

# Effects of gamma radiation on the immature pupae of the Mediterranean Fruit Fly, *Ceratitis capitata* Wied. (Diptera: Trypetidae): Dose response of laboratory reared and wild strains\*

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## Ö z e t

### Gamma radyasyonunun doğal ve yapay ortamlardan elde edilen Akdeniz Meyve Sineği (*Ceratitis capitata* Wied.)'nin gelişmekte olan pupalarına etkisi

Gamma radyasyonunun 6 ve 10 krad'lık dozları doğal ve yapay ortamlardan elde edilen 4 gün yaşlı *C. capitata* pupalarına tatbik edilmiş ve her iki dozda da, her iki populasyona ait pupalardan ergin çıkışı çok düşük bulunmuştur. Uygulanan dozlar erkeklerde %97,2 - 100, dişilerde ise %100 kısırılık meydana getirmiştir. Düşük oranda ergin çıkışı ve yüksek oranda kısırılık oluşumunun, radyasyonun, tam olarak gelişmemiş pupaların somatik hücrelerine ve üreme organlarına olan zararlı etkisinden ileri gelmiş olması en kuvvetli ihtimaldir. Aynı dozlarda gamma radyasyonu ile ışınlanacak genç pupalardan meydana gelecek erkeklerin hayat uzunluğu, cinsi rekabet ve sperm transfer yönünden araştırılması, yapılan bu çalışmanın tamamlayıcısı niteliğinde olacaktır.

## Introduction

The use of irradiation to sterilize males or both sexes of various insect species is the basis for control or eradication by the sterile insect technique. In a large-scale sterile insect release program, irradiation of the pupal stage is usually more practical than treatment of adults. Ho-

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wever, although, in recent years some researches have been carried out on the irradiation of the adult stage of the Mediterranean Fruit Fly, *Ceratitis capitata* Wied., (Ohinata et al., 1971), pupal irradiation have been studied by several researchers (Balock et al., 1963; Katiyar, 1965; Feron, 1966; Hooper, 1969). All these researchers have showed that gamma irradiation doses of ca. 9-10 krad applied to the pupae one day before adult eclosion, produced very high level of sterility in males as well as resulted high level of adult eclosion. Therefore, this study was designed to explore the dose-sterility relationship of irradiation in ambient atmospheres of 4-day old pupae of laboratory reared and wild strains and to compare the adult eclosion of both sexes treated as immature pupae at, 6 and 10 krad doses of gamma radiation.

## Material and methods

*C. capitata* pupae were obtained from the rearing facility of our laboratory using the larval diet formulated by Zümreoğlu (unpublished data) at 27°C and 60-70 % RH based on a combination of dehydrated powdered carrot (Mitchell et al., 1965) and wheat bran (Nadel, 1965).

The pupae of the wild strains were obtained from the peaches collected in the field and cultured under laboratory conditions. Pupae and test adults were maintained at 25 ± 1°C and 70 % RH. Adults were provided water and food consisting of a mixture (3 : 1) of sugar and protein hydrolysate (Fig. 1).

Irradiation was done in a well-type, 5000-Ci Cobalt<sup>60</sup> irradiation in Küçükçekmece Nuclear Research and Training Center, Istanbul. A batch of 1200 pupae of both strains were placed in plastic vials 100 in each and then were irradiated at doses of 6 and 10 krad. Same number of pupae of both laboratory and wild strains were separated as control. Accordingly, the experiment was set up with three dose levels (0, 6 and 10 krad), two factors (laboratory and wild strains) and three replications.

To determine emergence, a random sample of 100 pupae of each treatment was placed in small containers. Emergence was checked 3 days after the expected emergence date.

To determine fertility and fecundity of males and females respectively, the adults were sexed within 24 hr. of emergence and crosses of 100 irradiated (I) males X 100 normal (N) females and vice versa made in 20 cm diameter cylindrical wire cages. The females were provided to oviposit through the fine nylon or terylene cloth sealed the front side of cages facing a light source. It was provided that the eggs falling to a receptacle containing water. The numbers of eggs laid were determi-

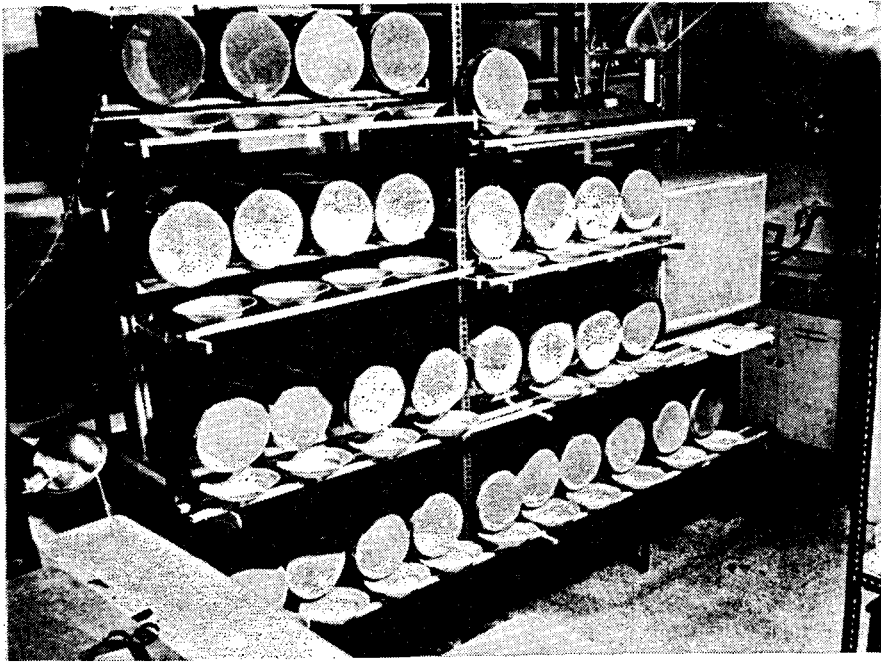


Fig. 1. Adult flies were caged in the rearing room for eggling under continuous lighting.

ned daily for 3 weeks. Then they were placed on the larval diet and the hatch was scored according to the mature larvae or pupae obtained. Mortality was checked before collecting the eggs.

Analyses of variance were used to note differences among the treatments and factors and the means were ranked by using interaction range test.

## Results and discussion

The effect of different doses of gamma radiation on the adult eclosion of 4-day old *C. capitata* pupae is given in Table 1.

As shown in Table 1, adult eclosion was higher in untreated pupae than treated ones. Apparently, there was a trend of decreasing adult eclosion with increasing the dosage rate as indicated by 32,6 and 20,6 in laboratory strains, 5,2 and 2,6 in wild strains respectively. When the data were analyzed statistically highly significant differences were found ( $P=0,05$ ) among the doses and populations. This is supposed to be in favour of laboratory strains because of the continuous rearing

Table 1  
Effects of gamma radiation on emergence of *C. capitata* irradiated with varying doses as pupae 5 days before adult eclosion.

Medium	Repli- cation	The numbers of flies emerged*								
		Untreated			6 krad			10 krad		
		♀	♂	Total	♀	♂	Total	♀	♂	Total
Artificial	I	42	41	83	16	26	42	16	9	25
	II	37	34	71	18	21	39	11	6	17
	III	42	47	89	7	10	17	16	4	20
	Mean	40,3	40,6	81	13,6	19	32,6	14,3	6,3	20,6
Natural	I	36	35	71	3	5	8	3	2	5
	II	38	34	72	0	2	2	1	1	2
	III	14	17	31	5	1	6	0	1	1
	Mean	29,3	28,6	58	2,6	2,6	5,2	1,3	1,3	2,6

\* 100 Pupae each treatment

technique. However, the interaction between populations X doses was not significant. Thus we may conclude that higher doses of gamma radiation decrease the adult emergence when the immature stages of *C. capitata* pupae are treated.

The mortality among the adults was higher in males than females during the first three weeks as indicated by 59,8 % in 6 krad and 74,6 % in 10 krad. Feron (1966) mentioned that increasing radiation doses resulted higher mortality in males than females.

Table 2 shows the effects of gamma irradiation of immature *C. capitata* pupae on fecundity and fertility. Both doses of gamma radiation induced complete sterility in females of laboratory reared and wild strains of *C. capitata*. Males treated similarly were 97,2-100 % sterile. Although we can not be sure, this may be the result of some recovery of fertility in males with time irradiated as pupae.

There was no significant difference between the given doses from the induced sterility standpoint. Katiyar (1965) found that there was a correlation between the radiation dose and medium in which the larvae reared. However, slightly difference found between the mediums, it was not also significant because of the irradiation of younger pupae. As a matter of fact, Causse et Feron (1968), found that 4-day old *C.*

Table 2  
Effects of gamma irradiation of 4-day old *C. capitata* pupae on fecundity and fertility

		Crosses of adults						
Medium	Dose (krad)	Rep-lica-tion	N ♂ X S ♀			S ♂ X N ♀		
			No. of eggs counted	No. of larvae obtained	Steri-lity %	No. of eggs counted	No. of larvae obtained	Steri-lity %
Medium	6	I	4	0	100	967	10	96,7
		II	2	0	100	588	0	100,0
		III	4	0	100	278	3	98,9
		Mean			100			98,5
Artificial	10	I	0	0	100	405	0	100,0
		II	0	0	100	137	0	100,0
		III	0	0	100	148	0	100,0
		Mean			100			100,0
Natural	6	I	0	0	100	396	30	92,3
		II	0	0	100	13	0	100,0
		III	0	0	100	147	1	99,3
		Mean			100			97,2
Natural	10	I	0	0	100	49	2	96,0
		II	0	0	100	1	0	100,0
		III	0	0	100	107	0	100,0
		Mean			100			98,5

*capitata* pupae was the sublimit age for irradiation purpose and 5 krad or higher radiation doses induced very high level of sterility when applied to the pupae 4-8-day old.

This study showed that, irradiation of 4-day old immature pupae of *C. capitata* resulted poor adult eclosion and high level of sterility presumably because of the detrimental effects of radiation on their somatic tissues and less developed reproductive system even if optimum or lower irradiation doses are applied. For further studies, longevity, sexual competitiveness and sperm transfer of males should be studied as well as adult eclosion and sterility in order to have a certain opinion of the effects of gamma irradiation on the immature pupae of *C. capitata*.

## Summary

When 4-day old laboratory reared and wild strains pupae of the Mediterranean Fruit Fly (*Ceratitis capitata* Wied.) were exposed to the 6 and 10 krad gamma radiation, adult eclosion was poor as compared with control. The doses applied induced high level of sterility in males (97,2 - 100 %) and females (100 %). The level of sterility between the populations was nearly similar. High level of sterility probably is due to the detrimental effect of gamma radiation on the less developed reproductive system of immature pupae.

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