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Radio sensitivity and Sexual Sterility Induction in Cucurbit Fruit Fly *Dacusciliatus* (Loew): adult Irradiation

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Abstract:

The current study was conducted to measure the radio sensitivity of cucurbits Fruit Fly Dacus ciliatus (Loew) adults and induce sexual sterility by irradiated them at age of 1-2 days at radiation doses of 10 , 30 , 50, 70 , 80, 90 , 100 and 120 Gray in addition to the control treatment. Results showed a significant reduction in the females fecundity with an increase of radiation doses at all mating types, particular when females are irradiated. There was slight effect for gamma ray in average adult longevity of both males and females. The results, also indicated to significant reduction in the eggs hatching percentage in all mating types , with acute reduction when female was irradiated .The possibility of induction of complete

sexual sterility in males and females was occurred when they exposed to doses of 120 and 80 Gray respectively .

According to these results it can be concluded that there is ability to full sexual sterility in males of cucurbits fruit fly D. ciliatus after exposure to gamma rays at a dose of 120 Gy and thus their suitability for the program of release sterile insects after confirming the level of competitive mating and other quality specifications.

Key words: Radio sensitivity, Sexual Sterility Induction, Cucurbit Fruit Fly *Dacusciliatus* (Loew), adult Irradiation

INTRODUCTION

The cucurbits fruit fly, *Dacus ciliates* Loew., is a major pest of cucurbit crops in some countries (Azab et al., 1970; Nagappan et al., 1971), causing large economic losses. Its economic importance refers to the direct damage caused by females that oviposit into the host fruit and larvae feeding on the fruit flesh. In addition to direct losses, severe quarantine policies are imposed by importing countries to avoid importation and establishment of exotic pests. Because of the environmental impact of chemical pesticides and by the nature feed of their larvae inside the fruit, the chemical pesticides was ineffective strategy to control this pest, so it was recommend to use agricultural operations(Hosni et al. 1976) , Protein baits and lures (Seewooruthun *et al.*2000; Suhail *et al.* 2000). Attention is also focusing on the sterile insect technique, to determine appropriate radiation doses to develop full sterility. The practicability of the Sterile Insect Technique to control insect pests has been applied successfully against many pests, especially the screwworm fly of new and old worlds (*Cochliomyia hominivorax*) and (*Chrysomya bezziana*) as well as the fruit flies Tephritidae, at least on a regional scale(Dyck *et al.*2005 , Alcagno *et al.*, 2002).

Integrated research program has been implemented to measure Radio sensitivity and induce sexual sterility of this pest during the egg and the larva stages (Yoseph *et al*, 2009) and pupae (Al-Rubaie *et al*.2012) . The aim of the current research is to measure radio sensitivity and sexual sterility of adults (male and female) of cucurbits Fruit Fly *D.ciliatus*.

MATERIALS AND METHODS

The infected fruits with eggs of cucurbits fly *D. ciliatus* were placed in cages of Plexiglas (40×40×40 cm) and were reared in the laboratory under optimal conditions (temperature 25–29 C; relative humidity 75–85%; photoperiod 16:8 h L: D) the larvae feed after eggs hatching on the fruit pulp, then leave the fruit after complete their growth and go down to the ground corn for pupate. Pupae were collected in Glass jar (14 cm high and 9 cm diameter), covered with cloth, and placed in incubators under similar conditions of rearing room, except it is without lighting. all emerging adult were transferred to mating cages (20× 20×20 cm) equipped with yeast solution as a source of protein for females and to improve the activity mating of males , and sugar solution 5% besides dry sugar as well as pieces of cotton moistened with water in a small petri dish (Keiser & Schneider, 1969, Drew, 1987). Mating cages were provided with fruits of ground as a natural medium to lay eggs, placed under the conditions of rearing room, these fruits have been replaced to calculate the eggs and hatching ratios.

Radiation Source:

Gamma cell 220 which provided with Cobalt 60 was used to irradiate adults. (ACEL, 1984).

Irradiation of adult and types of mating:

Males and females were separated after the emergence and irradiated them at age of 1-2 days at radiation doses of 10 , 30 , 50, 70 , 80, 90 , 100 and 120 Gray in addition to the control treatment. Then they were distributed on mating cages, in each of them was 3 males and 3 females. The experiment was included 4 mating types, the first was irradiated males and non- irradiated females, the second group was irradiated males and females, the third group contained non- irradiated males and irradiated females, and the fourth group has contained non- irradiated a males and females as control group.

Experimental design and statistical analysis:

The experiments were designed in a completely randomized design CRD, and data were analyzed by using the SAS program, and Duncan multiple range test (DMRT) to compare the means in probability level of 0.05 (SAS, 2001).

RESULTS AND DISCUSSION

The average number of eggs that laid by the normal female mating with irradiated males are decreased significantly with increase of radiation dose, the less number was 39 eggs / female at dose of 80 Gy, compared with 55.0 eggs / female in the control group (Table 1). Great significant decline of the average number of eggs was by irradiated females mated with irradiated males as well as normal males, at average number of 4.25 and 3.67 eggs / female for both mating types respectively at dose of 80 Gy, there was not laid of eggs at dose of 90Gy and higher. These results indicated clearly that the numbers of eggs are declined with increasing of radiation doses in all types of mating, especially when the females are irradiated.

Results also shown significant differences in the irradiated adults longevity compared with control group when irradiated the males at dose of 90Gy and females at dose of 80Gy. The lowest average age of irradiated males was 25.75 days at dose of 120 Gy compared with33.0 days at control group, and the longevity of the irradiated females was 27.67 and 35.75 days respectively.

Table (2) showed decreasing of the Percentage of eggs hatching that were laid by normal females mating with irradiated males at dose of 30 Gy and higher, the males were completely sterile when exposed to radiation dose of 120 Gy. Percentage of eggs hatching for the irradiated females mated with irradiated or normal males are decreased to 6.25 % and 7.04 %, respectively, at dose of 70 Gy.

Females are become completely sterile when exposed to radiation dose of 80Gy. These results illustrate the sensitivity of females of cucurbits fruit fly to radiation was more than males, and in spite of this, it is advisable to induce complete sterility in the adult male of fruit fly cucurbits at the dose 120 Gy due to the wounds that occurred in the fruits by their ovipositor (Bakri et al. 2005)

It was found that radioactive doses involved to induce a complete sterility by irradiating pupae of cucurbits fruit fly at age of 7 days was 70 Gy for females and 100 Gy for males (al-Rubaie, *et al*., 2012) The same study indicated to sensitivity of pupae at age of 1-2 days to radiation compared with pupae at age of 7 days , the emergence of adults for the second group did not stop until 700 Gy while it was stopped in the first age at dose 40 Gy. In general, it was found that adults are more resistant to radiation than pupae and these are more resistant than larvae (Bakri *et al*., 2005)). On the other hand, the females of insects are more sensitive to radiation than males with some expectation (Hooper, 1989, Hallman, 2000). It was also found that the best age of radiation of complete metamorphosis

insects is the later age of pupae or earlier age of adults, and this is true with Tephritidae (Ohinata *et a*l. 1987)

Hooper (1975) noted that the irradiation of *Dacus cucumis* adults at dose of 90Gy and130 Gycaused sterility of 98.5% and 99.8 % respectively.

Williamson *et al.* (1985) pointed out that the rate number of eggs in the ovary of44.04 % of irradiated females of Mediterranean fruit fly at age of 3 hours at 150 Gy were 5.55 eggs, while the average number of eggs were 1.90 eggs for irradiated females at pupae stage in age of one day pre-emergence and explained that by rapidity of ovary growth during the development period to adult that making the cells less affection.

According to the above results it can be concluded that there is ability to full sexual sterility in males of cucurbits fruit fly *D.ciliatus* after exposure to gamma rays at a dose of 120 Gy and thus their suitability for the program of release sterile insects after confirming the level of competitive mating and other quality specifications.

Table(1) Effect of irradiation of *Dacusciliates* adults by different gamma ray doses on females fecundity and adults longevity

Doses (Gray)	Eggs/female Type of mating			Longevity(days)	
	N ♀ X ♂ I	I ♀ X ♂ I	I ♀ X ♂ N	♂	♀
0	a*55.42	a55.42	a55.42	a33.00	a 35.75
10	ab51.67	b 39.0	b34.83	ab32.58	a 35.75
30	.58 b48	c31.67	c 27.58	ab32.42	ab34.58
50	ab49.50	d 25.83	c27.92	ab32.58	abc33.83
70	b46.33	e 7.58	d5.75	ab31.00	abc32.83
80	c 39.17	e4.25	de 3.67	ab30.83	bcd32.75
90	c38.58	f0.0	e0.0	b 29.67	cd31.75
100	c 39.75	f0.0	e 0.0	c25.83	de 30.08
120	c38.33	f 0.0	e 0.0	c25.75	e27.67

Means followed by the same letter in the same column are not significantly different. $p \leq 0.05$. I: irradiated N: non irradiated

Table (2) Effect of irradiation of *Dacus ciliates* adults by different gamma ray doses on % of eggs hatching.

Doses (Gray)	% of eggs hatching		
	Type of mating		
	N ♀ X ♂ I	I ♀ X ♂ I	I ♀ X ♂ N
0	a 88.02	a 88.02	a *88.02
10	a86.94	b 43.68	b45.77
30	b 75.87	c 18.43	c 20.13
50	c56.71	c 16.27	d 12.91
70	d 38.10	d 6.25	e7.04
80	e26.19	d0.0	f 0.0
90	e17.43	d0.0	f0.0
100	f6.86	d 0.0	f0.0
120	f0.0	d 0.0	f0.0

Means followed by the same letter in the same column are not significantly different. $p \leq 0.05$. I: irradiated N: non irradiated

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