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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INFORMATION CIRCULAR

ON

RADIATION TECHNIQUES AND THEIR

APPLICATION TO INSECT PESTS

No. 32

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ANNOUNCEMENTS

1. A limited number of copies of the Book of Extended Synopses of the Symposium on the Sterile Insect Technique and the Use of Radiation in Genetic Insect Control are still available on a first-come, first-served basis. Please use the reply form attached to the outside of this Informaion Circular to request a copy.

2. FAO/IAEA Advisory Group on the Application of the Sterile Insect Technique for Tsetse Fly Eradication or Control, 19 - 23 September 1983, Vienna, Austria.

3. Combined Research Co-ordination Meeting on Tsetse Fly Control or Eradication by the Sterile Male Technique and Using Radiation and Isotopes to Develop Diets for Mass Rearing Haematophagous Insects for Sterile Insect Releases and to Study Disease Transmissions by these Vectors, 26 - 30 September 1983, Vienna, Austria.

CONTENTS

PLEASE NOTE

The summaries of unpublished work often represent preliminary reports of investigations in progress and, therefore, such findings are subject to possible revision at a later date. The contents of this Information Circular should not be published or referred to in articles for publication without obtaining permission from the authors first.

A. Publication Policy of Information Circular

The policy of the Joint FAO/IAEA Division in publishing this Information Circular is to emphasize the results of recent research on the use of radiation and radioisotopes in entomology. Therefore, emphasis is placed on unpublished data. Please bear in mind that we cannot edit your contributions and that these are reproduced by a photographic process. Therefore, their appearance and content in the Circular will faithfully reflect your own care. Some of you have sent in reprints of published papers or long articles as contributions to the Information Circular. We include summaries of recently published data only. The length should be no more than one typewritten page when double-spaced (a form for this purpose is included in this copy of the Information Circular).

B. Professional Staff

Headquarters

D.A. Lindquist	Head, Insect and Pest Control Section
E.D. Offori	Insect and Pest Control Section
G.C. LaBrecque	Insect and Pest Control Section

BICOT (Biological Control of Tsetse by the SIT) - PO Box 76, Vom, Plateau State, Nigeria

R. Sarmiento	Project Director
M. Oladunmade	Project Co-Director
H-J. Hamann	Supervisor of Laboratory and Rearing Operations
T. Tenabe	Co-Supervisor of Laboratory and Rearing Operations
W. Takken)	Supervisor of Field Operations
(vacant)	Co-Supervisor of Field Operations

Seibersdorf Laboratory

R.E. Gingrich	Head, Entomology Laboratory
G. Hooper	Mediterranean Fruit Fly Investigations
U. Feldmann	Tsetse Fly Investigations (FAO Associate Expert)
A. Van der Vloedt	Tsetse Fly Investigations
E. Bush-Peterson	Genetic Sexing of Medflies
J. Kabayo	Tsetse Artificial Diets

C. Entomology Laboratory

The IAEA has an international laboratory located at Seibersdorf, Austria, about 30 km. from Vienna. A part of this laboratory is devoted to the use of atomic energy in entomology.

The primary research objective of the entomological programme at the Agency's Seibersdorf Laboratory is to support and service the Joint FAO/IAEA Division's programmes on insect control. This involves primarily the development of the Sterile Insect Technique (SIT) as a means of insect control or eradication. Because of the dependence of this technique on efficient, economical mass rearing of insects, much of the research at the laboratory involves rearing. Other major research areas include (1) methods of radiation sterilization for producing the best possible sterile insect (in terms of sexual competitiveness, longevity and quality), (2) handling techniques for large numbers of insects, and (3) field programme direction and/or supplying insects for field programmes. The laboratory's programmes are associated with existing field programmes and much of the research is concerned with the field problems that arise.

In general, research is undertaken to:

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

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

(1) Mediterranean fruit fly, Ceratitis capitata (Wiedemann);
(2) Tsetse fly, Glossina palpalis palpalis (Robineau-Desvoidy);

1. Medfly programme

(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 (100s of millions) of flies.
(e) Improve methods of releasing sterile flies in the field from aircraft.
(f) Provide emergency supplies of sterile medflies for field programmes.
(g) Develop genetic and mechanical sexing systems.

2. Tsetse fly programme

(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 (freeze-drying).
(d) Use of blood additives for improving tsetse fly 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.

3. Isotopes and Radiation in Integrated Pest Management programme

(a) Predator-prey and host-parasite relationships.
(b) Mass rearing.
(c) Selectivity of insecticides.
(d) Alternate hosts.
(e) Adult population estimates for forecasting.
(f) Pest dispersal.
(g) Training.

4. Current Technical Co-operative and Assistance Programmes for which this Section has responsibility

(a) Medfly	(b) Tsetse	c. Isotopes	d. Others
Mexico	Nigeria	Kenya	Sri Lanka
Egypt	Zambia	Indonesia	Iraq
Peru	Ghana		Pakistan
	Tanzania/USAID		

D. Fellowships Awarded in Radiation Entomology (1980-83)

Subject to quarantine regulations, availability of funds, etc., the laboratory can serve entomologists in developing countries planning or carrying out sterile insect projects. The laboratory also 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.

Fellowships may be awarded for a period of several months to a maximum of twelve months. In certain exceptional cases, extensions of up to twelve additional months may be granted. Fellowships can be awarded as part of a comprehensive project or on an individual basis as a direct contribution to projects in the country's atomic energy programme, and provide opportunities for training there.

Applications for fellowships must be made to the Agency exclusively through official channels, and priority is given to requests associated with projects of direct benefit to individual Member States.

Country and Name of Fellow	Host Country	
BANGLADESH		
Muhammed Husain	USA	
Manjur A. Chowdhury	USA, Austria	
A.K.M. Qudrat-e-Khuda	USA, Austria	
EGYPT		
Soher M. Riad Souka	UK	
A. El-Zooka	Austria	
T. El-Abassi	Austria	
GHANA		
Abdullah Essaka	Netherlands	
Rajainder Kumar	USA	
Henry Meier	USA	
Kojo Gyapia Montford	USA	
Jackson K. Akuamoah	Austria	
INDIA		
Amara Sambasiva Rao	USA	
Ohondiba H. Rananavare	USA	
KENYA		
Philip A. Onyango	Austria	
MEXICO		
Cecilia Garcia Viesca	Spain	Scientific Visit
J.L. Zavala Lopez	Austria	
D. Orozco	England	
P. Liedo	England	

NIGERIA	
Godis U. Okengwu	USA
Emmanuel Ofodile	Austria
Timothy Tanko	Austria
Stephen O. Tenabe	Austria
Moses Oladunmade	Austria
PAKISTAN	
Sana Ullah Khan Khattak	USA
SPAIN	
M.E. Riva Francos	Netherlands
SRI LANKA	
B.H. Rohitha	India
SUDAN	
O.A.S. Mohammed	USA
N. Sharaf El Din	USA
THAILAND	
Ratana Poramarcom	USA
Pravait Kaochoung	USA, Austria
ZAMBIA	
Blackwell Kafwimbi	Austria, Nigeria
Geoffrey G. Haangwanji	Austria
Geoffrey M. Kapatsa	Austria
S.M. Moobola	Austria
K.H. Chisanga	Austria

E. Technical Assistance Assignments, January - June 1983

Name	Nationality	Location of Assignment	Major Responsibility
W. Takken	Dutch	UK	To hold discussions on field aspects of the BICOT Project in Nigeria.
D.A. Lindquist G.C. LaBrecque	USA USA	Egypt	To hold discussions with Egyptian officials and UNDP re Project.
D.A. Lindquist	USA	Egypt	To attend the 2nd Preliminary Project Committee Meeting for the Egyptian Project.
E.D. Offori	Ghana	Zambia	To review the Agency's tsetse SIT Project and to discuss arrangements for Tsetse Seminar planned for 1984.
E.D. Offori	Ghana	Kenya	To discuss implementation of the Agency's isotope programme at ICIPE Research Centre.

F. Recent Publications by the Insect and Pest Control Section

Symposia

STI/PUB/525	Isotope and Radiation Research on Animal Diseases and their Vectors. (1980) FAO/IAEA Symposium, May 1979, Vienna, Austria.
STI/PUB/595	Sterile Insect Technique and Radiation in Insect Control. Proceedings of a symposium, Neuherberg, 29 June - 3 July, 1981. Jointly Organized by IAEA and FAO.

Technical Reports Series

STI/DOC/10/61/2	Laboratory Training Manual on the Use of Isotopes and Radiation in Entomology - Second Edition. (1977).

Institute for Application of Atomic energy
Chinese Academy of Agricultural Sciences
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The sterilization of Peach Fruit borer (Carposina nipponensis Wals) Resulting from radiation - some of effects of gamma-ray radiation on the spermatogensis and sperm transfer

1

In this paper we have determined the effects of r-ray on the time of mating (from beginning to ending), the number and mortality of sperm in the ductus ejaculatorius duplex and transfer process of irradiated and non-irradiation sperm in female reproductive tract of Peach Fruit-borer. The spermatogensis and morphology of the reproductive system in Peach Fruit-borer were observated and described.

Peach Fruit-borer was reared with varieties of applies at 26± 3°C, 70±10% R.H. and 15 hours illumination. Gamma radiation was obtained from a cobolt-60 source at dosage rate 125.5-131.6 R/minute. The pupae were treated with 0.30 and 50 KR at 1-2 days before emergence. The measurement of motility in the sperm was carried out by the modified Shepher's method (1974). Hemacytometer was used for counting sperm quantity. The principal results were as follows:

1. During development of reproductive organ in Peach Fruit-borer, two separated tests combined into a spherical testis. The size of the testis was changed regularly before 8-day old pupa, it enlarged gradually with increasing of the pupa age, but after 8-day old, the size of testis shortened gradually.

2. The reproductive system of male moth in Peach Fruit-borer contained mainly: testis, ductus ejaculatorius duplex, ductus ejaculatorius simplex, seminal vesicles and accessory glands. The reproductive system of female moth contained: ovaries, lateral oviduct, common oviduct, bursa copulatrix, spermatheca and accessory glands.

3. When late pupae were irradiated with 30 KR, the mating frequenct and the time of mating (from beginning to ending) were similar to that of controls.

4. Irradiation was made at 1-3 days before emergence, the effects of gamma-ray on sperm quantity and motility in the ductus ejaculatorius deplex were not striking. Sterile sperm has competitiveness as good as normal while the dose value was 50 KR, although the number of sperm didn't vary markedly, the sperm activativity and competitiveness were comparatively inferior.

5. The pupae were irradiated with 30 and 50 KR, the sterile sperm can transfer normally in the female reproductive tracts.

6. The spermatogensis in Peach Fruit-borer starts from the larva. The meiosis occurs at the near end of the last larv stage. By 1-3 days before adult emergence a large number of mature sperm bundles transfer into semianl vesicls.

Antonio Pereira MARTINS and Julio Marcos Melges WALDER

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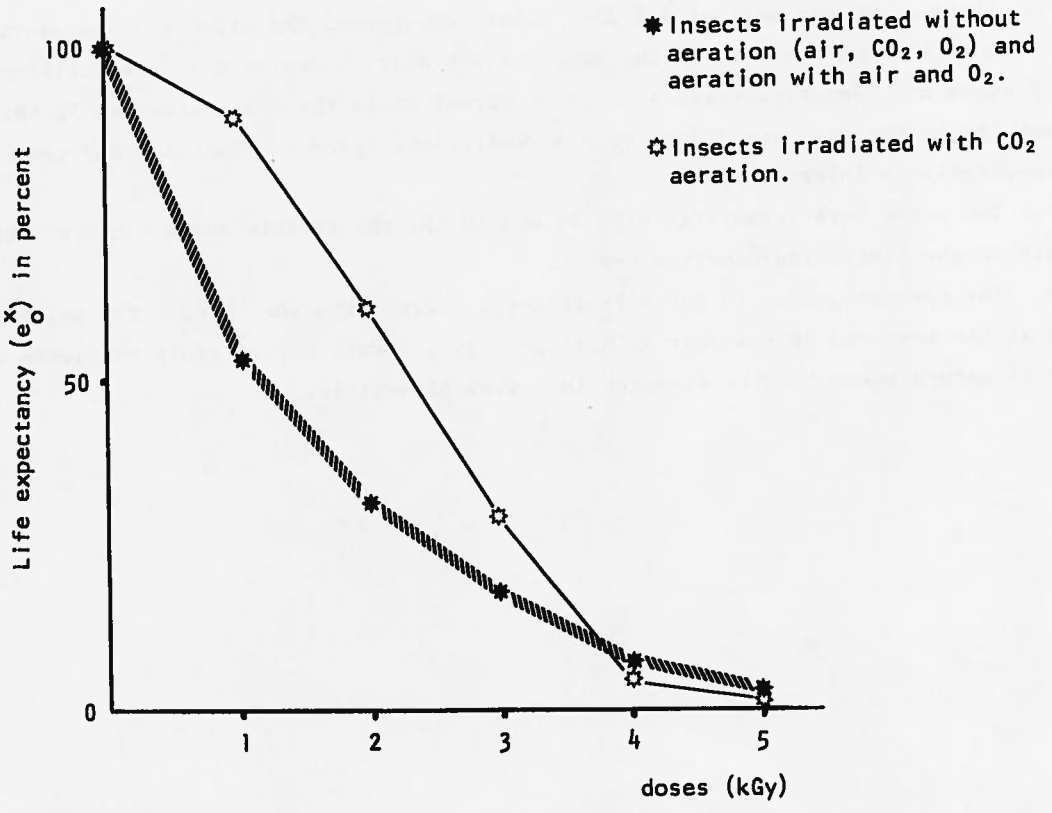
Influence of aeration (air, O_2, CO_2) during gamma irradiation of *Zabrotes subfasciatus* (BOH., 1833) imagoes.

2

All treatments were made in a cobalt-60 source type Gammabeam 650. The dose rate was .52 kGy/h for sterilization test and 3.85 kGy for lethal dose test. For irradiation the insects were placed in an apropriate glass cylinder (18 mm in diam. and 85 mm long). Supplies of air, oxigen and carbon dioxide were filtered and then passed through a flowmeter at rate of one litre per minute. The sterilizing doses were: air without aeration - 60 Gy; O_2 without aeration - 60 Gy; CO_2 without aeration - 50 Gy; aeration with air - 60 Gy; aeration with O_2 - 40 Gy; aeration with CO_2 - 100 Gy.

The longevity was reduced in 50% when the insects were treated with 2.0 - 2.5 kGy of gamma rays with CO_2 aeration, and 1.0 - 1.5 kGy when the insects were irradiated in the other condictions.

Figure shows the effects of hight doses of gamma radiation plus gases on *Zabrotes subfasciatus* longevity.



Yuan-ying, Lo hong-zhang, Zhang He-qin
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Multiple Mating of Corn Borer (Ostrina furnacalis Guenee) and the Application of Radio-sterility method
Scientia Agricultura Sinica 1980 (2): 79-82

3

Abstract

Most of the female Corn borer (Ostrinia furnacalis Guenee) mate once in a life, and only 7.3% of them are twice mating, but in the wet suitable state they mate many times; up to six - seven times. The males mate eight times at most in their lives. The number of mating twice is about half of that once. The number of mating three or four times is about half of that two or three times. Very few of males mate over five times.

Although mating of each female with male is in order, the number of fertile egg produced and the percentage of egg hatchability are not in a regular manner. A normal female having consecutively mated with normal male and irradiated male produced eggs whether of fertility form or sterility form depend on the sperm of the male of second mating.

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Effect of gamma irradiation of phosphine-fumigated dates on the development of the fig moth Ephestia cautella (Walker).

4

The Joint FAO/IAEA/WHO Expert Committee on the wholesomeness of irradiated food have recommended, at its 1980 Geneva meeting, a clearance for the irradiation process for conservation purposes of all food up to a dose of 10 KGy. Among the food items evaluated was gamma irradiated dry dates for the purpose of controlling insect infestation during storage. Data of several toxicological studies on irradiated dates were reviewed by the committee (WHO, Tech. Report No. 659, 1981). However, most of these studies were carried out on " clean " dates (i.e. never been treated with any pesticide before irradiation).

The high production of dates in Iraq, about 350,000 tons annually, necessitate periodical fumigation with phosphine gas of prepacked dry dates for insect disinfestation in storage. The present investigation is therefore conducted to explore any possible interaction between gamma radiation and phosphine residues in fumigated dates and their subsequent toxicological effect when given as the only diet to the fig moth Ephestia cautella

Carefully sorted fruits for uniform shape, size and color were divided into 4 groups of 150 fruits each and treated as follows :-

Group 1 : Control (no phosphine, no irradiation).
Group 2 : Fumigated :(28.1 mg/l. phosphine for 72 hours and aerated for 24).
Group 3 : Fumigated & Irradiated :(same phosphine dose + 1 KGy gamma radiation , dose rate 46 rad/sec.).
Group 4 : Irradiated : (1 KGy gamma radiation, dose rate 46 rad/sec.).

Dates of each group were then divided into 5 one-liter rearing jars, and seeded with a batch of 250 Ephestia eggs, then sealed and incubated for development at 25 C and 50-60% R.H. After 40 and 60 days all the jars were opend and each date fruit was carefully examined. Insects at all development al stages were collected and counted. A number of pair mating cresses were made between the adults developed in each date group.

The results showed comparable development, fecundity and fertility of this insect when reared on complete diet of phosphine-fumigated, fumigated-gamma irradiated, irradiated and untreated dry date fruits. This result could be considered as a further support to the validation of using gamma radiation, alone or in combination with this effective fumigant to achieve the highest possible level of insect disinfestation of Iraqi dates provided that certain requirments, such as the development of insect-proof packages, proper handling and the construction of modren storage facilities, should be fulfilled to overcome the re-infestation problem .

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Sterility of Peach Fruit borer
(Carposina nipponensis Wals.)
Resulting from irradiation

5

Abstract

When peach fruit borer pupae of 4, 6, 8 and 10 days old were irradiated with dosages or 0, 10, 20, 30, 40, 50 KR of ^{60}Co-gamma rays, the pupae of 8-10 days old (1-3 days before emergence) were the best period for irradiation. The percentage of F1 egg-sterility from irradiated males mated with normal females was 14.2 (Control), 14.6, 52.7, 83.4, 95.8 and 97.8 respectively, when the pupae were irradiated with dosages mentioned above at 1-3 days before emergence, while that from irradiated females mated with normal males was 14.2 (control), 31.4, 78.2, 94.4, 97.5 and 100.0 respectively. Female pupae were more susceptibel than male pupae to radiation at same dosage. The percentage of mating and competitiveness of adults emerging from pupae irradiated at 8-10 days old with 30, 40 KR were not significantly different from normal adults. In laboratory mating competitivness test, ratio of 5:5:1:1 (1 : 1 : u :u) were more effective than that of 5:1:1 (1 :u :u or 1 :u :u) in controlling egg hatch. The percentage of mating and competive ability of adults emerging from pupae irradiated at 8-10 days old with 50 KR were significantly reduced. Esterase isozymes of pupae irradiated at leater stage its adults were significantly different from that of normal pupae and its adults (control). Adults emerging from later stage pupae treated with different dosages of fast neutron also gave good sterilizing effects.

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FIELD EVALUATION OF Ephestia cautella (walk) infestation of different Varieties of dates .

6

Six varieties of date palms : Jamal Aldeen , Khathrawi , Zahdi , Sayer , Lilwi and Khassab were evaluated for susceptibility to attack by Ephestia cautella , the results indicate that the Ephestia infested the date prior to harvesting , and the infestation rate related directly to late harvesting . Also , there were significant differences among varieties tested , and among the dates on the tree and wind detatch dates within the same variety .

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Application techniques and effect of thiotepa in the chemosterilization of the Ragi stem borer, Sesomia inferens (Walker) Lepidoptera, Noctuidas

7

Abstract

Studies were undertaken for inducing maximum steriity with thiotepa in the ragi stem borer, Sesamia inferens. The chemosterilant was administered through artificial diet and by contact method in the larval stage by dipping and fumigation in pupal stage and through food and fumigation in adult stage. Thiotepa at 0.1% in the larval food was highly toxic to the 5th instar larvae; concentration below 0.05% was harmless. Larval period was not affected, while pupal period prolonged with increase in the concentration. The emerging adults treated with thiotepa through larval food showed significant decline in their fecundity and hatchability of eggs, though sterility was only 69.29%. However, longevity of adults was not affected. The larval and pupal periods with contact method increased with increase in the period of contact unlike earlier method, where only the larval period increased with increase in the concentration of thiotepa.

Pupal dipping with thiotepa resulted in the mortality of the pupae, the pupal period increased signifciantly with increase in the concentration. Neither the fecundity of the female, the longevity of the adults, nor the hatchability of eggs was significantly affected.

In the fumigation method (stationary atmoshphere), there was no significant effect even up to 20 hours on the pupal mortality or pupal period.

Fumigation of adult males for 6 hours with thitepa resulted in 95% sterility in the untreated females mated wit the treated males. Sterile males were almost equal competitors to normal males for mating with normal females. Increase in the concentration of the thiotepa in the adult food decreased the longevity of adults and hatchability of eggs, but increased the percentage sterility. Further increase in the concentration was toxic to adults.

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Effects of gamma radiation on the fertility of Tyrophagus putrescentiae (Schrank) (Acarina: Acaridae)

The paper presented at the VI Intern. Congress of Acarology, Sept. 5-11, 1982 Edinburgh, Scotland.

8

The effects of gamma radiation on Tyrophagus putrescentiae were studied. The nymphs and adult stages of the mite were treated with 30-100 krad of gamma radiation.

Deutonymphs were able to transform to the adult stage at 60 krad, but protonymphs did not mature at dosages above 40 krad. Adults developed from irradiated nymphs exhibited reduced fertility. The sterilizing dosages of gamma radiation for adults were 60 krad and higher.

Untreated females mated to males irradiated with 60-100 krad dose laid only several eggs during the first days, and they stopped producing eggs thereafter. Females kept with irradiated males for 5 days and then mated to untreated males were as fecund as controls kept all the time with normal males. The eggs laid by these females were viable. In an opposite combination, females laid more eggs during the first 10 days after changing the males than later. All these eggs were originated from normal males.

Data on accelerated mortality of females exposed to a 3:1 or 5:1 male-female ratio were utilized in Baumhover's SAG test to assess the impact of radiation on sexual activity of males. The test showed greatly reduced male activity as the radiation dose increased from 60 to 120 krad.

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Chemosterilisation of Almond moth,
Cadra cantella (Walker)
Lepidoptera : Phycitidae.

9

Abstract:

A study was taken up to find out the best technique in the application of chemosterilants (thiotepa and hempa) for inducing maximum sterility in the almond moth, Cadra cantella. The chemosterilants were screened for optimum exposure periods - fumigation of pupae and moths in a stationary atmosphere, larval contact through tarsi, and for optimum dosage by pupal dipping. Larval contact for an exposure period of 30 min. to 16 hr resulted in 0 and 70.30% and 20 & 80% mortality in thiotepa and hempa, respectively, while the percentages of egg hatch were 0, 46.3 and 26.4, in control, thiotepa and hempa, respectively.

Pupal fumigation did not affect pupal period and adult fecundity, Egg hatch was not significantly reduced with increase in exposure period resulting in very low sterility. Adult longevity was not affected in thiotepa fumigated males, but it was significantly affected with hempa in the fumigated males. Fecundity was significantly reduced in females when mated with the treated males both with thiotepa and hempa. The fecundity ranged from 101.07 to 155.53 and 123.67 to 166.00 to control at 8 hr exposure period in thiotepa and hempa, respectively. Further, the percentage sterility was significantly increased with increase in exposure period in both the chemosterilants. The treated males in both the chemosterilants were as competitive as untreated males in mating with untreated females.

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The Inherited sterility of the Corn Borer
(Ostrina furnacalis Guenee),
Scientia Agricultura Sinica 1980 (1):70-73

10

Abstract

Normal female corn borer moths, when mated with male moths irradiated with a partial sterilizing dose (20 to 25 KR), produced R_1 larvae with delayed development, increased mortality, distorted sex ratio, and even almost fully sterilized offsprings. When the same dose was used to irradiate female moths, fully or nearly fully sterilization was produced.

The competitiveness of irradiated males to normal males, when release together with irradiated females, did not decrease as compared with releasing the males alone. This indicates the possibility of releasing both sexes of irradiated moths in practice.

However, the surviving R_2, although very few in number, recovered their fertility quickly, and became almost normal in R_3.

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Preliminary Report on the Spermatogensis
and Transfer of Sperms in Normal and
Irradiated Corn Borer (Ostrina Furnacalis
Guenee), Yuanzineng Nongye Yingyong
1980 (3) : 10 - 14

11

Abstract

In this paper, the internal reproductive systems of male Corn Borer and the types of germ cells in different developmental stages of males were studied. The spermatogonia and spermatocyte appear mostly in the larval period; and the spermatid and sperms of of different developmental stages - the pupal period. Many mature sperms begin to appear in the late pupal period and reach their peak in the adult period.

Preliminary research on the mating behaviour and the transfer and transformation of sperms of this insect have also been carried out. While treating the insect with a sub- or semi-sterile dose of 25 KR, no reduction in quantity and vitality of sperms in either the parent or the F_1 male has been observed. The eupyrene sperms may properly be transferred to the spermatheca and "fertilize" the eggs, although fail to hatch after certain development. Thus provides the basis of fully competitionof the irradiated males to the wilds.

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Artificial Media for Rearing of the Oriental Fruit Fly, *Dacus dorsalis* Hendel.

12

The purpose of this experiment was to develop the suitable artificial media by using local raw materials for rearing of the oriental fruit fly, *Dacus dorsalis* Hendel. Studies were conducted to compare the effectiveness of whole banana (natural food), Wheat bran medium (sodium benzoate 0.1%, methyl-p-hydroxybenzoate 0.1%, sugar 12%, brewer's yeast 3.6%, wheat bran 26%, Hydrochloric acid 0.2% and water 58%), rice bran and corn cob medium (same ingredients as wheat bran medium except rice bran and corn cob in place of wheat bran) and blended banana medium (same ingredients as wheat bran medium except acid and sugar were omitted and blended banana in place of wheat bran) on pupal recovery, pupal weight and adult eclosion. The results of this experiment showed that the whole banana was dissatisfactory when compared to artificial media. The percent pupal recovery from wheat bran medium was no significant difference ($p=0.05$) with rice bran and corn cob medium but had significant difference with the blended banana medium and whole banana. However, there were no significant differences ($p=0.05$) in percent adult eclosion among artificial media.

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Artificial Medium Development for American Bollworm [*Helicoverpa armigera* (Hubner)] Mass Rearing

13

The artificial medium developed for mass rearing of the american bollworm, *Helicoverpa armigera* (Hubner), was composed of mung bean, brewer's yeast, vitamins, preservatives, water and antibiotic. Studies on development of this species reared on the new formulation for 4 successive generations were conducted at $26\pm1^{\circ}C$ and 70-75% RH.

The results of this experiment showed that there were no significant differences ($p=0.05$) in percent egg hatch, pupal recovery, adult eclosion and pupal weight in each of 4 successive generations.

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L.R. Blanco,
S.S. Resilva and
L.C. Casubha
Agricultural Research Division
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Comparison of Ovarian Development and Mating Preference in Laboratory-reared and Field-Strains of the Oriental fruit fly, Dacus dorsalis Hendel

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Studies designed to compare the ovarian development and mating preference of laboratory and field strains of the Oriental fruit fly were conducted prior to the actual release program for this species.

Ovarian measurements of 8-day-old females showed the mean width and length of the ovaries of L- and F-strain flies as 1.46 ± 0.05, 1.66 ± 0.08 and $0.53 \pm$, 0.03, 0.54 ± 0.04, respectively. Also, the ovaries of the L-strain females contained 6.93 ± 1.27 ovarioles while that of the F-strain was undeveloped. However, at 16 days emergence, some developed ovarioles (6.08 ± 1.79) were observed. Thus, ovarian measurements and ovariole counts indicated that the ovaries of the L-strain females developed earlier than those of the F-strain.

Laboratory colony flies mated readily with their respective strain than with the field or wild flies. Field flies mated less readily than the laboratory flies and the latter mated longer with a mean of 14.87 as compared with the other mating combination (2.36 to 4.20 min).

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Preliminary attempts to induce translocations in Tribolium castaneum (Herbst) (Coleoptera: Tenebrionidae).

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Wild type males of Tribolium castaneum 10 days old were exposed to gamma rays from a J. L. Shepherd and Assoc. Mark I, Model 30 irradiator containing Cesium 137 at 400 curies, emitted at a dose rate of 8.86 rad/sec. for a period giving an approximate dosage of 4500 rad. The irradiated males were crossed with females from strains bearing two genetic markers known to be on separate linkage groups (for example, pearl, p, an autosomal recessive on the second linkage group affecting eye color, and black, b, an autosomal semidominant body color gene on the third linkage group). The F_1, heterozygous for both traits, were crossed back to pearl. Single pairs of F_1 beetles were introduced into vials, and allowed to deposit eggs for two periods of four days. Eggs present were scored at the end of each four day period, and the larvae emerging from them scored three weeks later, and the adult phenotype of the backcross progeny determined after three additional weeks.

Judging from semisterility determined from the egg and larval counts of backcrosses of irradiated beetles and non-irradiated controls, translocations were induced. However, subsequent examination of the phenotype of backcross progeny suggested that the chromosomes bearing the genetic markers were not involved in producing the translocation. Experiments to produce translocations are being continued.

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SOME EFFECT OF INSECTICIDE DEPOSIT PATTERNS ON THE PARASITISM OF TRIALEURODES VAPORARIORUM BY ENCARSIA FORMOSA

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SUMMARY

The functional response of Encarsia formosa parasitising Trialeurodes vaporariorum on Phaseolus vulgaris was a typical type II functional response (Holling, 1959) where, with increasing host density, the numbers of hosts parasitised by a single parasitoid show a negatively accelerating rise to an upper plateau. A mean maximum parasitism of 6.6 per female per 24 h reached at host densities near 80 larvae per leaf was observed. When presented with insecticide ('Pynosect 30 ULV') deposits, the parasite's search pattern changed, conforming to a typical Sigmoid functional response curve. With a uniform cover spray deposit of 27.6×10^{-7} ml/cm^2 searching began only at host densities of c. 80 larvae per leaf and the mean maximum parasitism was only 1.5 per female per 24 h. When the insecticide deposit of 27.6×10^{-7} ml/cm^2 was in the form of discrete groups of 100 µm droplets, searching began at host densities of c. 40 larvae per leaf but the mean maximum parasitism was low at 2.2. However by using the same discrete deposit pattern but reducing the deposit level to 2.65×10^{-7} ml/cm^2 it was possible to obtain the same high mean maximum parasitism as with the untreated control.

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Determination of LD50 Value and Diurnal Rhythm of Sensitivity of Carbofuran (Furadan) in Adult Chinch Bug Blissus leucopterus (Say) .

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The preliminary LD50 Value of Carbofuran for chinch bug Blissus leucopterus (Say) has been estimated (Table 1) . The results indicate that the LD50 value varied during a 24-hr photoperiod , resulting in a sensitivity rhythm dependent upon time of treatment during the photoperiod.

Table 1 . MORTALITY OF CHINCH BUG Blissus leucopterus TREATED WITH DIFFERENT CONCENTRATION OF CARBOFURAN .

Dose No.	Dose (µg/µl)	Net Response (% mortality)
1	0.001	15.00
2	0.002	55.00
3	0.004	80.00
4	0.006	85.00
5	0.008	90.00
6	0.015	100.00

The percent dead in the control was 0.00 , and the average insect weight was equal to 0.0323g . The LD50 derived from the data was 0.001ĝ µg /insect and 1.1875 µg/body weight . The practical significant of such a work is to ensure a reduction in insect density as a supplemental suppression method in the management of the insect pest.

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OZONE-INDUCED LETHALITY IN HABROBRACON JUGLANDIS (ASHMEAD)

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Ozone is the three-atom allotrope of oxygen. It is a highly reactive gas which is known to cause decreases in plant productivity, increases in animal respiratory disorders and clastogenic effects in various cell types. This study was done to determine the toxicity of ozone on a wasp and its possible application in the control or eradication of insect pests.

An Orec Model 03VI-0 Ozonator produced 44± 2 ppm ozone. Fifty adult newly eclosed female Habrobracon were used in each group and exposed for 0, 4, 10, 16, 24 and 27 hours. They were observed twice daily at which time the numbers of living and dead wasps were determined. Dead wasps were discarded.

Table 1. Percent lethality(±S.E) on different days for adult Habrobracon females exposed to 44 ± 2 ppm O_3 for various periods of time.

Groups	Days Post-Ozonation 1	11	20	22	27	30
Control	0±0	0±0	30±1.4	56±2.7	80±4	100±6.3
4 h	0±0	14±5.1	66±10.0	76±10.3	100±8.9	-
10 h	0±0	60±3.4	82±6.2	100±7.3	-	-
16 h	10±0.8	80±5.4	100±7.5	-	-	-
24 h	16±1.0	100±10.8	-	-	-	-
27 h	100±0	-	-	-	-	-

There were no significant differences between the control, 4 and 10 hour groups on the first day after ozonation; whereas, significant lethality occurred in those groups exposed for 16, 24 and 27 h on the first day. The LD_{100s} for 27, 24, 16, 10 and 4 hour exposures were on day 1, 11, 20, 22 and 27 respectively. These data showed that exposures at 44 ± 2 ppm ozone for 27 hours under the conditions of this experiment could be used to eradicate Habrobracon. The other exposures allowed time during which the wasps could reproduce thereby negating ozone as a control measure. The next aspect of this work will concern the effect of ozone on the reproductive potential of Habrobracon.