RADIATION EFFECTS ON THE GRAPE VINE MOTH *LOBESIA BOTRANA* DEN. AND SCHIFF. (LEPIDOPTERA, TORTRICIDAE)

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Abstract

Pupae of *Lobesia botrana* (one day before eclosion) were irradiated with 10, 15, 20, 25, 30, 35 and 40 krad. Combinations of irradiated males x normal females, normal males x irradiated females and normal males x normal females were tested. The results showed that sterility of males were obtained to some extent at the different dosages of gamma radiation. Males were completely sterile at 40 krad. In general, as the irradiation dose increased, egg hatchability decreased. The data indicated that there was a significant effect of radiation on fecundity of females compared with that of control. At 40 krad, the reduction of eggs laid by female reached 86.86%, as the irradiation dose increased the number of deposited eggs by female decreased and consequently the reduction increased. Hatchability of eggs laid by irradiated female was 0.00 at 25-40 krad. In general, females were more sensitive to radiation than males. Also, the same results clarified that the irradiation of pupae of *L. botrana* reduced the longevity of emerged males and females. Longevity of emerged males signifiacantly decreased to 8.30 days at 40 krad compared with 17.30 days for untreated ones. Female longevity, that insignificantly affected with radiation, was 18.30 days when received 40 krad. The longevity of untreated females was 22.50 days.

INTRODUCTION

The grape vine moth, *Lobesia botrana* is one of the most harmful pests destroying berries of various grape vine varieties in all growth stages. Females lay eggs on inflorescence buds, immature and mature berries.

In the past decade, the increasing of insect- resistance to insecticides, along with the more restrictive use of many chemical pesticides, has prompted research for new avenues of insect control. Many researchers studied the possibilities of population suppress on though the release of radiation - sterilized moths, trying to emulate the success with the screw worm fly, *Cochliomyioa hominivorax* (Bushland, 1971).

The pupal stage was chosen for the initial studies of radiation because of the ease of handling compared with adult moths as well as irradiation studies of other lepidopterans showed that this stage was more tolerant to irradiation damage than the egg and larval stages (Flint & Kressin, 1967; El-Sayed & Graves, 1969; Beraltief, 1974;

Mochida & Miyahara, 1976; Harizanova, 1977; El-Hakim & Abdel-Salam, 1987 and Korashy, 1991).

The aim of the present work is to determine the radiation dose for complete sterility and the effect of radiation on fertility, fecundity and longevity of *L. botrana*.

MATERIALS AND METHODS

1- Rearing Technique

All pupae of *L. botrana* used in this study were obtained from a laboratory strain, where larvae were reared on artificial medium diet (Gabel, 1981) under constant conditions of 27± 2 °C, 65± 5% R.H. and a photoperiod of 16 L : 8D in plastic containers of 7 cm diameter and 10 cm height. Excess moisture was avoided by placing tissue paper directly under the container cover. Stripes of corrugated cardboard (1.3 cm wide) were provided as pupation sites. If pupae were to be tested, the stripes were collected when the pupae were within 24 hrs of emergence, as judged by their dark brown color. The stripes were pulled apart and pupae were tested from their cocoons and irradiated at the desired dose.

2- Irradiation Source

The grape vine moth pupae were irradiated by Co-60 source delivering gamma radiation at the Middle East Regional Radioisotope, Cairo, Egypt center. Pupae were initially dosed with 70 Gy/minute and decay of the source was computed each month.

3- Irradiation Technique

Pupae of *L. botrana* (1-day before emergence) were irradiated with 10, 15, 20, 25, 30, 35 and 40 krad. After eclosion, for each dose, 10 females were individually paired with 10 males (as 10 replicates) in ovipostion cages that kept under the above-mentioned constant laboratory conditions as follows:

- Irradiated males x Normal females
- Normal males x Irradiated females
- Normal males x Normal females (as sheck)

Each cage was provided with a piece of cotton wick soaked in honey solution (10%) which renewed daily by fresh one. The cages were examined daily to count the number of eggs laid. Hatchability percentages as well as the longevity of both males and females, were determind

4- Statistical Analysis

The reduction in egg production was calculated according to Abbott (1925), whereas sterility was calculated according to Chamberlain formula (1962) which modified by Toppozada *et al.,* (1964). Analysis of variance was conducted to test the significance between treatments using "F" test and L.S.D values according to Snedecor (1957).

RESULTS AND DISCUSSION

1- Irradiated Males Crossed with Normal Females

Results listed in Table (1) show the effect of radiation on males of *L. bortrana* irradiated with 10, 15, 20, 25, 30, 35 and 40 krad at the pupal stage and mated with normal virgin females at the same age.

As shown in the table, there were unexpected decrease in the mean number of eggs/normal female mated with irradiated male, as the dosage given to the male increased. Female of the check treatment laid as much as 175 eggs, while that of untreated female crossed to male treated with 40 krad laid only 59.60 eggs. Statistical analysis showed that there were no significant differences in the mean numbers of eggs laid per female crossed to males irradiated with 15 and 25 or 20 and 30 krad, but the difference was significantly clear between the check and treatments. Also, there was a significant difference in the number of eggs laid per female between 30 and 35 krad (106.60 and 75.90 eggs) and between 35 and 40 krad (75.90 and 59.60 eggs). The percentage of reduction in the mean number of eggs laid per female ranged between 20.97 – 65.94 %.

Respecting eggs hatching, the results show that as the dosage given to the male pupae increased, the hatchability of eggs laid by normal females decreased. The percentage of hatchability ranged between 0.00 – 68.30% in the treatments , while it was 94.90% in the control. Accordingly, the reduction in hatchability significantly increased with the increasing of radiation dose showing % reduction in hatchability of 28.03, 38.88, 64.49, 73.02, 78.71, 97.37 and 100.00% with the doses of 10, 15, 20, 25, 30, 35 and 40 krad, respectively (Table, 1).

As shown in Table (1), the treatments gave % sterility of 43.12, 56.62, 78.08, 80.98, 87.03, 98.86 and 100.00% with the radiation doses of 10, 15, 20, 25, 30, 35 and 40 krad, successively. These results are in agreement with those obtained by Mochida & Miyahara(1976) who stated that doses of 8 krad or more afforded complete sterility in males of *Spodoptera litura* when crossed with normal females and none of the eggs laid hatched. Also, both Harizanova (1977) and Korashy (1991) obtained completely sterile males of *L. botrana* at 40 krad of gamma radiation.

Also, the mean longevity of males emerged from irradiated pupae was significantly reduced. The mean longevity of treated males was 12.50, 13.50, 13.40, 13.90, 11.60, 11.90 and 8.30 days for 10, 15, 20, 25, 30, 35 and 40 krad compared with 17.30 days for untreated males (Table, 1). Mochida & Miyahara (1976) stated that the length of adult male life of *S. litura* was reduced after exposure in the pupal stage to gamma radiation. Korashy (1991) found a significant reduction in the longevity of emerged males of *L. botrana* due to gamma radiation.

2- Irradiated Females Crossed with Normal Males

The effect of radiation on female pupae of *L. botrana* when crossed with normal males is shown in Table (2). The mean number of deposited eggs/female significantly decreased with the increasing of irradiation dose. The range of mean number of eggs in case of irradiated females was 23.00 – 110.00 eggs/female compared with 175.00 eggs per the untreated one. The exposure of female pupae of *L. botrana* to gamma rays of 10, 15, 20, 25, 30, 35 and 40 krad gave % reduction in eggs production of 37.14, 44.46, 62.63, 70.91, 78.74, 81.26 and 86.86 %, respectively.

Also, the increasing of radiation dose followed by sharp decreasing of % hatchability that ranged between 0.00- 4.20% for the treated females comparing with 94.90% for the untreated ones. The hatchability of eggs laid by irradiated females when crossed with normal males was reduced by 95.57- 100.00 %.

The percentages of sterility were 97.22, 98.07 and 99.41 % for the radiation doses of 10, 15 and 20 krad, successively. The other doses of 25, 30, 35 and 40 krad recorded 100.00 % sterility for each. As shown in Tables (1 and 2), the females of *L. botrana* were more sensitive to radiation than the males. Flint & Kressin(1967) and El- Sayed & Graves (1969) reported that the irradiated females of *Heliothis virescens* produced very few eggs when the dose was greater than 35 krad (the first) and hatchability of oviposited eggs was nil at 30 krad (the latter). Also, Korashy (1991) found that the sterility of treated female of *L. botrana* with 25,30,35 and 40 krad (crossed with normal male) was 100%

The mean longevity of irradiated females was insignificantly affected and ranged between 17.10 – 20.40 dyas compared with 22.50 days for the non-irradiated females (Table, 2) .

Table 1. Fertility and longevity of irradiated *L. botrana* males in pupal stage crossed with normal females.

Dose (krad)	Mean no. of eggs/ female	% Reduction	% Hatchability	% Reduction	% Sterility	Mean longevity of male (day)
10	138.30±10.84 (94-190)	20.97	68.30±2.30 (60.30-82.30)	28.03	43.12	12.50±1.30 (7-18)
15	124.20±12.70 (83-204)	29.03	58.00±5.20 (40.60-84.80)	38.88	56.62	13.50±0.62 (11-17)
20	108.00±14.50 (48-180)	38.29	33.70±4.70 (19.60-50.80)	64.49	78.08	13.40±1-22 (9-18)
25	123.40±15.10 (7-184)	29.49	25.60±1.40 (17.90-29.70)	73.02	80.98	13.90±0.96 (10-18)
30	106.60±10.20 (55-142)	39.09	20.20±1.80 (16.40-30.90)	78.71	87.03	11.60±0.73 (8-16)
35	75.90±10.30 (17-110)	56.63	2.50±0.89 (0.00-4.50)	97.37	98.86	11.90±1.36 (7-17)
40	59.60±8.70 (29-100)	65.94	0.00±0.00	100.00	100.00	8.30±0.91 (5-14)
Control	175.00±13.20 (85-213)	-	94.90±1.00 (89.50-98.00)	-	0.00	17.30±1.65 (9-27)
Fvalue	94.99 *	-	169.47 *	-	-	*
L.S.D.at0.05	15.20	-	7.30	-	-	3.10

Table 2. Fecundity and longevity of irradiated *L. botrana* females in pupal stage crossed with normal males.

Dose (krad)	Mean no.of eggs / female	% Reduction	% Hatchability	% Reduction	% Sterility	Mean longevity of female (day)
10	110.00±12.90 (44-178)	37.14	4.20±1.30 (0.00-8.20)	95.57	97.22	18.90±1.31 (13-26)
15	97.20±13.00 (33-144)	44.46	3.30±3.30 (0.00-32.50)	96.52	98.07	17.70±1.22 (11-24)
20	65.40±7.60 (19-101)	62.63	1.50±1.50 (0.00-15.50)	98.42	99.41	20.30±1.62 (12-29)
25	50.90±8.20 (20-87)	70.91	0.00±0.00	100.00	100.00	19.30±2.09 (9-27)
30	37.20±7.40 (21-71)	78.74	0.00±0.00	100.00	100.00	17.10±0.80 (11-20)
35	32.80±6.00 (6-67)	81.26	0.00±0.00	100.00	100.00	20.40±1.90 (7-28)
40	23.00±5.00 (6-46)	86.86	0.00±0.00	100.00	100.00	18.30±1.56 (11-26)
Control	175.00±13.20 (85-213)	-	94.90±1.00 (89.50-98.50)	-	0.00	22.50±2.00 (11-28)
Fvalue	29.99 *	-	613.50 *	-	-	N.S
L.S.D.at 0.05	26.40	-	3.80	-	-	

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تأثيرات الإشعاع على دودة ثمار العنب

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عند تعريض عذارى دودة ثمار العنب (قبل الخروج بيوم واحد) لجرعات إشعاع ١٠، ١٥، ٢٠،٢٥، ٣٠، ٣٥، ٤٠ كيلوراد وبعمل تزاوجات بين ذكور مشععه x إناث عادية و ذكور عاديةx إناث مشععة و ذكور عاديةx إناث عادية فقد أوضحت النتائج أن الذكور عقمت تعقيماً كاملاً عند جرعة ٤٠ كيلوراد، و عموماً بزيادة جرعة الاشعاع تقل نسبة فقس البيض- كذلك وجد تأثير معنوى للإشعاع على خصوبة الأناث إلى ٨٦,٨٦% عند جرعة ٤٠ كيلوراد حيث بزيادة جرعة أشعاع يقل عدد البيض للأنثى. كما تنخفض كذلك نسبة فقس البيض الذى تضعه الأناث المعاملة فعند جرعات٢٥-٤٠كيلوراد لا يفقس البيض كلية، وعموماً أثبتت النتائج أن الإناث أكثر حساسية للإشعاع من الذكور أيضا كان للإشعاع تأثيره على طول عمر كل من الذكور و الإناث حيث انخفضت بدرجة معنوية فترة حياه الذكور الخارجة لتصل إلى ٨,٣٠ يوماً عند جرعة٤٠ كيلوراد فى حين بلغت ١٧,٣٠ يوماً للأفراد غير المعاملة. أما فترة حياة الإناث فقد إنخفضت بدرجة غير معنوية حيث بلغت ١٨,٣٠ يوماً عند جرعة ٤٠كيلوراد بينما كانت ٢٢,٥٠ يوماً للإناث غير المعاملة.