

EFFECTS OF GAMMA RADIATION ON THE MOTILITY AND  
ATTRACTION OF THE MEDITERRANEAN FRUIT FLY  
*CERATITIS CAPITATA* WIED,  
TO LIGHT, COLOURS AND ODOUR

By

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ABSTRACT

Full grown pupae of the Mediterranean fruit fly, *Ceratitis capitata* were irradiated at three gamma dosages (50, 70 and 90 gray). The different effects on the motility and attraction to light colours and odour of the produced adults were studied. All the doses applied did not affect the visual sense organs responsible for light discrimination in both sexes. There was no significant effect of gamma radiation at all doses used on the percentage attraction of irradiated males or females to the orange colour. Normal females were more attracted to the green colour than irradiated females especially at the high dose (90 gray). However, males were less attracted to the green colour than females in both normal and irradiated insects. Males were not affected by low doses for their attraction to the green colour while they were significantly affected at the high dose (90 gray). Both males and females were clearly affected by radiation regarding their response to Guava odour especially at the high dose (90 gray) and females were more affected than males. Irradiation of either males or females at all doses tested did not affect the motility of the fly.

INTRODUCTION

The natural habitat of tephritid flies consists of those host and non-host plants on which members of the wild population may be found. The plants may provide the flies with the resources of food, rendezvous sites for mating, oviposition sites and shelter (Southwood, 1973; Hocking, 1975; Prokopy, 1977). If released irradiated laboratory cultured flies are to survive and compete successfully with wild flies, they must be comparable to wild flies in ability to locate these resources. This

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implies comparable levels of responses to specific stimuli emanating from the resources.

Tephritids locate vegetation evidently primarily by vision, with the colour of foliage or the darkness of plant silhouette being especially important cues (Prokopy, 1977). Olfactory attraction to specific compounds emanating from vegetative tissues may also play a role in some species. Besides vegetation, odours emanating directly from fly food or from the hydrolytic, oxidative, or microbial-break-down products of food are also attractive. The odour of host fruit is a specific stimulus attracting several tephritids to hosts in suitable stage for oviposition (Prokopy, 1977).

Moreover, irradiation and factory production may induce alterations in locomotory characteristics. These alterations, if undetected could readily render futile the release of flies that otherwise appear totally competent.

In the present study the effects of gamma radiation on both sexes of the Mediterranean fruit fly as to their response to light, colours of fruits and vegetation, fruit odour and motility were tested.

#### MATERIALS AND METHODS

Adults and larval rearing of the medflies was as described by Wakid (1975) in the Entomology laboratories of the Egyptian Atomic Energy Authority at Inshas. Irradiation was conducted using  $^{60}\text{Co}$  unit with a dose rate ranging from 8-14 rad/second.

For the experiments carried out to measure the effects of irradiation on the response of adults to surrounding environmental factors such as light, colour and odour, the design suggested by Rossler (1977) and modified by Abdu *et al.* (1987) was used. It consisted of 2 cubic transparent plastic containers ( $14.5 \times 11.5 \times 11.5$  cm) connected from sides by a long plastic or paper tube (10 cm in length and 2.5 cm in diameter). The design was placed under laboratory conditions and illuminated uniformly from above. Twenty five irradiated males or females (4 days after emergence) were placed in one container. The other one contained the material that is thought to be attractive to the flies (light, food, colour). Flies reacting this container were recorded throughout 24 hours. A control test (for unirradiated flies) was carried out. The number of flies reacting the container at the termination of the experiment was compared by Chi<sup>2</sup> test to determine whether the movement towards the attractive factor was random or directed. Three gamma doses were used for each experiment and which was replicated 3-5 times under the same conditions.

The apparatus used to measure locomotor activity was similar to that used by Connolly (1966) to select active and inactive strains of *Drosophila*. In the present experiments, the apparatus was slightly modified. It consist of a plastic foam base

10 cm square, 0.5 cm. thick, into which a circular groove (8 cm outside diameter, 7 cm inside diameter and 0.5 cm deep) was cut the base was fitted with a clear glass top with radii engraved from the centre at 10° intervals, so that they intersect the runway beneath. A sample fly was introduced to the runway by means of a hole, 0.5 cm. square in section, cut into one side of the square base. The hole was then plugged with a close-fitted piece of plastic foam. The sample fly was introduced to enter the runway by placing a light source opposite the entrance hole. Once inside, the fly was allowed 3 minutes to habituate. Then, for the following one minute the number of lines that the fly crossed was counted. This total, the activity score, was converted to distance travelled in cm. After testing, the fly was removed and a new fly was introduced.

Doses of 0, 50, 70 and 90 gray were tested on both sexes of the medfly. Fifteen replicates were carried out to detect the differences between different doses and between male and female locomotor activity.

## RESULTS AND DISCUSSIONS

### 1. Attraction to Light

The data presented on figure (1) ensure that the applied doses, 50, 70, and 90 gray did not affect the visual sense organs responsible for light discrimination in both females and males. This result of the positive phototropism in the medfly differs from that obtained by Hilmy *et al.* (1985) who found that high doses of gamma radiation seemed to affect the negative phototropism of the rice weevil, *Sitophilus oryzae*, especially at 60 and 80 krad.

### 2. Attraction to colour

Physical stimuli such as colour are important factors for the selection of oviposition sites in nature as well as for eliciting oviposition into inanimate objects under laboratory conditions. Moreover, as fruit as well as foliage serve not only as an oviposition site but also as a mating site for many fruit fly species (Bateman, 1976, Greany *et al.*, 1977), the failure in discriminating the fruit or foliage by irradiated females or males could also adversely affect the mating competitiveness of laboratory irradiated insects, with concomitant deleterious effects on sterile insect release. So, fruit preception ability is significant in sterile insect programs, and it is, therefore, important to determine the visual acuity of irradiated flies in the region of the spectrum to which they respond when seeking fruit.

The present experiment was carried out for evaluating the influence of irradiation on the response of flies one of the physical characteristics of the oviposition sites i.e. colour of the fruits (orange) and foliage (green) of the citrus or apricot trees, which are of the most affected orchards by the medfly in Egypt. For this evaluation,

### Radiation effect on Medfly

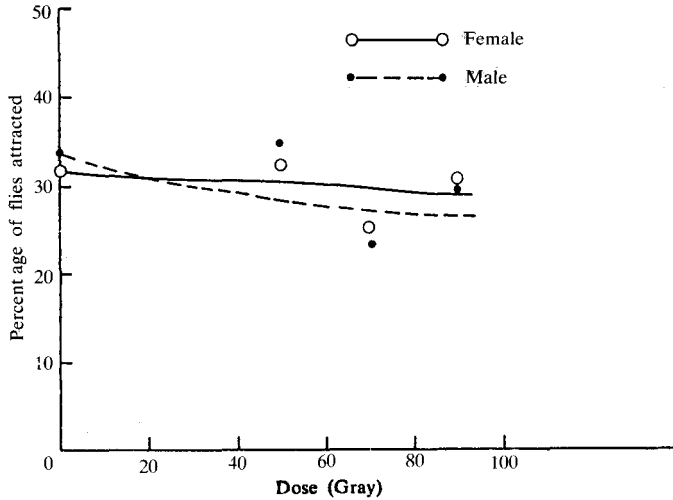


Fig. 1: Effect of gamma radiation on the response of *Ceratitis capitata* to light

the response of medflies irradiated with 50, 70 and 90 gray to the orange (spectrum 590 nm) and green (spectrum 420 nm) colours tested.

Figures (2 and 3) illustrate the results obtained in this experiment on the orange and green colours. The data obtained showed that females were slightly but insignificantly affected by all doses tested. Females attracted to the green colours were less at the high dose of gamma radiation (90 gray) than at the lower doses (50 and 70 gray). However, more normal females were attracted to the green colour than irradiated females at all doses. Males were less attracted to the green colour than females in both normal and irradiated insects. They were not affected by gamma radiation except at the high dose (90 gray). Greany *et al.* (1977) reported that the Caribbean fruit fly, *Anastrepha suspensa* appeared to respond behaviourally to orange (590 nm) rather than red objects when seeking fruit.

### 3. Attraction to Fruit Odour

The Mediterranean fruit fly tends to congregate on ripening fruit in nature. Host fruits are known to be the oviposition and mating sites for many tephritids (Prokopy, 1968; Prokopy *et al.*, 1973). Bush (1974) considers the attraction to and congregation on a specific host fruit to be an important factor in the formation of races and the sympatric specification of fruit flies.

Figure (4) illustrates the data obtained on the effects of gamma radiation with 3 doses, 50, 70 and 90 gray on the response of both males and females to the odour of Guava fruit, a host that shows the most destructive injury by the medfly in Egypt.

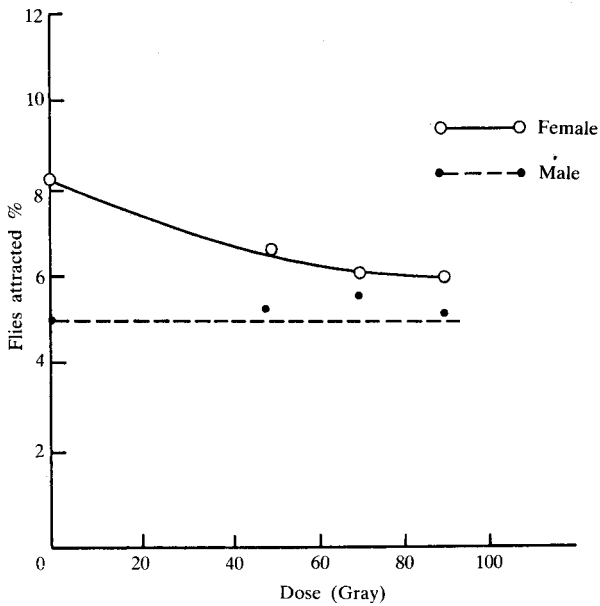


Fig. 2: Effect of gamma radiation on the response of *Ceratitidis capitata* adults to orange colour

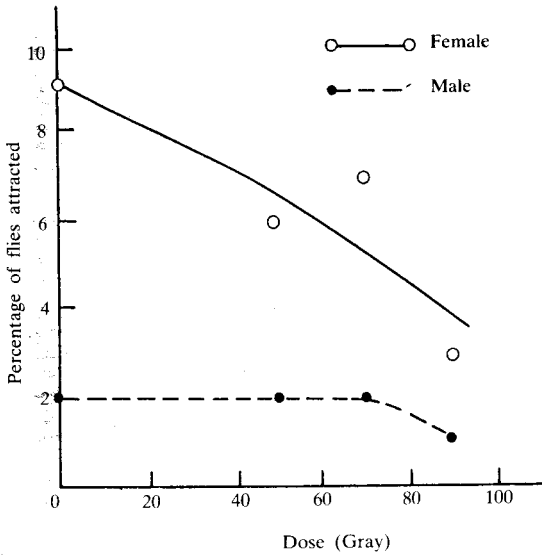


Fig. 3: Effect of gamma radiation on the response of *Ceratitidis capitata* to green colour

### Radiation effect on Medfly

The results showed that both males and females were affected drastically by radiation regarding their response to guava odour.

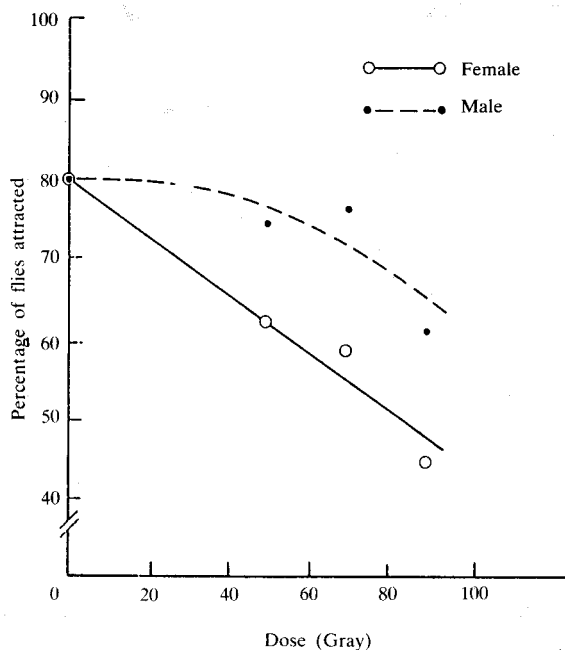


Fig. 4: Effect of gamma radiation on the response of *Ceratitidis capitata* to Guava odour

#### 4. Motility

The irradiated fly must upon release display a characteristic well maintained by selection in its wild counterparts, that is flight. So it is useless if the released fly can not or will not escape predation and environmental stress and seek shelter, food and water. Thereafter, it must move over greater or lesser distance in seeking its native target within appropriate habitats.

Irradiation and factory production may induce alterations in locomotory characteristics. These alterations, if undetected could readily render futile the release of flies that otherwise appear totally competent (Chambers, 1977).

The results obtained are illustrated in Fig. (5). The data showed that irradiation of either the male or female medfly did not affect the motility of them at all the doses tested.

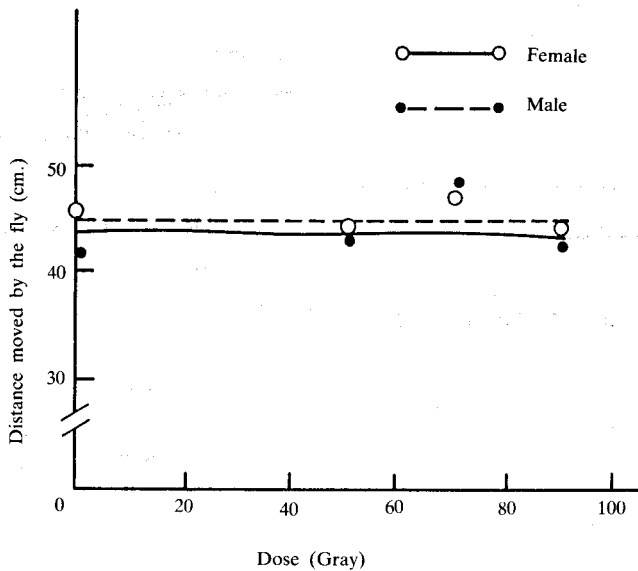


Fig. 5: Effect of gamma radiation on the motility of adult *Ceratitiss capitata*

#### REFERENCES

- Bateman, M.A., 1976.** Fruit flies. Pages 11-49 in V.L. Delucci, (ed.) Studies in biological control. International Biological Programme 9, Cambridge Univ. Press, London, New York, Melbourne, 304 pp.
- Bush, G.L., 1974.** The mechanism of sympatric host race formation in the true fruit flies, in: M.J.D. White, (ed.) Genetic Mechanism of specification in Insects. Australian and New Zealand Book Co., p. 3-23.
- Chambers, D.L., 1977.** Motility of fruit flies, Introduction. In: Quality control, an ideal book for fruit fly workers, (eds.), Baller, E.F. and D.L. Chambers, p. 26.
- Connolly, K. 1966.** Locomator activity in *Drosophila*. II. Selection for active and inactive strains. Anim. Behav., 14, 44-49.
- Greany, P.D., H.R. Agee, A.K. Burditt and D.L. Chambers, 1977.** Field studies on colour preferences of the Caribbean fruit fly, *Anastrepha suspensa*. Entomol. Exp. Appl., 21, 539-66.
- Hilmy, N.H., A.M. Wakid, and El-Monairy, O., 1985.** Effect of gamma radiation on the response of the rice weevil, *Sitophilus oryzae* to light and heat. Isotope and Rad. Res., 17, 27-32.

- Hocking, B., 1975.** Ant-plant mutualism, Evaluation and Energy. In: L.E. Gilbert and P.H. Raven, (eds.), Coevaluation of Animals and Plants. Univ. of Texas Press, Austin, p. 78-90.
- Prokopy, R.J., 1968.** Visual responses of apple maggot flies, *Rhagoletis pomonella*: Orchard studies. Entomol. Exp. Appl., 11, 403-22.
- Prokopy, R.J., 1977.** Stimuli influencing trophic relations of Tephritidae. In: V. Labeyrie, (ed.) Compartment des Insects et Milieu Trophique.
- Prokopy, R.J., V. Moericke, and G.L. Bush, 1973.** Attraction of apple maggot flies to colour of apples. Environ. Entomol., 2, 743-49.
- Russler, Y., 1977.** Testing the response of *Ceratitidis capitata* to host odour. In: Quality Control, An Ideal Book for Fruit fly Workers, edited by E.F. Baller and D.L. Chambers, IOBL, p. 62.
- Southwood, T.R.E., 1973.** The Insect/plant relationship on evolutionary perspective, In: H.F. Van Emden, (ed.) Insect/plant Relationship. Blackwell, London, p. 3-30.
- Wakid, A.M., 1975.** Studies on the control of the Mediterranean fruit fly *Ceratitidis capitata* using gamma radiation. Part of a co-ordinated programme on Fruit Fly Eradication or Control by the Sterile Male Technique. Final Report, IAEA, R. 1264, 28 P.
- Wakid, A.M., R.M. Abdu and El-Kholy, Eman M.S., 1987.** Effects of gamma radiation on the sexual attraction of the Mediterranean fruit fly, *Ceratitidis capitata* Wied., Qatar Univ., Sci., Bull., Vol. 7, p. 195-202.



## تأثير أشعة جاما على حركة وانجذاب ذبابة فاكهة البحر الأبيض المتوسط إلى الضوء والألوان والرائحة

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و إيمان محمد سعيد الخولي

عرضت العذارى الكاملة النمو لذبابة فاكهة البحر الأبيض المتوسط إلى ثلاث جرعات من أشعة جاما (٥٠ ، ٧٠ ، ٩٠ جرای) ثم دُرس تأثير الإشعاع على حركة وانجذاب الذباب إلى الضوء والألوان والرائحة . وقد وجد أن جميع الجرعات المستخدمة لم تؤثر على حاسة النظر المسؤولة عن تمييز الضوء في كلا الجنسين . كما لم تؤثر هذه الجرعات على انجذاب الجنسين إلى اللون البرتقالي . وقد كان انجذاب الإناث غير المشعة إلى اللون الأخضر أكثر من الإناث المشعة وخاصة بالجرعة العالية (٩٠ جرای) وكانت الذكور أقل انجذاباً للون الأخضر عن الإناث سواء المشعة أو غير المشعة . ولم تتأثر الذكور المشعة بالجرعات المنخفضة من ناحية انجذابها للون الأخضر ولكنها تأثرت تأثيراً معنوياً عند الجرعة ٩٠ جرای . وقد لوحظ أن كلا من الذكور والإناث قد تأثرتا بالإشعاع وخاصة عند الجرعة العالية بالنسبة لانجذابهم إلى رائحة فاكهة الجوافة ولو أن الإناث كانت أكثر تأثيراً من الذكور . وبالنسبة لحركة الذبابة فإنها لم تتأثر عند الذكور أو الإناث في جميع الجرعات الإشعاعية المستعملة .