



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. 36

December 1985

TRAINING COURSE ANNOUNCEMENT

INTERNATIONAL TRAINING COURSE ON THE USE  
OF ISOTOPES AND RADIATION IN  
ENTOMOLOGY AND PEST MANAGEMENT

UNIVERSITY OF FLORIDA, GAINESVILLE, FLORIDA, U.S.A.

16 JUNE - 8 AUGUST 1986

DEADLINE FOR NOMINATION : 21 MARCH 1986

SEE ENCLOSURE

## Prospectus

**Title:** FAO/IAEA INTERREGIONAL TRAINING COURSE ON THE USE OF ISOTOPES AND RADIATION IN INTEGRATED PEST MANAGEMENT WITH SPECIAL REFERENCE TO THE STERILE INSECT TECHNIQUE

**Place:** University of Florida, Gainesville, Florida, U.S.A.

**Date:** 16 June - 8 August 1986

**Deadline for nominations:** 21 March 1986

**Organizers:** Food and Agriculture Organization of the United Nations and the International Atomic Energy Agency in co-operation with the Government of the United States of America and the Department of Entomology of the University of Florida.

**Participation:** The course is open to 20 participants from developing countries, FAO and IAEA Member States, in all geographical regions.

**Language:** The language of instruction will be English.

**Purpose:** The object of the course is to provide intensive training for research entomologists not adequately familiar with isotope and radiation methodology. Emphasis will be given to the provision of a thorough background review and to coverage of the principles and practices of these modern techniques. The course will underline in particular the kinds of investigations in which isotope and radiation techniques can most profitably be used in entomology, their relationship to the sterile insect technique and applications in pest management.

**Participants' qualifications:** Applicants must have had graduate training with special emphasis on the scientific principles underlying research in some aspect of entomology. Preference will be given to those who have had at least a few years of practical experience in post-graduate research.

As the course will be conducted in English, participants must have an adequate working knowledge of that language. In cases where proficiency in English is not self-evident, preference will be given to candidates able to present a recent certificate of having satisfactorily passed either the Davies test (British Council) or the TOEFL test (U.S. embassies).

After training, participants are expected to continue to be engaged in a field of entomological research or teaching in which their training can be utilized.





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5. Reports and Communications: Insect - June 1955

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.

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## I. INTRODUCTION

### Publication Policy

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

While emphasis is on unpublished data, we include, whenever possible, summaries of recently published papers. In that case, the material submitted should be no more than one page when typed doubled-spaced. (A form for submission of contributions is included in each distributed copy of the 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
J. Kabayo	Tsetse Investigations: Artificial Diets
E. Busch-Petersen	Genetic Sexing of Medflies
N. Bruzzone	Medfly Rearing
(FAO Associate Expert)	

BICOT

W. Takken	Project Director and Supervisor of Field Operations
M. Oladunmade	Project Co-Director
U. Feldmann	Technical Advisor, Laboratory Operations

MISR-MED

J. Hendrichs	Project Co-Director
--------------	---------------------

PERU-MED

R. Rhode	Project Director
A. Perdomo	Medfly Ecologist



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

C. Programmes of the Insect & Pest Control Section

1. Medfly

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

- (a) Develop less expensive larval and adult diets with particular emphasis on locally available ingredients (non-imported) from various parts of the world.
- (b) Improve 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) <u>Medfly</u>	(b) <u>Tsetse</u>	(c) <u>Isotopes</u>	(d) <u>Others</u>
Egypt Peru Guatemala	Nigeria Zambia Ghana Tanzania	Kenya	Sri Lanka Iraq Pakistan Algeria Libya Tunisia

**E. Experts and Consultants: January - December 1985**

Name	Nationality	Location of Assignment	Dates and Task Performed
D.A. Turner (ICIPE)	U.K.	Nigeria	Review of BICOT Project 5-15 February 85
J.G. LeRoux FAO	U.K.	Nigeria	"
W. Enkerlin (Programa Moscamed)	Mexico	Egypt	MISR-MED Field Investigations 16 May-23 June 85
J.F. Reyes (Programa Moscamed)	Mexico	Egypt	MISR-MED Field Investigations 24 Sept-18 Oct. 85

F. Trainees in Entomology

SEIBERSDORF

a) TSETSE GROUP

BANDAH, Mr. Hastings	Kenya	85-01-07 to 85-04-06
OCHIENG, Mr. R.S.	Kenya	85-02-11 to 85-07-10
MAKUMYAVIRI, Mr. M'Pondi	Zaire	85-04-10 to 85-07-09
CLAES, Mr. Y. (Trainee)	Belgium	85-04-10 to 85-06-07
MAKISHE, Ms. F.W.	Tanzania	85-06-04 to 85-10-03
OKINE, Mr. J.S.	Ghana	85-07-01 to 85-12-15
MUKIRIA, Ms. P.W.	Kenya	85-09-16 to 86-01-13
OLOO, M. F.P.W.	Kenya	85-09-16 to 85-09-27

b) MEDFLY GROUP

ZEIN EL ABDIN, Mr. A.M.	Sudan	84-05-01 to 85-04-20
ELFANGARY, Mr. M.A.E.	Egypt	85-01-14 to 85-01-18
TAMAM, Mr. A.E.-K.	Egypt	85-01-14 to 85-01-18
BEN YOUSSEF, Mr. M.A.	Libya	85-10-28 to 86-07-27
ELAGAL, Mr. M.N.	Libya	85-10-28 to 86-08-27

c) SCIENTIFIC VISIT

MUKIAMA, Mr. Titus	Kenya	85-09-02 to 85-09-13
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### III. NEWSLETTER

#### A. Special Features and Comments

##### 1. Why Study Development in the Tsetse Fly?

D.L. Whitehead\*, formerly of ICIPE, P.O. Box 30772, Nairobi, Kenya, answers as follows:

The mode of reproduction and subsequent development of the tsetse fly offer certain distinct advantages to the student of insect endocrinology. For instance, the events following the initiation of pupariation until pupation take 10 - 12 h in blowflies and even less time in Drosophila, whereas in the tsetse larva they are spread over 5½ - 6 days. Thereafter 28 - 30 d elapse before eclosion in tsetse but only 4 - 5 d in most diptera. Another example concerned here is that the hardening of the polypneustic lobes (analogous to the peritreme around the posterior spiracles of bow-fly larvae) occurs 2 d before larviposition in tsetse while less than 1 - 2 h elapse for the similar process in Calliphora spp.

It has already been reported that ecdysteroids cannot be detected, using radioimmunoassay, at the time of lobe hardening in G. m. morsitans stage III larvae in utero. Consequently a factor other than the ecdysteroids was thought to be implicated. However, the rate of <sup>14</sup>C-L-tyrosine uptake by the body integument has now been compared with uptake into the polypneustic lobes in vivo and in vitro a few hours before sclerotization was expected to start. Label entered twice as quickly into lobes when 20-hydroxyecdysone (20-OHE) was added to the medium but ecdysone itself did not stimulate uptake at the deliberately low titres used. 20-OHE is therefore most probably the trigger for the essential hardening of the spiracle openings which must be completed towards the end of the pregnancy cycle.

Ligature of tsetse larvae after birth is followed by sclerotization posteriorly but not anteriorly. The inhibition anterior to the constriction is not overcome by injecting ecdysteroids with labeled tyrosine. The presence of the ligature not only greatly inhibited uptake of <sup>14</sup>C-tyrosine by the cuticle but it also surprisingly inhibited metabolism of tyrosine in the cells of the haemolymph and epidermis. This was true whether the constriction was tight or loose. Furthermore the inhibition was demonstrable in haemolymph removed from ligatured larvae as well; therefore lack of oxygen cannot in this case explain the inhibition.

Use of DOPA decarboxylase inhibitors at doses which retarded pupariation for 18 - 24 h showed that, because DOPA accumulated rather than tyrosine, tyramine present at times was not the major precursor of the sclerotizing agent.

The flux of labeled metabolites derived from the <sup>14</sup>C-tyrosine, injected into pregnant G. m. morsitans carrying a stage III larva with white lobes, showed that the "barrier" to tyrosine or its metabolites is suddenly lowered in the lobes but not in

the rest of the body (except, of course, the mouthparts and anus which harden simultaneously). That this process is mimicked in vitro by 20-OHE but not by ecdysone is worthy of closer study.

The role of ecdysteroids in programming the epidermis and perhaps haemocytes to synthesize the enzymes required for tyrosine metabolism can profitably be studied in tsetse larvae where the major events occurring before pupation are so conveniently spaced in time. That the lobe epidermis responds to such low titres of 20-OHE offers a convenient tool for studying anti-ecdysones.

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Middlesex, Hospital Medical School,  
London W1P 7PN, U.K.



2. The Sterile Insect Technique (SIT) associated with insecticide-impregnated targets is now a financially valid technique for the eradication of tsetse

by Dr. H. Politzar,  
C.R.T.A., B.P. 454, Bobo-Dioulasso, Burkina Faso

An integrated campaign using population suppression by insecticide impregnated screens, followed by the release of sterile males led to the eradication of the two riverine tsetse species G. p. gambiensis and G. tachinoides in the pastoral zone of Sideradougou in 1984. Thus, for the first time, a large-scale operation over more than 3.500 km<sup>2</sup> using the SIT has eradicated tsetse, demonstrating the feasibility of this technique in a multispecies operation. In 1985 the savannah species G. m. submorsitans has equally been eradicated from the south-eastern part of the area (the only place where it occurred) by the use of alternating traps and screens for population reduction and the subsequent release of sterile males of this species. Three trap barriers, installed in 1980 along the main rivers have isolated the area against reinvasion of riverine species.

Traps and blue/black targets with invisible mosquito netting on both sides have isolated the area against reinvasion by G. m. submorsitans. The use of olfactory attractants (acetone 100 mg/h and 1-octen-3-ol 0,5 mg/h) permitted to place only 4-5 targets per km<sup>2</sup> which made that method financially competitive. An economic evaluation of costs and benefits and comparison with the costs of other methods has demonstrated that an integrated campaign with SIT is financially competitive with other control or eradication methods as well as that gains from tsetse control are higher than the costs of the operation. Since 1984 the C.R.T.A. is, besides the conservative measures for Sideradougou, engaged in research to increase the efficacy of the population suppression methods by working on forms and colours of traps and targets as well as the use of olfactory attractants for trapping; mainly for G. m. submorsitans. At present, the use of blue and black screens with netting increased capture data by nearly 2,5 times compared to the formerly used blue screens. Adding a combination of acetone and octenol to a trap increased captures by 4-8,7 times, depending on the seasons. Further research on other attractants is presently carried out in collaboration with the research group in Zimbabwe and the TDRI in London with funds provided by the EEC. Additional research is carried out on the behaviour of G. m. submorsitans in order to increase the efficacy of traps or targets for this species.

#### B. Meeting Reports

##### 1. Research Co-ordination Meeting : Genetic Sexing of Medflies

Ten research contractors and agreement holders and two others participated in a Research Co-ordination Meeting (RCM) in Vienna, in connection with the programme, "Development of

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

The meeting which lasted for five days (15 - 19 July 1985) was also attended by staff members of the Joint FAO/IAEA Division and the Entomology Unit of the Seibersdorf laboratory.

Formal presentation of papers by programme participants was followed by discussions and recommendations for follow-up research. The meeting also recommended that the Joint FAO/IAEA Division should issue, at six monthly intervals, a Medfly Genetics Information Circular for distribution to scientists working on medfly genetics. The first issue, which resulted directly from the RCM was published in September 1985.

The meeting reiterated the advantages of eliminating (through genetic sexing), females at an early stage of development, in a medfly mass-rearing system. Among these are reduced cost of rearing, prevention of "sterile" stings (by sterile released females), and overall efficiency of the release programme. A comprehensive report of the meeting is available for consultation.

2. Consultants' Meeting

A three day meeting on "Application of Genetic Engineering and Recombinant DNA Technology in the Development of Genetic Sexing Mechanisms for the Mediterranean Fruit Fly, Ceratitidis capitata" was held at the Vienna International Centre (4 - 6 December 1985).

Five consultants from Australia, Italy, the U.K. and the U.S.A. and five staff members of the Joint FAO/IAEA Division and Seibersdorf Entomology Unit participated. The meeting report is in preparation.

C. Field Programmes

1. BICOT : The story so far

Emphasis in 1985 has been on increasing the Glossina palpalis colonies fed in vivo and in vitro, and on clearing, as much as possible, the target species from the project area through sustained trapping, use of insecticide impregnated screens and the release of sterile males.

The in vivo (guinea-pig fed) colony which contained 60,000 females in May 1984 suffered a set-back, due to recurrent disease outbreaks in the guinea-pig colony, and accidental insecticide contamination of the guinea-pig food. Rigid quality control measures, coupled with input of puparia from the back-up colony in Seibersdorf, brought rapid improvements.

The in vitro colony continued to fluctuate in numbers due largely to microbial contamination of the blood fed to flies. A 50:50 mixture of locally collected cattle blood and reconstituted freeze-dried pig blood gave good results,

provided the blood had passed a specially developed quality control test. Staff discipline and reliability of equipment in the climatic rooms appear to be keys to successful rearing.

During the year a colony of G. tachinoides was initiated with puparia kindly provided by the G.T.Z./C.R.T.A. tsetse project in Bobo Dioulasso, Burkina Faso.

Field work proceeded satisfactorily. The southern part of the project was completely freed of G. palpalis. To prove that eradication had been achieved, laboratory-reared, radiation-sterilized female G. palpalis were released in the "cleared" area. Recaptured females were studied for signs of mating/insemination. Of 400 such females recaptured to date, none had been mated nor inseminated, and ovulation had not taken place.

Intensive trapping has resulted in effective suppression of the population of G. p. palpalis in the remaining (northern) sector of the project area. Sterile male releases have resulted in eradication of the target species in most of the area, however, the final results cannot be known until early 1986.

The project boundaries are all protected against re-invasion through the use of insecticide impregnated screens, which are inspected periodically and replaced or re-impregnated when necessary. There appears to be no remedy against loss of the blue cloth screens. Approximately 60% loss was recorded this year.

## 2. Moscamed-Peru

Activities continued, aimed at reducing the native population of Medflies to very low densities, prior to release of sterile flies. These included intensive trapping (Steiner traps) in all infested valleys, destruction of infested and susceptible host fruits and application, by ground or aerial spraying, of malathion-protein bait (Nu-lure) mixtures. In addition, farmers were educated to remove all fruits at harvest time, irrespective of the stage of maturity. While the overall effect of these measures was satisfactory, maturing chilli fruits during the month of May caused an increase in wild fly populations.

Fly production at the La Molina laboratory was adversely affected by occasional electrical power cuts. Nevertheless, a weekly production of 95 million pupae was maintained towards the end of 1985, making it possible for up to 80 million flies to be irradiated and released weekly in Tacna Valley. Ratios of 32 sterile to 1 wild fly or sometimes, 60:1 were maintained during the months of June through October when production improved and continued trapping and bait-spraying resulted in very low fly densities. At this rate, eradication of the Medfly in Tacna Valley could be achieved in the foreseeable future. Sterile flies were released from aircraft, in areas where flying conditions proved unsafe, or where infested fruits have been detected, ground releases were made.

The movement of flies along the narrow gorges, up to approximately 3000 m was confirmed. Since host fruits are freely imported into Tacna Valley from neighbouring Bolivia, a quarantine post or check-point is contemplated.

D. What's on in Seibersdorf

A colony of 75,000 female Glossina palpalis is maintained in the laboratory as back up and source for supplemental release in the SIT programme (BICOT) underway in Nigeria. The many thousands of excess males from this colony that are shipped each month have been a valuable adjunct to the release efforts in the project site.

Work continues at Seibersdorf to improve the nutritional quality of artificial diets for adult tsetse flies. Supplements of serum albumin improved bovine blood. Biochemical comparisons, however, have failed so far to show any difference in components that can account for the nutritional superiority of porcine over bovine blood.

Bacteria in the blood diet fed in vitro were shown to be an important mortality factor to adult tsetse flies. Procedures to detect and eliminate bacteria from the diet are essential for successful maintenance of colonies.

Studies have shown that the trypanocide, Samorin, can be added to the bovine blood diet without adversely affecting survival or reproduction of female tsetse flies. Thus, the possibility exists that trypanocides can be used to interrupt the development of trypanosomes in infected flies and also to protect released flies from becoming vectors in the field.

Efforts continued to develop mass-rearing systems for Medflies. It was found that short exposure to microwave radiation is lethal to larvae and pupae and as such a potentially useful means to decontaminate larval rearing medium before disposal. Also, it was found that adult Medflies can be adapted, in a few generations, to oviposit as well under 14:10 hours, light:dark conditions as under constant light.

Diets have been successfully formulated with ingredients from Egypt, a potential SIT project site, to rear Medfly larvae. Such diets would relieve the need to import more expensive ingredients for a mass-rearing operation.

Progress has been made in developing a genetic sexing system for the Medfly. A chromosomal recombination suppressor line has been isolated, which appears to be suitable for continuing pursuit of the temperature sensitive lethal strain that can be mass-reared for a SIT programme.

E. Tsetse and Trypanosomiasis in Mano River Union Countries

The Mano River Union (MRU), comprising Sierra Leone, Liberia and Guinea, established, originally as a customs union, with emphasis on inter-country trade, has recently expanded its

objectives to include improvement of rural economies and development of basic infrastructure such as highways and agricultural development in Member Countries.

In response to a request from the Mano River Union Secretariat, a 2-man mission (Evans Offori, Technical Officer, Joint FAO/IAEA Division and Willem Takken, BICOT Project Director, Vom, Nigeria) visited the Union Secretariat and Member Countries to identify possible areas of co-operation between the MRU and IAEA within the context of the Joint FAO/IAEA Division's programme on tsetse and trypanosomiasis control. Since all three Member Countries consider animal trypanosomiasis a problem, the mission recommended that the MRU should initiate action to up-date information on tsetse and trypanosomiasis in each country as a first step in planning a control programme.





A.  
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1  
STUDIES ON MASS REARING AND  
MARKING TECHNIQUE OF CORN BORER  
*Ostrina furnacalis* Guenee

Application of Atomic Energy in  
Agriculture 4:27-33 (1984)

ABSTRACT

The improved rearing container for preventing contamination from microorganism was designed. Methods for marking corn borer with dye and the developing of artificial medium for mass rearing have also been shown.

1000 larvae were fed in improved container. The capacity of feeding was increased 3—4 times, and the percent of pupae amounted to 70%. The honey-comb type paper for raising pupae was advantageous for collecting, irradiating, carrying and releasing the pupae. Contamination was eliminated successfully when the eggs were sterilized in 2% formalin solution for 15 minutes, and streptomycin (200,000 units) was added to 1 kg diet. The larvae, pupae and adults could be dyed in pale blue colour when the artificial medium containing 0.01% dye of Sudan Blue II was used. The rate of dye-marked corn borer was 100%. It did not affect the pupae weight, emergence and mating of adults, and the development of larvae, while the cost of diets was decreased from ¥ 0.42 to ¥ 0.17/100 larvae by substituting 15% soybean meal and corn meal with sawdust of same weight.

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2  
Preliminary report  
Successful mass production and release  
of snail-killing fly-larvae (*Sepedon  
sphegea*) to control aquatic snails  
(Diptera, Sciomyzidae)

*S. sphegea* is one of the most dominant species of snail-killing flies in IRAN, and many sites of massive-natural populations have been located in northern part of the country.

The biology of this species has been studied since 1972 and substantial progress has been achieved in laboratory rearing of their larvae. Each larvae consumed 18 to 28 snails during 8 days to 15 days in laboratory at 23°C to 30°C.

It was evaluated that mass releases of <sup>young</sup> larvae is decisively advantageous to the rearing larvae up to pupal stage and then the mass releases of adult flies.

In April 1979, an Insectarium was set up of 6 cages containing about 700 adult flies, (Males and females) that were caught directly from the field in Kazeroun, Fars Province, South of Iran. The flies were kept inside the cages about one month and fresh eggs were collected every day. Following 3 to 5 days of incubation period of eggs, a total of more than 11500 young larvae were obtained and they were released in 14 experimental plots, in an old rice field full of aquatic snails: *Physa* sp. and *Gyraulus* sp. This was a pre-attempt to biological control of aquatic snails in relation to Schistosomiasis at its local foci in Khuzestan Province.

Similar experiment was repeated in May 1985 in Dezful, Khuzestan. In this trial, 8 cages were employed and 2000 flies were kept in them. More than 50 000 larvae were reared and successfully released in the field.

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Cost Reduction of Artificial Media  
for Rearing the Oriental Fruit Fly  
Larvae, Dacus dorsalis Hendel

Control or suppression of the oriental fruit fly, Dacus dorsalis Hendel by sterile insect release method requires low cost of producing millions of flies. The purpose of this experiment is to reduce the cost of artificial larval media for rearing the oriental fruit fly by using local protein sources such as instant dry yeast and yeast from brewery to substitute the imported brewer's yeast. The wheat bran medium consists of wheat bran, sugar, brewer's yeast, preservatives and water. The oriental fruit fly larvae were reared in wheat bran media with various protein sources at  $26 \pm 1^\circ\text{C}$  and 60-80% RH.. Evaluation of this experiment was based on pupal recovery, pupal weight, adult eclosion, fecundity, fertility and longevity. The results showed that there were no significant difference ( $p < 0.05$ ) in pupal recovery from all artificial media. Artificial medium with instant dry yeast gave significantly highest pupal weight ( $p < 0.05$ ) while artificial medium with yeast from brewery produced pupae with lowest percentage of adult eclosion ( $p < 0.05$ ). In addition, no significant difference was observed in percent egg hatch of flies reared in all artificial media. Adults reared from artificial medium with instant dry yeast oviposited significantly largest numbers of eggs ( $p < 0.05$ ). In contrast, longevity of adults reared from artificial medium with yeast from brewery was shorter than those reared from the other artificial media. In conclusion, the local protein source such as instant dry yeast can be used to substitute imported brewer's yeast. The cost of the wheat bran medium with local protein is reduced by 11 folds and cost only US \$ 26 per million pupae.

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STUDIES ON PARAMETERS FACILITA-  
TING LOCAL PRODUCTION OF BACILLUS  
SPHAERICUS

ABSTRACT

The factors influencing cell yield and synthesis of mosquito larvicidal toxin in Bacillus sphaericus H5ab were studied. The organism reached the phase of maximum growth 15 hr. after inoculation. The synthesis of larvicidal factor was initiated around seventh hour after inoculation and reached maximum level when the growth cycle entered stationary phase. The biomass production and toxin synthesis were not affected in the pH range of 5.5 to 10. The organism proliferated well and synthesized more amount of larvicidal principle at 25°C and 30°C. Two media, one containing corn starch as carbon source with brain heart infusion or diammonium phosphate and peanut cake as nitrogen source and the other containing jaggery as carbon source with BHI as nitrogen source supported good growth of cells with higher levels of toxin production.

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Radiation-induced sterility in  
the tsetse fly, Glossina palpalis  
palpalis: Effect on uterus and  
milk gland system in relation to  
embryonic arrest

In Glossina females the milk gland is a highly modified accessory reproductive gland of merocrine secretion consisting of a series of ramified tubules. The gland undergoes cyclical changes during adult life, correlated with development of offspring in the uterus and presumably regulated by the female's neurocrine system.

Irradiation of adult tsetse flies represents a basic step in the application of the SIT (Sterile Insect Technique) in the field. Induced sterility results in serious disorders in the reproductive system and causes complete sterility (Van der Vloedt & Taher, 1978; Matolín & Van der Vloedt, 1982). This paper is intended to complete our knowledge on the relationship between embryonic development and development of milk gland in both irradiated females and females mated to irradiated males.

Apparent degeneration of milk glands and uterus surface was observed in females treated with x-rays from a Co<sup>60</sup> source as well as in untreated females mated to irradiated males. These changes are manifested by a considerable decrease of milk gland diameter in both basal and apical portions, histopathological changes of secretory cells and by coarse granulation of some gland portions seen on electron micrograms. Structural changes of uterine walls were also observed. These changes are evidently connected with lytic changes in developing eggs and disorders in embryogenesis resulting from induced sterility. The characteristic cyclical changes did not occur in the milk gland of irradiated females as well as in that of normal females fertilized by irradiated males, whose dead embryos had been mostly expelled. Their limited secretory action resembled that in virgin females. Degenerative changes found in the experimental material are relevant as regards their possible use for screening the impact of irradiated material during field releases.

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Effect of Gamma Radiation on Various  
Stages in the Life Cycle of  
Meal Worm, Tenebrio molitor Lin.

Effect of gamma radiation on each growth stage of meal worm (Tenebrio molitor Lin.) were conducted at  $27 \pm 2^\circ\text{C}$  and  $75 \pm 2\%$  relative humidity.  $\text{LD}_{50}$  and  $\text{LD}_{99}$  of 5-day-old eggs at 5 days after irradiation were 76 and 367 gray. The survived larvae could live no longer than 5 days and seldom moved or without feeding.  $\text{LD}_{50}$  and  $\text{LD}_{99}$  of instar larvae at 10 days after irradiation were 662 and 1,367 gray. No pupation occurred in larvae after irradiation. Dead larvae caused by radiation turned blackish, liquid oozed out from the body, and survived no longer than 5 days. Some irradiated larvae had incomplete molting and died.  $\text{LD}_{50}$  and  $\text{LD}_{99}$  of 6-day-old pupae at 3 days after irradiation were 874 and 1,492 gray. Abnormal irradiated pupae, some abnormal pupae were undeveloped wing and abdominal pupal characteristic was still remained. Pupal legs could develop to adult legs only and could survive no longer than 1 week. Unfortunately pupae irradiated at low dosage of radiation would develop to be complete adult head, but could survive no longer than 2 weeks with slow movement and no oviposition.  $\text{LD}_{50}$  of male adults and female adults was checked in 7 days postirradiation and it was estimated as 788 and 786 gray while  $\text{LD}_{99}$  was estimated as 1,375 and 1,350 gray respectively. Results of male adults and female adults checking in 10 days postirradiation found that  $\text{LD}_{50}$  was estimated as 533 and 598 gray and  $\text{LD}_{99}$  was estimated as 1,227 and 1,229 gray respectively. The remained survivors of both sexes could survive no longer than 10 days without feeding and mating.

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Gamma Irradiation as a Quarantine  
 Treatment of Oriental Fruit Fly,  
Dacus dorsalis Hendel in the  
 Nang Klang Wan Mangoes

Quarantine treatments for the control of fruit flies in fruits and vegetables are needed for international trade. The problem of EDB fumigant ban for fresh fruits and vegetables has led to renew interest in the use of gamma irradiation for disinfecting export commodities. The purposes of this experiment are to determine lethal dose at 50 % ( $LD_{50}$ ) and 99 % ( $LD_{99}$ ) of oriental fruit fly, Dacus dorsalis Hendel eggs and larvae in Nang Klang Wan mangoes. The results of this experiment are as follows: 1) The  $LD_{50}$  and  $LD_{99}$  for 20-hour-old eggs at 3 days after irradiation were 0.17 and 0.28 kGy, 2) The  $LD_{50}$  and  $LD_{99}$  for 1-2 day-old larvae at 3 days after irradiation were 0.71 and 1.32 kGy. At the dose of 1.0 and 0.6 kGy were required to irradiate larvae to prevent pupation and adult emergence, 3) The  $LD_{50}$  and  $LD_{99}$  for 3-4-day-old larvae at 3 days after irradiation were 1.15 and 1.69 kGy. There were no pupation and adult emergence from irradiated 3-4-day-old larvae at the doses of 1.2 and 1.0 kGy.



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Gamma irradiation as a quarantine  
treatment for walnuts infested  
by codling moth larvae.

The use of gamma irradiation has been proposed as a technique to reduce or eliminate infestations of codling moth larvae in host commodities. Codling moth, Cydia pomonella (L.), overwinters as mature, cocooned, diapausing larvae. Usually they do so under the tree bark or in other sheltered locations. Occasionally they may attempt to overwinter in fruit (apples) that have been heavily damaged by their feeding and is dried out, or in such hosts as walnuts. Research was undertaken to determine the effects of gamma radiation on codling moth larvae in walnuts.

Walnuts that had been drilled with 0.4 cm diameter holes were infested by placing them on previously infested thinning apples. When the larvae matured they would leave the apples, enter the walnuts and spin cocoons. Two types of experiments have been completed, using such nuts: one to determine dosage-mortality relationships and the second to determine if a dose of 200 Gy would be adequate as a quarantine treatment for such larvae.

Results of the dosage mortality experiment showed that 81.7% of the untreated, mature cocooned larvae were able to continue their development, pupate and emerge as adults, compared to 55.3, 22.4 and 0.8% of larvae exposed to 50, 100 and 150 Gy, respectively, of which 27.8, 21.9 and 0.8% were obviously malformed and unable to reproduce. Of the adults developing from untreated larvae, 56% were males, compared to 76, 100 and 100% for those exposed to 50, 100 and 150 Gy that could be sexed. Attempts made to mate surviving moths from treated larvae showed that eggs produced were infertile.

Probit analysis of these data indicated that irradiation of walnuts at a dose of 220 Gy would prevent emergence of adults from mature, cocooned larvae present in the nuts.

Mature cocooned diapausing and non-diapausing codling moth larvae were exposed to 200 Gy. Of the larvae that had been reared at 16-18° C (diapause inducing conditions) 74.1% of the untreated larvae developed and emerged as adults, compared to none of those that had been irradiated. Of the larvae reared at 24°C (non-diapause conditions) 84.4% of the untreated and 1.2% of the treated larvae emerged as adults. All of the adults from the latter were obviously abnormal, compared to 4.7% of the adults from the controls.

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RADIATION-INDUCED INHERITED  
STERILITY IN HELIOTHIS ZEA (BODDIE)

Heliothis zea (Boddie) (Lepidoptera: Noctuidae) males and females were irradiated with substerilizing doses of radiation. These moths were inbred and outcrossed and observed for their ability to reproduce. The inherited deleterious effects resulting from the irradiated P<sub>1</sub> males were recorded for several generations. Larvae from both irradiated (10 krad) and normal parents were compared for their ability to survive under field conditions on whorl-stage sweet corn and these results were compared with those from a laboratory study using meridic diet. Irradiated males and females and F<sub>1</sub> males from an irradiated (10 krad) male x normal female cross were released in the field and in field cages and observed for their ability to search/attract and secure a mate. Females that had mated with normal and irradiated (10 krad) males were studied to determine the effect of different mating histories on the subsequent mating propensity of the females.

A 10-krad dose of radiation induced deleterious effects which were inherited through the F<sub>2</sub> generation. These radiation-induced deleterious effects were similar to those reported in other species of Lepidoptera. The relationship between the survival of normal larvae and larvae from irradiated parents was similar under laboratory and field rearing conditions. Irradiated (10 krad) laboratory-reared males and females were competitive with normal laboratory-reared moths in mating, and this competitiveness was not affected by the time interval between irradiation and release, by the mating status of the male, or by the time interval between mating and release. Females mated to normal males and males irradiated with 10 krad had the same mating propensity and experienced the same intermating interval. These effects of substerilizing doses of radiation and inherited sterility on the reproductive ability and behavior of H. zea suggest that a great potential exists for population suppression.

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Histopathological Effects of  
Gamma Irradiation on the larval  
Midgut of Spodoptera litura (Fabr.).

#### ABSTRACT

The midgut histology of a normal and gamma irradiated sixth instar larvae treated as the first instar larvae with 2, 4 and 7 krad, was investigated. Increased mitotic activity and enlarged epithelial cells with a very little disrupting effect were seen at 2 krad. At 4 krad the regenerative cells and the epithelium of midgut showed a high degree of disintegration which became highly intense at 7 krad.

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Utilization of Dietary Nitrogen  
by the Larvae of Spodoptera litura  
(Fabricius) under the Impact of  
Gamma Irradiation.

#### ABSTRACT

During its phagoperiod an unirradiated last instar larva of Spodoptera litura ingested 20.50 mg of nitrogen (N) and digested 7.8 mg of nitrogen, thereby amassing 5.5 mg nitrogen in its body tissue. The conversion efficiency of ingested nitrogen to body tissue [E.C.I.(N)] of the same larva was estimated at 27.10% which was about one-third of the efficiency of conversion of digested nitrogen [E.C.D.(N)]. As a consequence of irradiation, N-ingestion and N-balance showed reduction. N-elimination of the experimental larva exhibited an increase at initial sublethal doses administered to the first and third instar larvae which later showed a decline at higher doses. Consumption index for nitrogen [C.I.(N)] decreased in a dose-dependent manner, the effect being more pronounced when the younger larvae were irradiated. The coefficient of apparent digestibility for nitrogen [C.A.D.(N)] of S. litura was adversely affected when the insects were exposed to gamma radiation in the first and third instars but no significant influence was observed in the larvae treated in the sixth instar. E.C.I.(N) exhibited a stimulatory effect due to irradiation. E.C.D.(N) was distinctly increased with irradiation whereas high doses administered to the first instar larvae caused a decline in this efficiency.

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Gamma Irradiation-Induced Changes  
in the Nutritional Profile of the  
Larvae of Spodoptera litura (Fabr.)

ABSTRACT

The rate of food ingested, the per cent digestibility, and the efficiency of conversion of ingested and digested food to body matter during the sixth instar of Spodoptera litura were determined on castor leaves and were correlated in response to the different sublethal doses of gamma-radiation (2 to 7 krad) when given to the freshly moulted third instar larvae. Unlike in control the phagoperiod was negatively correlated with the food digested in treated insects. In irradiated insects the phagoperiod had negative correlation with consumption index (C.I.), approximate digestibility (A.D.), growth rate (G.R.) and efficiency of conversion of ingested food (E.C.I.) also. Irradiation could markedly affect the G.R. which was positively correlated with C.I., A.D. and E.C.I. but had a negative correlation with E.C.D. (efficiency of conversion of digested food).

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Acoustical Courtship Signals and Sexual Success in Irradiated  
Caribbean Fruit Flies [Anastrepha suspensa (Loew)]  
(Diptera: Tephritidae)

### Abstract

Caribbean fruit flies, Anastrepha suspensa (Loew), have two acoustical sexual signals, calling and precopulatory. Flies were irradiated at 2.5, 5, 7.5, and 10 kR 2-26 h before emergence, and the effects on sound production and sexual behaviors were noted. The pulse train intervals of the calling sound increased with dosage while the propensity to produce the sound decreased. The lower frequency of the bimodal pulse trains became lower with increased radiation but the higher frequency was unchanged. When flies were irradiated 24-48 h before eclosion, low frequency sounds decreased in proportion and often were absent altogether. The fundamental frequency of the precopulatory sound signals was also lower in flies irradiated with higher dosages. Such sound signals are longer in 10 kR irradiated flies, and may be indicative of relative sexual incompetence. Several of the changes in the sound production of irradiated flies may make them less effective as sexual advertisements. These include increased pulse train interval, decreased calling sound propensity, and lowering of the sound frequencies.

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The Effects of Gamma Radiation on Spore Viability  
and Mosquito Larvicidal Activity of *Bacillus sphaericus* and  
*Bacillus thuringiensis* var. *israelensis*

Gamma irradiation of 50-1750 kR progressively lowered spore viability in *Bacillus sphaericus* (2362) and *Bacillus thuringiensis* (H-14) spore powders. A slight, but statistically significant, loss of mosquito larvicidal activity was observed in *B. thuringiensis* (H-14) preparations exposed to radiation over 1000 kR. A noticeable but insignificant loss of activity was observed in *B. sphaericus* preparations at the highest dosages of radiation.

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THE EFFECT OF  $^{60}\text{Co}$  r-RAY IRRADIATION ON THE ESTERASE ISOZYME OF PUPAE OF CORN BORER

Application of Atomic Energy in  
Agriculture 3:44-48 (1984)

#### 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  $^{60}\text{Co}$  r-rays 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 EFFECTIVES OF IRRADIATION-  
SUBSTERILE-TECHNIQUE FOR CONTROL-  
LING CORN BORER POPULATION ON  
MO-PAN-SHAN-ISLAND

Application of Atomic Energy in  
Agriculture 2:5-9 (1985)

ABSTRACT

The effectiveness of releasing irradiated substerile insects of controlling corn borer (*Ostrina furnacalis* Guenee) population on a small island, "MO-PAN-SHAN", liaoning provice has been studied. The pupae of 1-2 days before emergence were irradiated with 25-30kr of  $^{60}\text{Co}$ -gamma ray. After irradiation the pupae were stored in a refrigerator at  $15^{\circ}\text{C}$  and released next day. The irradiated moths could mix with the wild population, and their dispersion ability was the same as the wild moths. Moths could not make non-stop flight over 1700 meters once. The release tests were made for three years. The results shew that the substerile moths have a stronger mating competitiveness in fields. The ratio of the releasing moths to the wild was 0.64:1, and the rate of the sterile and substerile eggs was about 44%. In compare with control, the number of corn borer in the field was decreased by 34.2%, suggesting that the irradiated moths have an effect of genetic sterility. The effect will be increased with increasing the number of releasing moth. So, the releasing of irradiated substerile corn borer is an effective method for controlling the corn borer population.

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STERILIZATION OF RICE MOTH,  
CORCYRA CEPHALONICA STANTON  
(LEPIDOPTERA : GALLERIIDAE)  
WITH GENUINE RADIATION.

The adult moths of Corcyra cephalonica were irradiated with a Cobalt-60 Irradiator at a dose rate of 2.4 krad/minute and the optimum dose was determined. The sterilising dosages of radiation were 35 and 20 krad for male and female moths, respectively. The ED<sub>50</sub> (effective dose) values for male and female moths were 8.23 and 5 krad, respectively. The fecundity of the treated female adults was reduced as the dosage increased. Further, longevity of the treated moths was affected by irradiation. Females had shorter life span than the males, indicating that females are more sensitive than males to irradiation. Radiation sterilised males were not as competitive as untreated males for mating with untreated females.



**EFFECT OF GAMMA AND ULTRAVIOLET IRRADIATION ON THE HEART BEAT  
AND HAEMOLYMPH OF COCKROACH PERIPLANETA AMERICANA L.  
AND SILKWORM BOMBYX MORI L.**

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**ABSTRACT**

Toxicity studies on the cockroach and 5th instar larvae of silkworm after exposure to ultraviolet and gamma rays showed little or no effects. However, the cockroach heart subjected to UV and gamma irradiation showed considerable decrease in the heart beat frequency followed by a steady decline below normal level. The silkworm heart subjected to UV and gamma irradiation have shown significantly high stimulation of the heart beat followed by a rapid decline. This differential effect of irradiation on the insect heart shows difference in their pacemaker mechanism.

The glycogen content of cockroach haemolymph after the direct and indirect exposure of haemolymph and exposure of insects followed by extraction respectively, to gamma rays showed increase in its content, while protein and other metabolites showed decrease. The exposure of intact insects to UV showed more effect than the exposure of its haemolymph. Decrease in pyruvic acid and lactic acid suggests stress phenomenon and utilization of carbohydrates. On the other hand, the gamma exposure caused notable effects on the exposed haemolymph. The haemolymph of silkworm larvae subjected to UV and gamma irradiation resulted in an increase of lactic acid content except which it had no other impact. Thus, it is evident that irradiation effect was negligible in silkworm as compared to cockroach. Further elucidation on these lines is in progress.

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Comparative effects  
of fasting and  
ionisation on the free  
amino acids concentration  
in *Tribolium confusum*.

Several authors showed that radiation damage is reflected by changes in the free amino acid pool of insects in every stage of developpement. In irradiated insects the food consumption and respiration are much reduced and the death mainly due to intestinal damage occur after several days or weeks according to the species and to the doses applied.

The aim of this study was to determine wether or not the change of the free amino acid (FAA) contents in *Tribolium confusum* male adults could be assigned to a lack of nutrition.

The concentration of the FAA in *T. confusum* males ionized at 63, 315 and 501 Gy changed with time nearly as if the insects were deprived of food. This result confirms the inhibitory effect of ionization on digestive functions. The time course of FAA changes was dose independant from 62 to 501 Gy. No specific effect on intermediary metabolism was observed. From a practical point of view the present study allows one to determine wether or not a given insect has been lacking food and since how long time. The FAA pattern analysed in an insect sampled from a store house where food is available would thus indicate wether or not this insect has been ionized at doses of 60 to 500 Gy. It would be useful to explore the possibility of using the FAA analysis for an identification test.

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On the genetics of diapause suppression  
in the two-spotted spider mite,  
*Tetranychus urticae* Koch

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Starting from the reference strain S of the two-spotted spider mite, *Tetranychus urticae* Koch, the strains ND<sub>1</sub> and ND<sub>2</sub> were selected for not responding with diapause on a short-day regimen (10L:14D, 18°C). The genetic basis of the suppression of diapause in ND<sub>1</sub> and ND<sub>2</sub> was analysed by means of mendelian crosses and backcrosses, using the photoperiodic cycle 10L:14D as diagnostic for the distinction of diapausing and non-diapausing phenotypes. Suppression of diapause is inherited as a recessive trait. From backcross analysis it was concluded that the suppression of diapause in ND<sub>1</sub> and ND<sub>2</sub> is under monogenic control. The major genes for suppression of diapause in ND<sub>1</sub> and ND<sub>2</sub> are alleles at a locus designated as d. Mutation for albinism of the locus a-p is pleiotropic for suppression of diapause in strain A. It was shown from crossings between the strains ND<sub>1</sub> and A, that d and a-p are distinct loci.

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Genetic basis of diapause in the  
 two-spotted spider mite, Tetranychus  
urticae Koch (Acarina: Tetranychidae)  
 Treatises and Monographs of SGGW-AR,  
 Warsaw, 1985

The "Sambucus" (S) strain of the two-spotted spider mite, Tetranychus urticae Koch, has been established in the laboratory in 1961. After more than 20 years, and about 500 generations, the strain preserved all photoperiodic response characteristics of the original strain. Heterogeneity of the S-strain with respect to photoperiodic response was rather slightly pronounced; diapause incidence varied from 97 to 100% (10L:14D, 18°C).

The non-diapausing strains ND<sub>1</sub> and ND<sub>2</sub> were derived each from a single mated female of the S-strain by means of sib-mating over 3 generations. The two founder females (of ND<sub>1</sub> and of ND<sub>2</sub>) were not responding with diapause to a short day regimen in the middle of an approximate 3,500 diapausing females. The established ND<sub>1</sub>- and ND<sub>2</sub>-strains reacted with low percentage of diapause to a range of photoperiods from 4L:20D to 10L:14D, with a temperature of 18°C. Reciprocal crosses between the ND<sub>1</sub>- and ND<sub>2</sub>-strains revealed that there is no complementation with respect to the ability to diapause between these strains. The suppression of diapause in the selected ND<sub>1</sub> and ND<sub>2</sub> strains (10L:14D, temp. 18°C) was dependent on the operation of single recessives, the alleles  $\underline{d}_1$  (of the ND<sub>1</sub>-strain) and  $\underline{d}_2$  (of the ND<sub>2</sub>-strain), of the same locus  $\underline{d}$ . However, the percentage of diapause in the hybrid  $\underline{ND}_1 \times \underline{ND}_2$  was due to operation of chromosomal determinant only, the hybrid  $\underline{ND}_1 \times \underline{ND}_2$  derived its suppression of diapause from chromosomal and extrachromosomal determinant(s). At a lower temperature (15°C), the hybrids reacted with nearly 100% diapause, and at this regimen "diapause" can be designated as fully dominant over "non-diapause". Diapause penetrance was higher at the lower temperature; the high temperature (e.g., 18°C) averted diapause in a part of hybrids and/or gave room for expression of some extrachromosomal determinants responsible for "non-diapause" character.

Also in crosses of the non-diapausing strains with the "Leningrad" (L) strain, the trait "diapause" of the L-strain exhibited incomplete dominance over the trait "nondiapause". Expression of maternal effects was different in crosses of L with the ND<sub>1</sub>- and ND<sub>2</sub>-strains.

Mutations at the  $\underline{a-p}$  locus not only result in albinism, but also in an affection of the diapause capabilities. Alleles of  $\underline{d}$  do not affect pigmentation, like the  $\underline{a-p}$  alleles, but affect only the ability to diapause. Obtained results indicated that  $\underline{a-p}$  and  $\underline{d}$  are distinct loci.

The determinants for "diapause" trait of the L- and S-strain are expressed as dominant after hybridization with the "Egypt" (E) strain, a homodynamic strain of T. urticae. In the crossing ND  $\times$  E, i.e. between different non-diapausing strains, a high proportion of female hybrids (about 50%) were found to be in the diapause condition (effect of overdominance?). However, the low rate of fertilization, hybrid infertility, and hybrid mortality, all these phenomena were the cause of that the genetic tests involving the E-strain were not workable.

Crosses between individuals of the L- and S-strain of T. urticae produced progeny which entered to the diapause condition under a range of photoperiods from 14<sup>1</sup>/<sub>4</sub> L:9<sup>3</sup>/<sub>4</sub> D to 15<sup>1</sup>/<sub>2</sub> L:8<sup>1</sup>/<sub>2</sub> D. The critical day-length for the reciprocal hybrid lied between 15 hr 30 min and 15 hr 45 min. Thus, crosses between individuals of these two separated populations produced hybrids with an intermediate critical day-lengths. Also, the photoperiodic responses of backcross progeny are intermediate between those of parents, as well of the L- and S-strains. The results obtained look to be consistent with those for polygenic inheritance of the critical day-length trait.

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ADH ALLELE FREQUENCY CHANGES IN OLIVE  
FRUIT FLIES SHIFT FROM OLIVES TO  
ARTIFICIAL LARVAL FOOD AND VICE VERSA,  
EFFECT OF TEMPERATURE

Entomologia Experimentalis et Applicata,  
Volume 40 (1986): in press

#### ABSTRACT

When field collected olive fruit flies, *Dacus oleae* (Gmelin) (Diptera:Tephritidae), were maintained on artificial larval medium or ripe (black) olives in the laboratory for four consecutive generations, the frequency of alcohol dehydrogenase (ADH) allozymes changed (impressively) only in the flies kept on artificial larval food. When flies reared in the laboratory for about two years (allele frequencies of artificially reared flies in equilibrium) were provided ripe olives for oviposition for three consecutive generations, the ADH allozyme frequencies changed substantially within only one generation, remaining stable thereafter. The change was towards the frequency levels of natural populations of flies. Finally, when field collected flies were reared artificially under three different daily temperature regimes (i.e. 17, 17-25 and 25°C), the general pattern of ADH allozyme frequency changes was not affected by the different temperature regimes. The only difference was that the stable temperatures, especially the high one, exhibited more rapid changes of allele frequencies than the daily fluctuating temperature regime.

Buguna, S.G.,

LETHAL FACTORS IN CULEX QUIN-  
QUEFASCIATUS

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#### ABSTRACT

The genetics of a sex linked recessive lethal and a larval mutant (DHS) which could be used as a balanced lethal system are reported. The possible use of lethal factors in the detection of new mutations and in the synthesis of cytogenetic mechanisms are discussed.

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Insects Affecting Man and Animals Research Laboratory

Use of a Commercial Color Sorter to Sex

U.S. Department of Agriculture, Agricultural Research Service Stable Fly Pupae from a Genetic Sexing Strain

P.O. Box 14565 Gainesville, FL 32604

A genetic sexing strain of stable flies with females having black pupal color and the males having brown pupal color were selected in a color sorter with ~99% accuracy. A single channel machine could sort 1,700,000 pupae in 24 h. The use of this color sorter and this genetic sexing strain show promise for use in integrated control programs using sterile male releases.

D.

25

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LABORATORY STUDIES ON THE BIOLOGY  
OF *MANSONIA ANNULIFERA*, THEOBALD  
1901 (DIPTERA: CULICIDAE)

#### ABSTRACT

*Mansonia annulifera*, vector of *Brugia malayi* in Kerala, India, has been colonized and a cyclic colony is being maintained at the Vector Control Research Centre. Studies were carried out on egg hatchability, immature developmental duration, insemination capacity, longevity, gonotrophic cycle and fecundity. Number of eggs per cluster varied from 74 to 146 (average 116.1) and hatchability from 88.03 to 98.32 % (mean  $94.74 \pm 3.64$ ). The longevity of male and female varied from 2 - 27 days and 3 - 32 days respectively.

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Study of the mycetome in tsetse  
flies (Glossina spp.)

II. In vitro synthesis of DNA and  
proteins in mycetome of G. palpa-  
lis palpalis

Insect symbionts of a different nature are generally believed to produce essential factors (especially the B vitamins-like substances reported for hematophagous species) latter utilized by host's organism. The key role of the tsetse mycetome in vitamin synthesis (e.g. thiamine, pyridoxine, biotin, panthoteic acid, folic acid, etc.) has been recently established experimentally. Moreover, it has been shown that aposymbiotic flies kept on arteficial diets containing 15 times higher vitamin content are able to compensate for the endosymbiotic vitamins lost. Other "essential factors" remained practically unknown. This paper is intended to show DNA and protein synthesis by tsetse microbial endosymbionts in vitro in order to contribute to the knowledge of tsetse reproduction and rearing for SIT.

Adult tsetse flies, Glossina palpalis palpalis from the stock colony (Nigerian origin) were obtained as puparia from the Entomology Unit of the Joint FAO/IAEA Division in Vienna, Austria. Isolated and superficially sterilized mycetomes were carefully homogenized and incubated with shaking in human serum with 10  $\mu$ Ci [ $^3$ H] - thimidine or 10  $\mu$ l of [ $^{14}$ C] - leucine, respectively. In vitro synthesis of DNA, measured as labeled thimidine incorporation into the acid-stable fractions, shows the highest intensity during the first 30 minutes then gradually ceases during a further 30 min. Using labeled leucine, the incubation (for 30, 60 and 90 min) of endosymbionts is accompanied by protein synthesis detected by SDS electrophoresis in gels counterstained with silver. Eight of these proteins, the molecular weight of which ranges from 52 - 150 kilodaltons, are apparently positive to a fluorographic detection.

Taking into account the similarity of insect endosymbionts to the subcellular organelles such as mitochondria, ribosomes etc., DNA production in tsetse endosymbionts could be expected. Moreover, the in vitro incorporation of [ $^3$ H] - thimidine into acid-stable fractions in tsetse endosymbionts exhibits very similar time patterns (most intensive incorporation during the first 30 min) as those of isolated endosymbionts of Acyrtosiphon pisum (Ishikawa, 1982, 1984). Similarly to aphid endosymbionts we also managed to detect the de novo productions of eight proteins in tsetse endosymbionts. This is the first evidence of proteo-synthetic activity of the tsetse mycetome; a structure in which only vitamin synthesis had been supposed to take place.

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Crossing between non-diapausing and  
diapausing allopatric strains of the  
two-spotted spider mite, Tetranychus  
urticae Koch (Acarina: Tetranychidae)

Pol. Pismo Entomol., in press

The non-diapausing strains ( $ND_I$ ,  $ND_2$ ) selected from the "Sambucus" colony of the two-spotted spider mite, Tetranychus urticae Koch, were crossed with the "Leningrad" strain (L), an allopatric strain responding with about 100% diapause incidence to short-day conditions. The diapause responses were observed in the  $F_I$  and backcross progeny.

The obtained results show that (a) the trait "diapause" of the L-strain exhibited incomplete dominance over the trait "non-diapause", (b) maternal effects were present in crosses of females of both non-diapausing strains with the L-males, (c) expression of maternal effects was different in the  $ND_I$ - and  $ND_2$ -strains when crossed to the L-strain.

Females of the L-strain do enter into diapause when they are submitted to a photoperiod of 16L:8D with a temperature of 18°C. The test conditions (10L:14D, temp. 18°C) may possibly be considered to represent a severe regimen for the induction of diapause in the L-strain. As the trait "diapause" of L-strain is dominant over the trait "non-diapause", the regimen is severe on hybrids of the reciprocal crosses between L- and  $ND_I$  or  $ND_2$ -strains, too. Appearance of non-diapausing females in the progeny of  $ND_I$ - or  $ND_2$ - females mated to L-males indicates therefore a great expressivity of maternal factors responsible for suppression of diapause in the hybrids.



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Diapause incidence in crosses of a  
homodynamic strain of the two-spotted  
spider mite, Tetranychus urticae Koch,  
with diapausing and non-diapausing  
strains

A strain of Tetranychus urticae Koch collected from the castor bean, Ricinus communis (L.), in Egypt (the E-strain) is non-diapausing strain. Under the prevailing conditions, a photoperiodic response is absent in these mites. Gene exchange between the E-strain and the alien strains is hindered by reduced fertilization combined with hybrid inviability not only when the E-female is mated to a male of an alien strain, but also in the opposite pairing pattern.

The determinants for "diapause" trait of the L- and S-strain are expressed as dominant after hybridization with the E-strain. When mated to the E-males, females of albino strain produce the hybrid daughters with the wild pigmentation and normal capability to diapause.

The very variable figures were obtained in the pairings of females of the ND<sub>1</sub>- or ND<sub>2</sub>-strain with the E-males. The diapause incidence varied from 0 to 100% between the replicates or in the progeny of particular pairs. It is not easy to comment on these results. However, remarkable is here the fact that in the crossing ND x E, i.e. between different non-diapausing strains, a high proportion of female hybrids (about 50%) were found to be in the diapause condition.

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Kinetics of Penetration of Methyl  
Parathion in Desert Locust,  
Schistocerca gregaria Forskal.

J. Nuclear Agric. Biol.,  
14(1985)41-42.

#### ABSTRACT

Studies on the rate of disappearance of <sup>14</sup>C-methyl parathion, applied topically on the mesonotum of desert locust, Schistocerca gregaria Forskal revealed that the penetration of this insecticide did not follow the first order kinetics and showed a biphasic pattern. The faster phase of penetration lasted upto 120 min from the time of application (half-life 74±18 min) whereas, the slower phase which was observed from 120 min to 24 hr had a half-life of 338±130 min.

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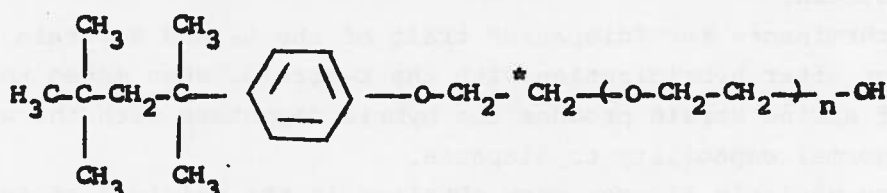
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PESTICIDE FORMULATIONS FOR FORESTRY:  
 BEHAVIOUR OF NONIONIC SURFACTANT  
 IN BALSAM FIR

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### Abstract

The <sup>14</sup>C-nonaethoxylate of p-(1, 1, 3, 3-tetramethylbutyl)phenol, where n=8, was applied to expanding lateral buds of *Abies balsamea* (L.) Mill. The aqueous surfactant was at micellar concentrations,



ca 1000 ppm and at ca 15% w/v. The treated tissues were subsequently excised and analyzed. Recovery of applied <sup>14</sup>C after one month was >90%, including an initial water-rinseable fraction that was <10%. The most <sup>14</sup>C was recovered by subsequent immersions of the treated tissues in ethylacetate. The major constituent of this fraction was the parent surfactant but several partially deethoxylated (n=0-7) metabolites were present. Additional <sup>14</sup>C was recovered by homogenizing the tissues in methanol but <25% of the applied <sup>14</sup>C was unextractable. The methanolic extract contained the parent surfactant and one polar metabolite. The persistence of the surfactant has possible significance in formulation technology.

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STUDIES ON THE CONTROL OF SCLEROTIZATION OF POLYPNEUSTIC LOBE CUTICLE OF STAGE III TSETSE LARVAE (*Glossina morsitans morsitans*).

The quinone of N-acetyldopamine, derived from tyrosine, is responsible for cross-linking proteins in the cuticle of the stage III larva to form the puparium, which protects the pupa, after metamorphosis in the soil. By monitoring  $^{14}\text{C}$ -L-p-tyrosine uptake into cuticle it is possible to study the factors which control sclerotization.

The mode of reproduction and subsequent development of the tsetse larva offers certain distinct advantages to the student of insect endocrinology. For instance, the events after the initiation of pupariation (i.e. hardening of the peritreme around the spiracles) and pupation takes 10-12 h in blowflies whereas in tsetse they take 5-6 d. Hardening of the polypneustic lobes (analogous to the peritreme) takes place 2 d before larviposition. If the lobes were not sclerotized before birth the air supply to the larva in utero could be cut off if the pregnant fly were to feed during the last 2 d of her pregnancy. In 1981 it was reported (17th OAU/STRC Meeting, Arusha) that, because ecdysteroids could not be detected using radioimmunoassay (RIA) at the time of lobe hardening, a non-steroid factor might be responsible for triggering sclerotization of the lobes. This hypothesis can now be discounted in the light of the following evidence.

The rate of tyrosine uptake by the body cuticle was compared with uptake into the lobe cuticle in vitro just before sclerotization was due to start. Label entered twice as quickly into lobes when 20-hydroxyecdysone (20-OHE) was added to the tsetse ringer (Table 1) but ecdysone (E) the precursor of 20-OHE, did not stimulate uptake at the low titre used deliberately to simulate the situation in vivo.

The entry of tyrosine into the cuticle of the anterior of larvae ligatured after larviposition was monitored in vivo in the presence of added 20-OHE, E, tanning hormone (TH) from adult *Sarcophaga argyrostoma* or Juvenile Hormone (JH) analogue. The experiment was conducted to see whether any of these hormones could overcome the inhibition reported earlier (Bull. ent. Res., 64, 223-240 (1974)). They did not! In fact the presence of the ligature itself not only greatly inhibited uptake of tyrosine by the anterior cuticle but it also inhibited metabolism of tyrosine in the haemolymph and epidermis (Table 2). This was true whether the ligature was tight or loose. The only logical explanation of this unexpected observation is that the constriction of the cuticle releases an inhibitor from the epidermis into the haemolymph. How the inhibitor shuts off decarboxylation and N-acetylation of dihydroxyphenylalanine (DOPA) - or its precursor tyrosine - is a mystery. The development of testes is also retarded in constricted larvae (Kokwaro and Yagi<sup>1</sup>). 20-OHE stimulated metabolism of tyrosine in haemolymph taken from newly deposited larvae (Table 2) but the increase was mainly due to oxidation of DOPA to melanin. E stimulated incorporation of label into neutral (pH 1.9) compounds X and Y which co-migrate with N-acetyltyramine and N-acetyldopamine. (They are not aldehydes for xanthine oxidase did not convert them into acids). This is the first report that the sclerotizing agents can form in vitro in haemolymph rather than in the epidermis.

Table 1 Percent Label Taken up After Incubating Tsetse Stage III Larval Cuticle in vitro with 50 nCi of L-[U- $^{14}\text{C}$ ]-Tyrosine\* in 20  $\mu\text{l}$  Tsetse Ringer for 1 hr at 24°C and then for 18 hr at 4°C.

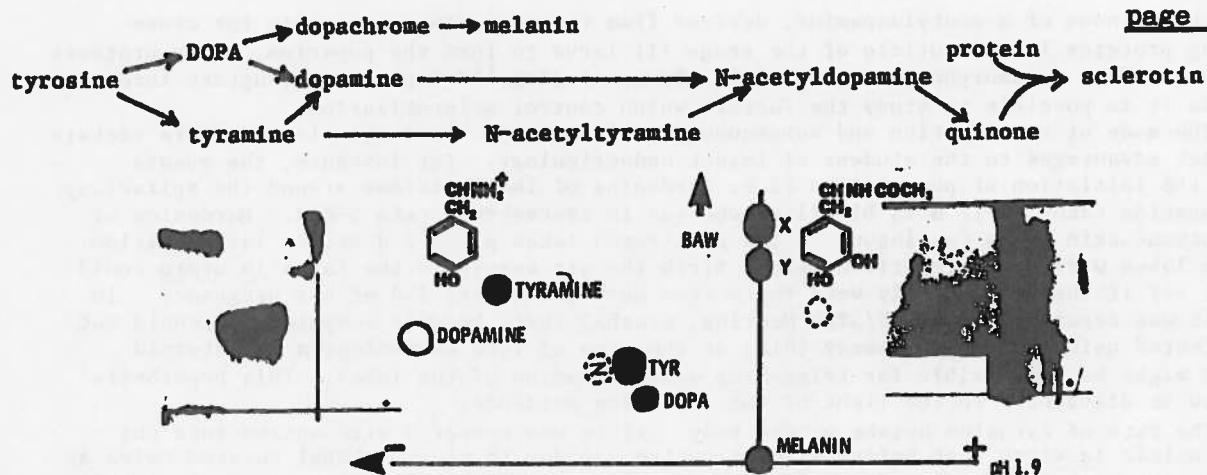
Treatment	Hormone Concentration per g. of larva	% Label in Lobe cuticle $\bar{x} \pm \text{S.E.M.}$	% Label in Body Cuticle $\bar{x}$	* 522 nCi mmol <sup>-1</sup>  1) 20-hydroxyecdysone
Control				
With 20-OHE <sup>1</sup>	2.38 nmoles	11.31 $\pm$ 0.54	10.2	
With Ecdysone	2.90 nmoles	19.45 $\pm$ 1.23	-	
With Larval Blood	-	9.28	2.46	
		4.26	-	

The role of ecdysteroids in programming the haemocytes and epidermis to synthesize the enzymes required to metabolize tyrosine thus can profitably be studied in tsetse where the major events occurring before pupation are separated temporally. Use of the decarboxylase inhibitors MK 485 and Ro 4-4602, which inhibited pupariation for 18-24 h, showed that, because DOPA accumulated rather than tyrosine, tryamine was not the major precursor of the sclerotizing agent.

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Studies on Control of Sclerotization of Poly-  
phneustic Lobe Cuticle of Stage III Tsetse  
Larvae Glossina morsitans

page 2.



How 20-OHE breaks down the barrier to tyrosine into lobe cuticle rather than the body cuticle is worthy of further study. The flux of labelled metabolites, derived from  $^{14}\text{C}$ -L-tyrosine injected into pregnant tsetse just before lobe hardening was due to begin, showed most dramatically how the barrier is lowered or the gates are opened for specific uptake of the precursors of the sclerotizing quinone into lobes. That the process was mimicked *in vitro* when 20-OHE was added to the incubation *in vitro*, in which excised white lobes were floating, proves the permeability of the epidermis can indeed be altered by this sterol but not by its precursor ecdysone (E).

Table 1: Percent Label in Metabolites<sup>1</sup> Deriv from L-(U- $^{14}\text{C}$ )-Tyrosine in Haemolymph<sup>2</sup> from Tsetse Larvae at Larviposition and Pupariation.

Treatment Metabolites	Just Deposited			Rounding off	
	N11	+E <sup>3</sup>	+20-OHE <sup>4</sup>	N11	Loosely Constricted (cumberbund)
X & Y	0.50	1.62(+1.41*)	1.76	22.43	0.64
Tyramine	0.14	0.43	0.02	0.66	0.01
Dopa	5.57	1.03	7.13	5.52	4.38
Melanin	1.23	0.85	21.31	40.18	0.33
Unknown <sup>2</sup>	-	5.68	-	-	-
Total	7.44	9.61	30.22	69.42	5.36

- 1) Separated on paper by electrophoresis @ pH 1.9 and chromatography in N-butanol/acetic/water: 4/1/1.
- 2) Incubated 1h at R.T. - final volume 100  $\mu\text{l}$ .
- 3) 87 fmoles, 4) 83 fmoles (0.4 ng  $\mu\text{l}$ )
- 2) Unidentified compound(s) migrating on the +ve side of tyrosine.
- \* ) Liberated by hydrolysis (6N HCl) from the conjugate<sup>2</sup>.

N.B. This paper was presented at the VII Ecdysone Workshop, Edinburgh on 2nd April, 1985.

+ Unpublished (see I.C.I.P.E. Annual Report for 1984)

Subramanian, S., Vanamail, P., Das, P.K. and Rajagopalan, P.K. ESTIMATION OF ACTION AND WARNING LIMITS FOR THE EFFECTIVE IMPLEMENTATION OF VECTOR CONTROL PROGRAMME  
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#### ABSTRACT

The Filariasis Control Demonstration Project (FCDP) data on all night biting density of C. quinquefasciatus collected from one of the collecting stations fortnightly, from 1981 to 1984 was used for the analysis of time series components, namely the trend, seasonal and cyclic variations and random fluctuations. The trend values fitted to a mathematical law  $T = Ax^B$  was found to be highly significant. Though uniform control pressure has been applied during the study period, its effect was drastically noticed only during the first year of control operations and thereafter the population has been stabilized to its minimum level with narrow range of fluctuations. Applying statistical quality control techniques, the action and warning limits for the year 1985 were calculated to indicate corrective action by the control team.

Kalyanasundaram, K., Amalraj, D., Paily, K.P., Nisha George and Sujatha, C.H., SYNTHESIS OF SUBSTITUTED AMIDES FOR REPELLENCY AGAINST MOSQUITOES  
 Vector Control Research Centre  
 Pondicherry-605006.

#### ABSTRACT

Thirty-five substituted amides of seven carboxylic acids by reacting the respective acid chloride with secondary amines such as diethylamine, dimethylamine, piperidine, N-methyl aniline and N-ethyl aniline were synthesized at this Centre. The compounds were tested for repellency on rabbits and human forearm at the application rate of 1 mg/cm<sup>2</sup>. Out of these compounds, five amides, viz., N, N-Diethyl O-Chloro benzamide, Piperidinyl 2-ethyl hexanamide, N-methyl 4-methoxy benzamide showed significant repellency against three to four day old unfed Aedes aegypti adult mosquitoes with protection time ranging between 5 and 7 hours. A comparative cost analysis of these compounds with DEPA (N,N-Diethylphenylacetamide) a repellent developed at this Centre is also discussed.

Panicker, K.N., Srinivasan, R., LARVIVOROUS POTENTIAL OF  
 Viswam, K. and Rajagopalan, P.K. SOME CYPRINIFORMES FISHES  
 Vector Control Research Centre  
 Pondicherry-6.

#### ABSTRACT

The common carp, Cyprinus carpio var. communis, the grass carp, ctenopharyngodon idella, and the major carp, Catla catla are widely cultured for food in south Indian region. The larvivorous potential of these fishes was studied in the laboratory. The common carp consumed on an average 876.0 mosquito larvae per day in the absence of aquatic vegetation and 763.7 larvae in the presence of aquatic weeds, whereas the corresponding figures for grass carp were 328.7 and 171.9 and for the major carp 928.2 and 922.8 respectively. Due to their edible value these fishes are more acceptable to the village community and their high larvivorous potential ideal for mosquito control operations in many situations. Hence a composite fish culture involving local community with governmental support was introduced for mosquito larval control in the ponds in rural areas of Pondicherry.

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PILOT SCALE PRODUCTION  
 AND EVALUATION OF BACILLUS  
THURINGIENSIS H-14

#### ABSTRACT

Pilot scale production of Bacillus thuringiensis, serotype H-14, a microbial pesticide, was successfully accomplished in 100 litre fermentors, by using jaggery (Country sugar) as the major source of carbon in the medium. Twelve batches of the bacterial formulation were produced. The average yield/l was 10.7 g. and the quantity of formulation obtained per batch per 100 litre of medium varied from 800 g. to 1150 g. Laboratory evaluation of the formulation obtained through different batches using Culex quinquefasciatus third instar larvae as target organism showed that their LC 90 doses varied from 75 - 100 ug. When different batches of the formulations were tested against Anopheles subpictus and Culex sitiens, larvae under field conditions, they caused an average reduction of 98 per cent among late instar and 67 per cent among early instar larval populations.

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FACTORS INFLUENCING IN  
VITRO ZOOSPOROGENESIS  
OF MOSQUITO PATHOGENIC  
FUNGUS LAGENIDIUM

ABSTRACT

Studies were carried out in vitro to understand the factors influencing zoosporogenesis of an indigenous strain of Lagenidium. Mycelium from PYG agar medium incorporated with sunflower oil yielded  $7.6-8.5 \times 10^4$  zoospores/ml compared with  $2.4-3.1 \times 10^4$  zoospores/ml produced by mycelia from other media. Mycelia from less than seven days old culture or from more than 16 days old culture produced significantly less number of zoosporogenesis was 6.5-7.5 and the zoospore production was not significantly affected in the presence of 1000 ppm of Sodium Chloride. Zoospore yield was always higher when the mycelia were incubated at 37°C rather than at 28°C. Zoospore production was significantly inhibited in the presence of 0.25 ppm of Fen-thion and Temephos.

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EVALUATION OF A NEW INSECTI-  
CIDE PAINT, VERNACIDE (R),  
TO CONTROL MOSQUITO VECTORS  
AND OTHER HOUSEHOLD PESTS  
WITH PARTICULAR REFERENCE TO  
CULEX QUINQUEFASCIATUS (CULICI-  
DAE) AND PERIPLANATA AMERICANA  
(BLATTIDAE).

ABSTRACT

Adulticidal efficacy of water base and oil base formulations of the insecticidal paint Vernacide (R), was assessed against Culex quinquefasciatus mosquitoes in the laboratory and against the Cockroach, Periplanata americana in a house. The paint was found highly effective giving 100% mortality for several months. It was also found that insecticidal properties of the paint were restored after a cold water wash to it. The paint will be very useful in controlling vector mosquitoes and the terrestrial household pests, particularly in Airports, Hospitals and Hotels, where good sanitary conditions are needed.



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EFFICACY OF AROSURF<sup>(R)</sup>, A MONOMOLE-  
CULAR SURFACE FILM, IN CONTROL-  
LING CULEX QUINQUEFASCIATUS SAY,  
ANOPHELES STEPHENSI LISTON AND  
Aedes Aegypti (L) (DIPTERA: CULI-  
CIDAE).

#### ABSTRACT

Arosurf<sup>(R)</sup> MSF, a surface active monomolecular layer, was evaluated against Culex quinquefasciatus, Anopheles stephensi and Aedes aegypti in laboratory, simulated and field conditions. Arosurf was found to significantly alter the surface tension of water in all types of breeding habitats and caused mortality in larvae and pupae, besides failure of emergence in the eclosing adults. In different breeding habitats Arosurf was effective at a dosage 11.2 lit/hect. against all the three vector mosquitoes and prevented their emergence from two weeks to twelve weeks. Arosurf was also found to interfere with the breeding of the gravid Cx. quinquefasciatus females as they were trapped before laying the eggs. In the integrated vector control programmes Arosurf can be certainly used as an additional effective tool.

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A NOTE ON THE HOST FEEDING BEHA-  
VIOUS OF FILARIA VECTOR C. QUINQUE-  
FASCIATUS IN PONDICHERRY

#### ABSTRACT

A study was carried out to monitor the feeding behaviour of filaria vector Culex quinquefasciatus in different climatological and environmental situations in Pondicherry. Blood meal identification was made from mosquitoes collected from different localities throughout the year and the results discussed.



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EVALUATION OF SPIDER AND AQUATIC  
INSECT PREDATORS OF MOSQUITO  
LARVAE USING  $^{32}\text{P}$

A series of laboratory experiments was performed with Culex pipiens pipiens L. 4th instar larvae irradiated with 0.1 to 0.4  $\mu\text{Ci/ml}$   $^{32}\text{P}$  for 24 hours. A mean dpm for the mosquito larvae ( $n=50$ ) was determined before each experiment (17 total) and approximately 1000 radioactive larvae were placed into two simulated grass bank ponds while another 1000 non-radioactive mosquito larvae were placed in a similar control. The first simulated pond contained only spiders captured in or near local ponds. They included a fishing spider (Pisauridae) Dolomedes triton (Walckenaer) and two wolf spiders (Lycosidae) Pirata sedentarius Montgomery and Pardosa delicatula Gertsch & Wallace. The second pond contained both spiders and aquatic insect predators also found in local ponds. The control pond contained both spiders and insects. After 48 hours, all spiders and insects were removed and taken through scintillation counting singly. A simple linear equation was used to roughly determine quantitative ingestion of larvae by three species of spiders. The results listed on the table below indicate species, the total number of individuals tested, the percent of these individuals positive for  $^{32}\text{P}$  and the mean number of mosquito larvae consumed per 24 hours.

SPECIES	#TESTED	%POSITIVE	MEAN LARVAE CONSUMED PER 24 HOURS
<u>Dolomedes triton</u>	73	76.7	12
<u>Pirata sedentarius</u>	160	73.8	2
<u>Pardosa delicatula</u>	56	27.6	3

The spiders were observed to grasp a larva from beneath the surface of the water, pull it through the surface tension and consume it.

The aquatic insects used (30 species) were only qualitatively evaluated with  $^{32}\text{P}$ . Although individual species are too numerous to mention here, the families represented (# of species in parenthesis) were Coenagrionidae (2), Aeshnidae (1), Corduliidae (1), Libellulidae (2), Corixidae (3), Pleidae (1), Notonectidae (3), Naucoridae (1), Belostomatidae (1), Nepidae (1), Gerridae (1), Dytiscidae (6), Noteridae (1), Gyrinidae (1), Hydrophilidae (4) and Helodidae (1).

Dispersion linéaire de Glossina palpalis gambiensis et de  
Glossina tachinoides dans une galerie forestière  
en zone soudano-guinéenne (Burkina-Faso)

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Résumé

CUISANCE (D.), FEVRIER (J.), DEJARDIN (J.), FILLEDIER (J.) Dispersion  
linéaire de Glossina palpalis gambiensis et de Glossina tachinoides  
dans une galerie forestière en zone soudano-guinéenne. (Burkina-Faso).  
Rev. Elev. Méd. vét. Pays trop.

Au cours de la saison sèche 1980, les auteurs étudient la disper-  
sion lignéaire de deux glossines riveraines, G. p. gambiensis et G. tachinoides  
le long de 35 km d'une galerie forestière bordant le cours supérieur de  
la Volta Noire au Burkina-Faso.

35 430 glossines sont lâchées en tête de galerie après marquage,  
par fractions hebdomadaires, au cours de 3 séries d'expérience : 20 349  
G. p. gambiensis mâles issus du laboratoire, 10 778 G. p. gambiensis sauvages  
(6 143 mâles et 4 635 femelles), 4 303 G. tachinoides (1 878 mâles et 2 425  
femelles). Les sondages se font à l'aide de 53 pièges biconiques CHALLIER-  
LAVEISSIERE disposés tout au long de la galerie (séries 1 et 2). Dans la série  
3, les 10 premiers sont retirés pour déceler un effet de "freinage" des  
pièges.

L'analyse statistique fait appel aux tests non paramétriques  
appliqués à 3 indices spécialement retenus : un indice de "centralité"  
(médiane), un indice de longue distance (9e décile) et les distances maximales.

Les longueurs parcourues augmentent significativement avec le temps  
pour les espèces et les sexes. Dans la série 1 (saison fraîche), si ce dépla-  
cement semble régulier et monotone pour les mâles, il est plus irrégulier  
pour les femelles en particulier G. p. gambiensis qui atteint rapidement les  
grandes distances (17 km). Dans la série 2, vraisemblablement avec le chan-  
gement climatique, toutes les espèces et les sexes sont capables de ces  
déplacements brutaux et importants avec des maximums de 12 à 25 km. Cette  
expérience confirme aussi le comportement identique de dispersion des glossines  
de laboratoire et des glossines sauvages. Elle permet de situer à 2 km  
l'espacement acceptable des points de lâcher dans les opérations de lutte  
utilisant la méthode des mâles stériles.

Les distances parcourues ne diffèrent pas entre les espèces mais  
varient avec les périodes de la saison sèche et avec les sexes, les femelles  
se dispersant le plus loin.

Les performances sont certainement pénalisées par l'effet de  
"freinage" des pièges et sont donc sous-estimées. La discussion des facteurs  
agissant sur la dispersion situe ces observations par rapport à celles  
d'autres auteurs qu'elles confirment ou complètent.

Enfin sont abordées les implications pratiques sur le plan de  
l'étude de l'épidémiologie des trypanosomoses et sur l'isolement des zones  
par des barrières. Cette étude sur la dispersion linéaire sera suivie d'une  
autre note sur la dispersion radiaire.

Mots-clés : Dispersion linéaire - Glossina palpalis gambiensis - Glossina tachinoides -  
Barrières - Burkina Faso.

Les lâchers de mâles irradiés dans la campagne de lutte intégrée  
contre les glossines dans la zone pastorale de Sédéradougou (Burkina Faso)

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Résumé

CUISANCE (D.), POLITZAR (H.), MEROT (P.), TAMBOURA (I.). Les lâchers de mâles irradiés dans la campagne de lutte intégrée contre les glossines dans la zone pastorale de Sédéradougou, (Burkina Faso). Rev. Elev. Méd. vét. Pays trop., 1984, 37 (4) :

Pour permettre le développement de l'élevage sur 240 000 ha de la zone pastorale de Sédéradougou, le C.R.T.A. est intervenu sur 300 000 ha. L'élimination de G. p. gambiensis et de G. tachinoides sur 600 km de galerie forestières a reposé sur l'alternance de deux méthodes non polluantes utilisées en intégration : écrans insecticides et lâchers de mâles stériles.

Après une phase préparative de deux années (ouverture de pistes, prospection, barrières, etc.), le C.R.T.A. a mis en place 7 204 écrans insecticides pendant la saison sèche 1983 suivis par les lâchers en saison des pluies, tous les 14 jours, à des points équidistants de 2 km sur le réseau hydrographique, de 379 000 mâles irradiés. En 1984, 1/3 de la surface a été retraitée avec des écrans puis 467 000 mâles irradiés ont été lâchés selon le même protocole.

Le bon comportement des mâles irradiés et leur forte domination numérique ont abouti à l'élimination des populations résiduelles, l'impact de la lutte génétique étant suivi par l'exécuteur des images ovaro-utérines des femelles capturées.

Les facteurs favorables et défavorables au projet sont discutés, en particulier l'absence d'une législation pastorale devant l'afflux des troupeaux. Cette zone abrite actuellement entre 50 000 et 70 000 têtes de bétail.

Mots-clés : Glossina palpalis gambiensis - Glossina tachinoides - Lâcher de mâles irradiés - Ecran insecticide.

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BIOCONTROL APPROACH OF SOME SUGARCANE  
BORERS IN BANGLADESH

Sugarcane stem borers namely, Chilo tumidicostalis Hampson, Chilo auricilius (Dudgeon) and Early shoot borer (Chilo infuscatellus Snellen) are serious pests of sugarcane in Bangladesh causing considerable damage to the crop every year. In Taiwan every sugar mill multiplies Trichogrammatids to control stem borers by releasing the parasites in the field. In the Philippines sugarcane stem borers, Tetramesa scitaceana Sn and Chilo infuscatellus Sn are successfully controlled by Trichogrammatids.

Since the borers in Bangladesh have similarities with those of the Philippines in many ways three egg parasites namely, Trichogramma australicum Girault, Trichogramma chilotraea and Trichogramma sp. were imported from the Philippines in July, 1984. T. australicum and T. chilotraea were successfully reared on the eggs of Rice meal moth, Corcyra cephalonica Stainton and they completed 55 and 51 generations respectively during one year period after importation. But Trichogramma sp. failed to emerge during its third generation perhaps the climate was not suitable for its perpetuation. Rearing of Corcyra on ground wheat started since 1983 and now reached the capacity for mass rearing of the same. Corcyra eggs are evenly spread over a gummed paper strip and inserted inside the test tube containing emerged parasites for parasitization. They are kept in separate test tube when parasitization is over and the process is continued. Life period of T. australicum and T. chilotraea in Corcyra egg ranged from 6 to 8 days and 6 to 9 days respectively depending upon the laboratory temperature (80°F-94°F).

This year (1985) several fresh egg masses of Chilo tumidicostalis were tested in captivity (test tubes) for parasitization by the two exotic parasites separately. Mean rate of parasitization were 97.10 percent and 29.78 percent by T. australicum and T. chilotraea respectively. Works on their performance in field condition is in progress. The potential of parasitization of C. auricilius and C. infuscatellus by T. australicum and T. chilotraea is also being studied in the laboratory.

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CONTROL OF DACUS OLEAE BY YELLOW STICKY  
TRAPS COMBINED WITH AMMONIUM ACETATE  
SLOW-RELEASE DISPENSERS

Entomologia Experimentalis et Applicata,  
Volume 40 (1986): in press

#### ABSTRACT

For 3 consecutive years, in an isolated olive grove of approximately 350 trees, one yellow sticky trap combined with an ammonium acetate slow-release dispenser was hung in every tree of the large fruit varieties at the end of June or beginning of July. In September, when small fruit varieties were becoming suitable for Dacus oleae (Gmelin) infestation, similar traps were also hung in all trees of these varieties, and the traps in the large fruit trees were replaced by new ones. All traps were removed at the end of December or in January, when harvest of the olive crop was completed. The olive fly population was low in the 1st year, while in the 2nd and 3rd it was high and very high, respectively.

In the 1st year, the infestation in the experimental grove was kept very low and was comparable to, or even lower, than the infestation in olive groves treated with insecticides. In the 2nd year, in most cases the infestation was between 15-30%, while in the insecticide-treated groves it remained below 10%. In the 3rd year the infestation climbed to levels above 80% while in the insecticide-treated groves it reached levels between 30-45%.

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EVALUATION OF COLOR AND FOOD-ODOR TRAPPING  
METHODS IN THE OLIVE FRUIT FLY

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Fruit Fly Management: Bad Windsheim,  
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#### SUMMARY

Traps based on visual (color) and olfactory (food) attraction have been tested for monitoring or control purposes. The correlation between trap catches and population size or fruit infestation has been studied in certain cases. Lure combination often resulted in catches substantially higher than those of individual lures. Control applications have shown that even powerful, combined-lure traps must be applied at high densities for substantial infestation prevention. In years of very high population densities, even large numbers of such traps may not be adequate for effective control.

Further experimentation is needed to study the correlation between trap catches and actual population density at different seasons and weather conditions. Further work is also needed on the development of powerful traps which could keep infestation low at low cost. The effect of such traps on non-target insects should be explored carefully.

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# USE OF TRAPS BASED ON COLOR AND/OR SHAPE

In, "Fruit Flies : Biology, Natural Enemies, Control" Eds A. Robinson, G. Hooper, Elsevier (in press)

## SUMMARY

Traps based on visual perception received increased attention in tephritid fruit flies in the recent years. This was often a follow-up of research on fly behavior. Although visual attraction is usually of short range as compared to odor attraction, it has the advantage of localized effect and reduced influence by temperature and humidity. In addition, both sexes are attracted to color or shape-color traps. Colored surfaces have been usually found not very specific, attracting individuals from a wide range of species. Such sticky traps have the disadvantage of getting dirty fast, becoming thus of reduced trapping capacity. The use of a long-lasting powerful insecticide, resistant to decomposition and rain wash-out, may not be the solution since, in case of mass application, many such panels will eventually disperse in the environment. In cases of mass trapping, big numbers of traps are required and many beneficial and non-target insects, are often destroyed. Fruit-mimicking spherical traps, usually of dark color for maximum contrast, have been found more selective than colored panels and often more powerful. Again, big numbers are required for effective control and this makes wide application costly and unpractical. Combination of color with spherical or other convex shapes and manipulation of trap orientation to suit specific insect behavior has resulted in increased selectivity in certain cases.

More research is needed on species behavior, especially foraging behavior, to adjust visual traps accordingly and make them more specific. Although several cases of effective control by using colored flat surfaces or spherical traps have been reported, the method seems not practical yet for wide application. Combination of color or shape-color traps with olfactory lures (e.g. food-type odor, host odor, sex attractant) usually increases trap efficiency and often selectivity. This enables applications of much fewer traps in control applications, and makes the method more practical. Again much research is still needed on lure combination and efficiency of combined-lure traps in the field.

