pupae. The line appeared stable and it was decided to use the line for field releases on Procida Island, Italy, the mass rearing being carried out at the IAEA laboratories at Seibersdorf.

The line was reared for 10 generations over a period of 8 months and *ca* 2.2 million flies were produced. Early in the mass rearing it was apparent that something adverse was occurring as by the 5th generation, 14% males were emerging from white pupae and 28% females from brown pupae. By generation 9 the values were 18% and 44% respectively. Scrupulous attention was paid to ensure that contamination did not occur. During mass rearing the fertility rose from 66% to 76%.

A computer model was developed to try to understand the course of events occurring in the population. It was concluded that neither contamination alone nor recombination alone was responsible for the observed breakdown. However, if viability differences were combined with a small degree of recombination then the course of events in the mass reared population could be accurately simulated.

It is concluded that viability differences under mass rearing conditions have to be taken into account when choosing a gene system for the development of a genetic sexing line.

GENOME ORGANIZATION OF *Ceratitis capitata* : LINKAGE GROUPS AND EVIDENCE FOR SEX RATIO DISTORTERS

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Abstract

Seventeen biochemical markers of *Ceratitis capitata* are distributed over four linkage groups. Two of these groups include also one visible marker, as follows:

ap, Hk_2, Est_1, Est_2, *sd*, *l*, *Pgi*
w , *Zw* , *Pgd* , *Fh* , *Had*
Mpi, Adh_1, Est_6, *Aox*, Mdh_2 (Chr. II)
Pgm, *Idh* , sd_2 , Got_1, *Gox*

The symbols of the *ap* ... *Pgi* group are listed according to the map order of the loci. Several pairs of enzymes sequentially involved in the energetic flux are coded by linked genes. The loci mentioned above show similar linkage associations also in *Drosophila melanogaster* and *Musca domestica*. The markers *Zw*, *Pgd*, *Fh*, *Had* are X-linked in *D. melanogaster*; they belong to Chr. III in *M. domestica*. No evidence of sex-linkage has been found in *C. capitata*. Linkage group *ap* ... *Pgi* includes locus *sd* (sex-ratio distorter). Males carrying *sd* generate families affected by excess of males, in the ratio of 5♂ : 3♀. Factor *sd* is generally inherited through the males, but females also may carry it. The residual genotype does not affect the expression of *sd*. Mendelian inheritance of gene markers linked to *sd* suggests that *sd* acts prezygotically. In families of *sd* lineage, excess of females occasionally occurs. Such occurrence suggests the existence of a factor acting as F of *M. domestica*. Factor *sd* has been found in flies from many different geographic localities. In medflies from South Africa another sex-ratio distorter which pertains to *Pgm* ... *Gox* linkage group has been detected.

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USDA MEDFLY GENETIC SEXING RESEARCH IN HAWAII

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Abstract

Ongoing USDA genetic sexing research in Hawaii on the Mediterranean fruit fly (medfly), Ceratitis capitata (Wiedemann), is focused in two areas: (1) the evaluation of pupal color sexing strains for mass production and field competitiveness characteristics, and (2) the development of a cooperative genetic engineering project involving gene transformation of a Drosophila P element. Evidence is presented to suggest that a Hawaiianized backcross hybrid sexing strain has superior lab and field traits compared to a pure foreign strain. On the gene engineering project, microinjection and rearing methods have been developed for the medfly. Several thousand eggs have been injected with, as yet, no evidence for genetic transformation.

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INFLUENCE OF DEF ON THE ACTION OF MALATHION AGAINST MALE AND FEMALE CERATITIS CAPITATA (DIPTERA: TEPHRITIDAE).

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Abstract

The effect of different concentrations of malathion on males and females of Ceratitis capitata was evaluated, followed by similar treatments with the addition of the synergist DEF (S, S, S- tributyl phosphorotrithioate). Females were found to be the more tolerant sex in both tests. A strong synergistic influence of DEF in both sexes was observed, the synergistic factors being 6.4 and 5.8 in males and females respectively. The difference in tolerance between the sexes, either to malathion alone or to the malathion/DEF combination, was not in the direction necessary to provide a means of separating the sexes by differentially killing females.

PROTEIN VARIABILITY AND POPULATION GENETICS OF *Ceratitis capitata*.

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Abstract

The distribution of genetic variability in 21 field collected samples of 4 populations of *Ceratitis capitata* were evaluated examining more than twenty gene-enzyme systems. The samples were obtained from geographically and ecologically distinct localities (Procida Isl., Sardinia, Libya, Kenya). The medfly population of Procida has been repeatedly sampled in the period April 1983 - August 1985. Seasonal fluctations in the relative frequency of *Mpi* and Hk_2 alleles has been observed; in addition, a trend toward increasing genetic variability apparently occurred in this population. Over this three year period, the mean relative frequency of heterozygous Procida flies ($\bar{H}$) has been 0.046, a very low value in comparison with those provided by samples from Kenya ($\bar{H}$ = 0.164) and Sardinia ($\bar{H}$ = 0.115). So far, the lowest value of $\bar{H}$ has been ensured by a sample from a very isolated locality of Libya ($\bar{H}$ = 0.021), possibly as the result of a "founder effect". The fairly high value of $\bar{H}$ provided by Sardinian samples is rather unexpected because it occurs in a peripheral population.

Electrophoretic analyses of a sample of *Ceratitis* (= *Pterandrus*) *rosa* from Kenya, collected together with a sample of *C. capitata* have revealed a number of diagnostic loci.

Special attention was paid to medfly *Adh* loci because of their relevance for practical and/or theoretical purposes. The two *Adh* loci codify isoenzymes which show different and integrated developmental pattern and tissue localization. Both isozymes showed low variability levels; generally Adh_1^B and Adh_2^A were the only alleles present or the most common ones; however, some rare Adh_1 alleles were recently detected in a South-African laboratory strain.

Preliminary observations suggest some degree of variability for larval serum proteins (LSP) in the above mentioned South-African laboratory strain.

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GENETIC VARIATION IN MEDFLY POPULATIONS: IS THERE ANY OVIPOSITION PREFERENCE PATTERN ASSOCIATED WITH THE TAXONOMIC STATUS OF THE FRUIT OR FRUIT-SIZE OF THE HOST PLANT?*

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ABSTRACT

Several hypotheses are proposed to explain the low genetic variation maintained by the introduced populations of medfly. By utilizing the urea denaturation method we did not detect any hidden genetic variability due to the usual electrophoretic conditions. The differences in allele frequencies for the polymorphic loci among these populations do not seem to be correlated either with the taxonomic status of the host fruit or with the size of the fruit. Therefore, our limited data, do not suggest any apparent pattern of preference for oviposition sites in medfly populations.

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POPULATION GENETICS OF MEDFLY: ENZYME POLYMORPHISM AND ROUTES OF DISPERSION OF THE FLY *

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ABSTRACT

The genetic structure of twelve wild populations of medfly sampled from different geographical areas and different host fruit species have been studied. Each population was analyzed for 25 enzyme polymorphisms detected electrophoretically. All the Mediterranean populations proved to be highly monomorphic ($\bar{H}$=0.051), whereas those from S. Africa and Reunion were polymorphic ($\bar{H}$=0.234 and 0.153 respectively). The differences in the genetic structure of these populations may be attributed to founder effects. The pattern of dispersion of the fly from its geographic centre of origin is discussed. Finally, no systematic changes in allele frequencies were observed in populations kept under laboratory conditions.

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CHROMOSOME POLYMORPHISM IN A POPULATION OF *CERATITIS CAPITATA*.

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Abstract

A morphological chromosomal polymorphism along with the observation of B chromosomes in a natural population of *Ceratitis capitata* is reported. A variability affecting the centromere size of chromosome 3 is described. The observed B chromosome is minute, heterochromatic and telocentric. It was found in the male and female germ cells and exhibed, in the males, intra-individual numerical variation with 0B and 1B cells, which suggested a mitotic instability. It was also found, in both sexes, in somatic cells (cerebral ganglia tissue). Only males transmitted the B chromosomes to the progeny. The high rate of transmission suggested a differential utilization of the sperm carrying the B chromosomes or a preferential segregation into secondary spermatocytes.

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SCREENIG FOR A FEMALE-LIMITED TEMPERATURE-SENSITIVE LETHAL MUTATION INDUCED ON A V-AUTOSOME TRASLOCATED STRAIN IN *CERATITIS CAPITATA*.

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Abstract

The aim of this paper is to describe a screening method for a mutation causing the elimination of females in an early stage of development-sought-after improvement of the Sterile Insect Technique.

A strain carrying a V-*nig*$^+$ traslocation (all the females are homozygous for the cuticular marker *nig* and all the males are wild-type) was previously obtained. Such strain shows no evidence of marker severing due to a recombination after more than 55 generations of culture in population cages. The temperature of 35°C was chosen as the restrictive treatment and the most appropriated TSP (Temperature Sensitive Period) was determined to be at the time of cephalic involution during embryogenesis. The permissive temperature was 26°C.

The most convenient mutagenic treatment was found to be provided by 2% EMS acting on eggs during 24 hours. The actual screening involved treating *nig*/*nig* females with EMS, crossing them to V-*nig*$^+$ males, selecting males in the progeny and crossing them individually, first to unrelated *nig*/*nig* females and later to his daughters. The discriminating treatment was received by a sample of embryos produced in the backcross father x daughter. Families showing a 50% deficit in female progeny after the temperature pulse are candidates to carry the desired mutation.

At present, several families have been already obtained and they are in the process of being further characterized.

Also a number of families probably carrying lethal mutations in the X-chromosome have been obtained.