EFFECT OF CERTAIN BIO-INSECTICIDES AND GAMMA IRRADIATION ON SOME BIOLOGICAL ASPECTS OF THE PINK BOLLWORM

REDA A. M. M. AMER

Plant Protection Research Institute, ARC, Dokki, Giza, Egypt

(Manuscript received 5 November 2006)

Abstract

The present study was conducted to evaluate some biological aspects of the pink bollworm, *Pectinophora gossypiella* (Saund.) exposed as newly hatched larvae to gamma irradiation doses of 5, 10, 20, 40 & 80 Gy. Also, the newly hatched larvae were treated by LC_{50} of the bio-pesticide compound, Dipel-2x and its exposure to gamma irradiation, in addition to Spinosad and Dipel-2x + Spinosad treatments.

The following biological aspects were studied, larval duration, larval mortality percentage, pupal duration, pupal mortality percentage, male and female adult longevity, adult mortality percentage, pre-oviposition, oviposition, post-oviposition periods, life cycle, egg laying rate (no. of egg/ female), egg hatching rate (no. of hatched egg/female) and the percentages of egg hatchability, control of hatchability, fecundity and sterelity.

When the pink bollworm treated as newly hatched larvae with LC_{50}'s of bio-insecticides, it could be mentioned that Dipel-2x caused the lowest latent effect on the most biological aspects. However, Dipel-2x exposed to gamma irradiation doses of 5, 10, 20, 40 & 80 Gy caused a potentiation delayed effect on the studied biological parameters especially when combined with 40 & 80 Gy of gamma irradiation.

Gamma irradiation doses caused a moderate delayed effect especially with 40 & 80 Gy when compared with the other irradiation doses of 5, 10 & 20 Gy.

Dipel-2x + Spinosad proved to be the most efficient treatment showing the highly latent effect on the biological aspects for the pest, followed by Spinosad alone.

INTRODUCTION

The pink bollworm, *Pectinophora gossypiella* (Saunders) was described by W.W. Saunders in 1843 as *Depressaria gossypiella* from specimens found to be damaging cotton in India. At present, the pink bollworm has been recorded in nearly all cotton-growing countries of the world and is a key pest in many of these areas (Ingram, 1994). The pink bollworm was first recorded in Egypt about 1906-1907 (Willcocks, 1916). The larvae (immature stage) bore into the developing cotton bolls, where they feed on the cotton lint and seeds. The pink bollworm spends the destructive larval phase inside the cotton bolls where it is well protected from control measures, so the control of this insect depend upon the time before cotton boll penetration such as a short growing season, which have successfully decreased the population to the point where eradication may be possible using sterile insects and genetically engineered cotton because the pink bollworm is an introduced insect with few plant hosts other than cotton.

Gamma irradiation had a drastic effect on many biological aspects of the bollworms such as the reduction in fecundity, egg viability, larval & pupal mortality, male & female adult longevity when adult moth of *E. insulana* (Boisd.) exposed to different gamma doses ranged between 80-600 Gy (Mohamed, 2002 and Sallam & Mohamed, 2004). Also, Suharyono & Sutrisno (2002) showed that number of egg production, egg hatching and mating competitveness were affected when the male pupae of *H. armigera* (Hubner) irradiated by 50 up to 120 Gy.

Bollworms are not sufficient controlled by *Bacillus thuringiensis* (Kurs.) (Deniz & Kornosor 1987 and El-Tantawy, *et al.* 2002). Thus, a combined the biocide Dipel2x with gamma irradiation doses against the pink bollworm was suggested. In this respects, Amer (2006) found that the efficiency of Dipel-2x increased gradually when it combined with gamma doses from 5 up to 80 Gy than Dipel-2x alone.

Spinosad have a new mode of action and leading the IPM programs in the major cotton countries as Australia and USA (Temerak, 2005). The mixture of Dipel-2x and Spinosad caused high efficient than such biocide alone against newly hatched larvae and eggs of the pink bollworm in the laboratory, also it caused a higher percent of reduction in the larval population and infestation in the cotton field (Amer, 2006).

The present study aimed to estimate certain biological aspects of the pink bollworm treated as newly hatched larvae by Dipel-2x and its combinations with gamma irradiation doses, in addition to the biocide, Spinosad as well as its mixture with Dipel-2x.

MATERIALS AND METHODS

Insect

A laboratory strain of the pink bollworm, *Pectinophora gossypiella* (Saunders) was reared in the Bollworms Department, Plant Protection Research Institute, Agriculture Research Center on semi artificial diet as described by Rashad and Ammar (1985). Rearing conditions were controlled at 27±1°C and 65-75% RH.

Tested compounds

Dipel-2x, a commercial formulation of *Bacillus thuringiensis* var. Kurstaki. A product of Vailent Bioscience Corporation, USA was obtained from May trade company, Giza, Egypt. It contains about 3200 International units potency per mg.

spores and protein crystals. The active ingredient constituted 6.4% of the formulation and the dose rate was 200 gm/feddan.

Dipel-2x was irradiated by doses of gamma irradiation, 0.0 (Control), 5, 10, 20, 40 & 80 Gy. All irradiations were done by a Co^{60} Canada Cell Research, National Center for Radiation Research and Technology, delivered at a dose rate of 1.3 Rad/S.

Spinosad 24% SC. is a commercial formulation derived from the actinomycete fungus, *Saccaropolyspora spinosa* (Mertz & Yao) following fermentation. The compound made by Dow Agrosciences- England and obtained from Wady El-Neil company, El-Mohandseen, Egypt. The dose rate was 50 cm/feddan. In case of evaluating synergistic effect a mixture of the two bio-insecticides as a ratio of 1:1 was used.

Biological aspects of the pink bollworm treated by bio-insecticides and gamma irradiation doses:

The pink bollworm, *P. gossypiella* treated as newly hatched larvae with gamma irradiation doses, 5,10,20,40&80 Gy, in addition, the LC_{50} value of Dipel-2x (LC_{50}: 0.1043 μg/cm^3) and its exposure to gamma doses of 5 Gy (LC_{50}: 0.1241 μg/cm^3), 10 Gy (LC_{50}: 0.0799 μg/cm^3), 20 Gy (LC_{50}: 0.0664 μg/cm^3), 40 Gy (LC_{50}: 0.04971 μg/cm^3) & 80 Gy (LC_{50}: 0.02065 μg/cm^3). Also, LC_{50} of the Spinosad 0.000617 μg/cm^3 and Dipel-2x + Spinosad 0.000272 μg/cm^3 were used.

The following biological aspects were investigated as follows:

1- **Larval and pupal durations:** (in days).

2-**Larval, pupal and adult mortality percentages:** were corrected according to Abbott's formula (1925).

3- **Adult longevity:** Data obtained were based upon cumulative number of males and females remaining alive each day.

4- **Pre-oviposition, oviposition and post-oviposition periods:** 2-5 pairs of emerged moths were placed in a clean glass cages (17 cm height and 7-12 cm in diameter) to determine the periods from adult emergence until the adult female dead.

5- **Life cycle:** This period extended from egg deposited until adult emergence (in days).

6- **Egg laying and hatching rates:** The total production and the number of eggs per female were calculated from daily counts of eggs deposited on the piece of paper. Each treatment yielded data on the daily egg production and on the differential survival of females. Also, the number of hatched egg/female (egg hatching rate) was counted.

7- **Egg hatchability percentage**: The deposited eggs in clean tubes (5 cm height and 3 cm diameter) until hatching. Egg hatchability percentage was counted as follows:

$$\frac{\text{No. hatched eggs}}{\text{No. deposited eggs}} \times 100$$

8- **Control of hatchability percentage**: was calculated according to Zidan and Abdel-Megeed (1987) as follows:

$$\frac{\text{No. egg hatchability in check} - \text{No. egg hatchability in treatment}}{\text{No. egg hatchability in check}} \times 100$$

9- **Fecundity percentage**:was calculated according to Crystal and Lachance (1963) as follows:

$$\frac{\text{No. eggs/ treated female}}{\text{No. eggs/ untreated female}} \times 100$$

10- **Sterelity observed percentage**: was calculated according to Zidan and Abdel-Megeed (1987) as follows:

% Sterelity observed = 100 – Egg hatchability percentage

11- **Corrected sterelity percentage**: was calculated according to Zidan and Abdel-Megeed (1987)

$$\% \text{ Corrected sterility} = \frac{\% \text{ Sterelity observed} - \text{Check}}{100 - \text{Check}} \cdot 100$$

RESULTS AND DISCUSSION

The latent effect of bio-insecticides and gamma irradiation on some biological aspects of the pink bollworm:

1-Larval duration

Data represented in Table (1) showed that the LC_{50} value of Dipel-2x + Spinosad treatment caused drastically decrease in larval duration (13.0 days) when the pink bollworm treated as newly hatched larvae, followed by Dipel-2x +80 Gy (17.5 days) compared with the control value (22.2 days). While, Spinosad (19.84 days) and Dipel-2x +40 Gy (19.89 days) had a moderate effect on the larval duration as shown in Table (1) and figure (1).

Gamma irradiation doses between 5 and 40 Gy had larval duration values ranged between 20.0 to 21.0 days. Also, the treatments of Dipel-2x and its exposure to gamma doses of 5,10&20 Gy had values near from the control where ranged between 21.0 to 22.0 days.

Table 1. Some biological aspects of *P.gossypiella* treated as newly hatched larvae with LC_{50} values of both tested bio-insecticides and gamma irradiation doses.

Bioinsecticides	Larval duration (days)	Larval mortality %	Pupal duration (days)	Pupal mortality %	Adult longevity (days)		Adult mortality %	Female adult longevity (days)			Life cycle (days)
					♂	♀		Pre-oviposition period	oviposition period	Post-oviposition period	
Dipel-2x	22.0 ^{ab}	46.4 ^{gh}	14.85 ^{bc}	17.82 ^{gh}	42.3 ^{a}	35.0 ^{a}	6.12 ^{g}	1.98 ^{a}	25.0 ^{a}	8.02 ^{bc}	48.85 ^{a}
Dipel-2x + 5 GY	21.98 ^{ab}	47.1 ^{fg}	14.82 ^{bc}	18.11 ^{gh}	39.5 ^{bc}	32.01 ^{b}	11.35 ^{ef}	2.0 ^{a}	22.0 ^{b}	8.01 ^{bc}	40.8 ^{bc}
Dipel-2x + 10GY	21.8 ^{abc}	47.8 ^{fg}	13.42 ^{cd}	19.21 ^{g}	31.5 ^{d}	27.0 ^{d}	12.12 ^{e}	2.0 ^{a}	17.0 ^{d}	8.0 ^{bc}	39.22 ^{cd}
Dipel-2x + 20GY	21.0 ^{abcd}	50.3 ^{e}	13.25 ^{cd}	21.4 ^{f}	28.3 ^{e}	26.9 ^{d}	13.83 ^{d}	2.0 ^{a}	15.1 ^{de}	9.8 ^{a}	38.25 ^{d}
Dipel-2x + 40GY	19.89 ^{cd}	54.5 ^{d}	12.33 ^{de}	25.9 ^{d}	26.7 ^{e}	21.5 ^{e}	15.74 ^{c}	2.1 ^{a}	12.5 ^{fg}	6.9 ^{cd}	36.22 ^{e}
Dipel-2x + 80GY	17.5 ^{e}	58.2 ^{c}	11.14 ^{e}	39.0 ^{c}	21.6 ^{fg}	17.2 ^{g}	18.0 ^{b}	2.18 ^{a}	11.1 ^{gh}	3.92 ^{e}	32.64 ^{f}
Spinosad	19.84 ^{d}	55.8 ^{d}	12.0 ^{de}	40.2 ^{c}	20.4 ^{g}	16.84 ^{g}	18.1 ^{b}	2.17 ^{a}	9.87 ^{h}	4.8 ^{e}	35.84 ^{e}
Dipel2x+Spinosad	13.0 ^{f}	61.8 ^{b}	11.6 ^{de}	49.4 ^{b}	17.0 ^{h}	14.24 ^{h}	20.22 ^{a}	2.2 ^{a}	8.13 ^{i}	3.91 ^{e}	28.6 ^{h}
Gamma irradiation doses											
5 Gy	20.3 ^{abcd}	46.5 ^{gh}	16.0 ^{ab}	17.21 ^{h}	40.2 ^{b}	33.0 ^{b}	6.904 ^{g}	2.0 ^{a}	23.3 ^{b}	7.7 ^{c}	40.3 ^{bc}
10 Gy	20.0 ^{cd}	46.9 ^{g}	16.2 ^{ab}	18.2 ^{gh}	38.3 ^{c}	29.2 ^{c}	7.123 ^{g}	2.0 ^{a}	19.4 ^{c}	7.8 ^{c}	40.2 ^{bc}
20 Gy	20.2 ^{bcd}	47.8 ^{fg}	16.4 ^{ab}	19.14 ^{g}	30.1 ^{d}	28.44 ^{cd}	9.978 ^{f}	2.1 ^{a}	16.7 ^{d}	9.64 ^{ab}	40.6 ^{bc}
40 Gy	20.1 ^{bcd}	48.8 ^{ef}	17.67 ^{a}	23.9 ^{e}	23.2 ^{f}	20.22 ^{ef}	11.11 ^{ef}	2.1 ^{a}	12.9 ^{e}	5.22 ^{de}	41.77 ^{b}
80 Gy	21.0 ^{abcd}	89.1 ^{a}	13.0 ^{cde}	68.6 ^{a}	-	-	-	-	-	-	38.0 ^{d}
Control (Check)	22.2 ^{a}	45.0 ^{h}	7.80 ^{f}	12.5 ^{i}	20.5 ^{g}	19.8 ^{f}	6.0 ^{g}	2.0 ^{a}	12.3 ^{fg}	5.5 ^{de}	30.3 ^{g}
L.S.D. $_{0.05}$	1.6725	1.6994	1.7365	1.7338	1.6117	1.6117	1.6117	0.6374	1.6117	1.6117	1.6725

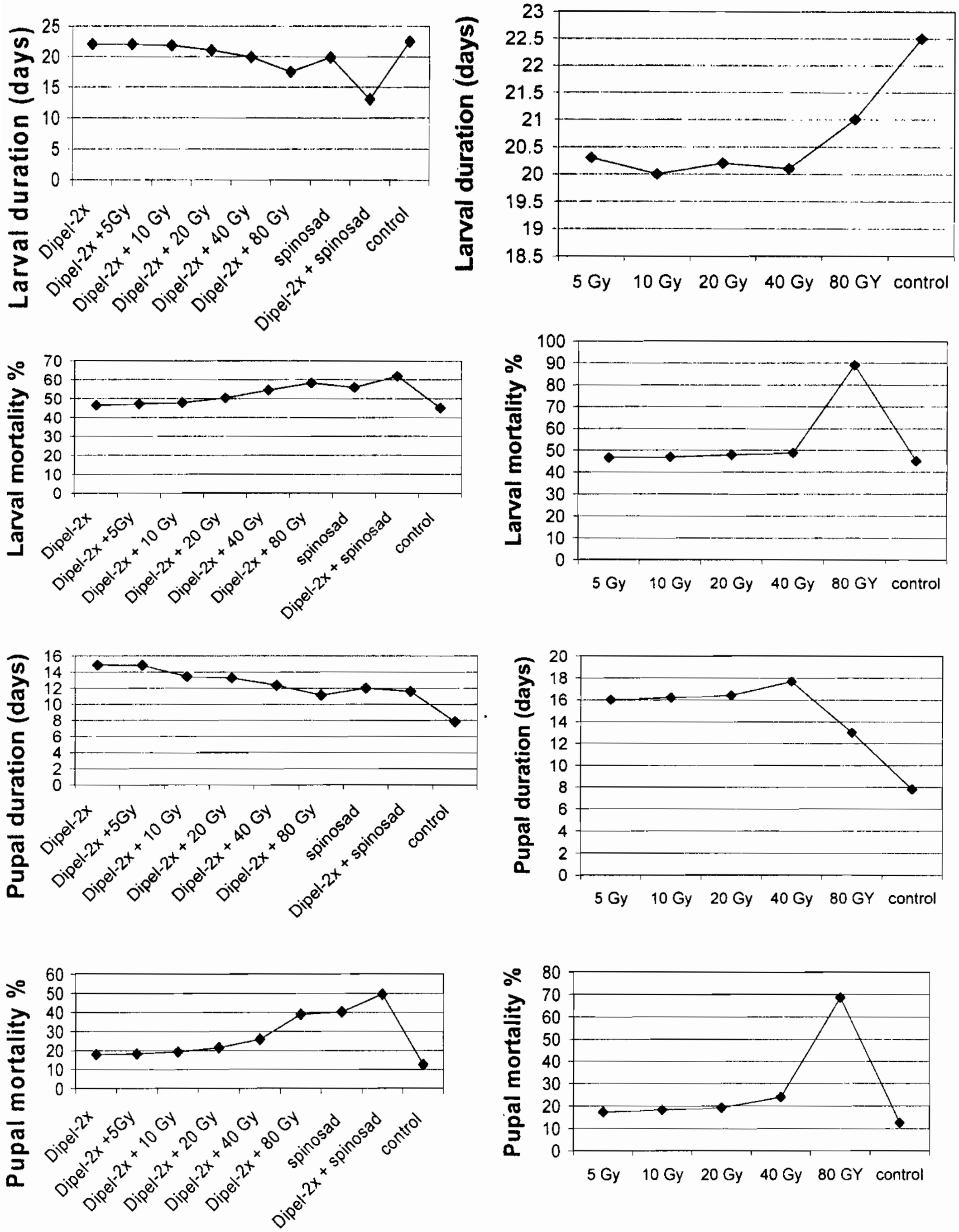

Fig. 1. Larval & pupal durations and mortality percentages of *P.gossypiella* treated as newly hatched larvae with LC_{50}'s of tested bio-insecticides and gamma irradiation doses.

2- Larval mortality percentage

As indicated in Table (1) and figure (1), gamma irradiation dose of 80 Gy had the highest percentage of larval mortality (89.1%), followed by Dipel-2x +Spinosad treatment (61.8%) when the pink bollworm treated as newly hatched larvae. Whereas, Dipel-2x and its exposure to 20,40&80 Gy of gamma irradiation, in addition to spinosad had a moderate latent effect on the larval mortality, where larval mortality ranged between 50.3 to 58.2%. Gamma irradiation doses between 5 to 40 Gy had larval mortality percentages of 46.5 to 48.8% which was near from the control value (45.0%). Also, Dipel-2x (46.4%) and its combination with gamma irradiation of 5 Gy gave (47.1%) and 10 Gy (47.8%), respectively.

3- Pupal duration

The newly hatched larvae of the pink bollworm treated by LC_{50}'s of Dipel-2x and its exposure to gamma irradiation doses, 5,10,20,40&80 Gy, in addition to Spinosad and Dipel-2x +Spinosad caused an increase of pupal duration as shown in Table (1) and figure (1). The pupal duration values ranged between 11.6 to 14.85 days. Gamma doses of 80 Gy gave 13.0 days. However, gamma irradiation doses of 5,10,20&40 Gy had the highest pupal duration values where ranged between 16.0 to 17.67 days compared with the control (7.80 days).

4- Pupal mortality percentage

Gamma irradiation dose of 80 Gy had the highest pupal mortality percentage (68.6%) when the pink bollworm treated as newly hatched larvae, followed by Dipel-2x +Spinosad (49.4%), Spinosad (40.2%) and Dipel-2x +80 Gy (39.0%) compared with the control pupal mortality (12.5%) as shown in Table (1) and figure (1). On the contrary with Dipel-2x treatment and its exposure to gamma doses of 5&10Gy and the same gamma doses alone gave the lowest pupal mortality percentages, where ranged between 17.21 to 19.21% compared with the previous compounds which gave the highest pupal mortalities. The other treatments of Dipel-2x +20 Gy and Dipel-2x +40 Gy, in addition to gamma doses of 20&40 Gy when used alone caused a moderate pupal mortality percentages compared with the other treatments aforementioned.

5- Adult longevity

<u>a- male adult longevity</u>**:** All the treatments used increased the male adult longevity of the pink bollworm initiated as tabulated in Table (1) and illustrated in figure (2) except

Dipel-2x +Spinosad treatment which shortened the male adult longevity compared with the check (20.5 days) or Spinosad treatment (20.4 days).

a- female adult longevity: The female adult longevity of the pink bollworm increased by all the treatments used except Dipel-2x + 80 Gy, Spinosad and Dipel-2x + Spinosad treatments.

6- Adult mortality percentage

Results presented in Table (1) and figure (2) showed that all the treatments increased the adult mortality percentage initiated from newly hatched larvae especially to Dipel-2x +Spinosad which was considered the most effective (20.22%). On the other hand, Dipel-2x treatment had low adult mortality (6.12%) that was near from adult mortality in the control (6.0%).

Table 1. and figure (3) illustrated the biological aspects of the pre-oviposition, oviposition and post-oviposition periods of the pink bollworm treated as newly hatched larvae as follows:

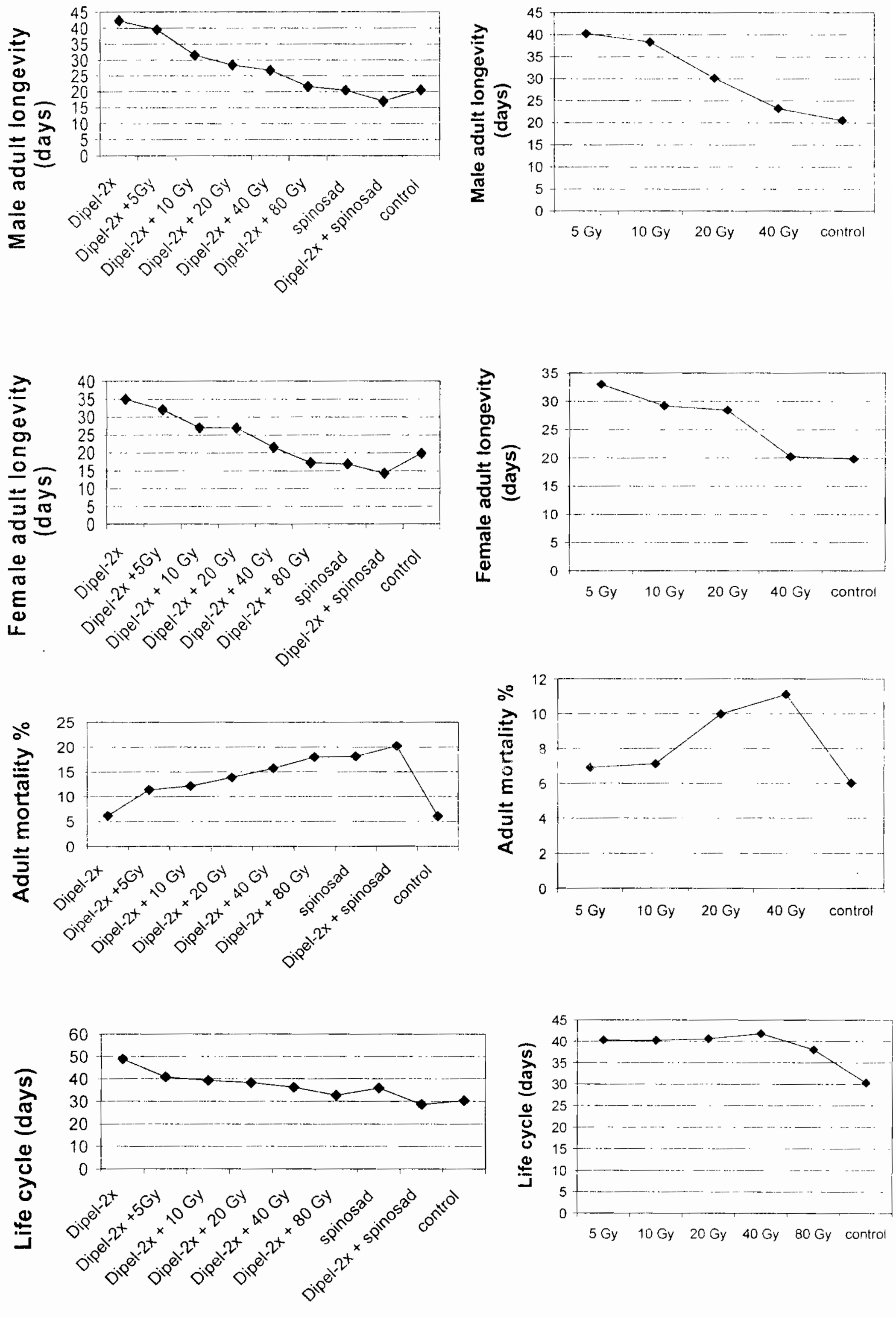

Figure 2. Adult longevity & mortality percentage and life cycle of *P.gossypiella* treated as newly hatched larvae with LC_{50}'s of tested bio-insecticides and gamma irradiation doses.

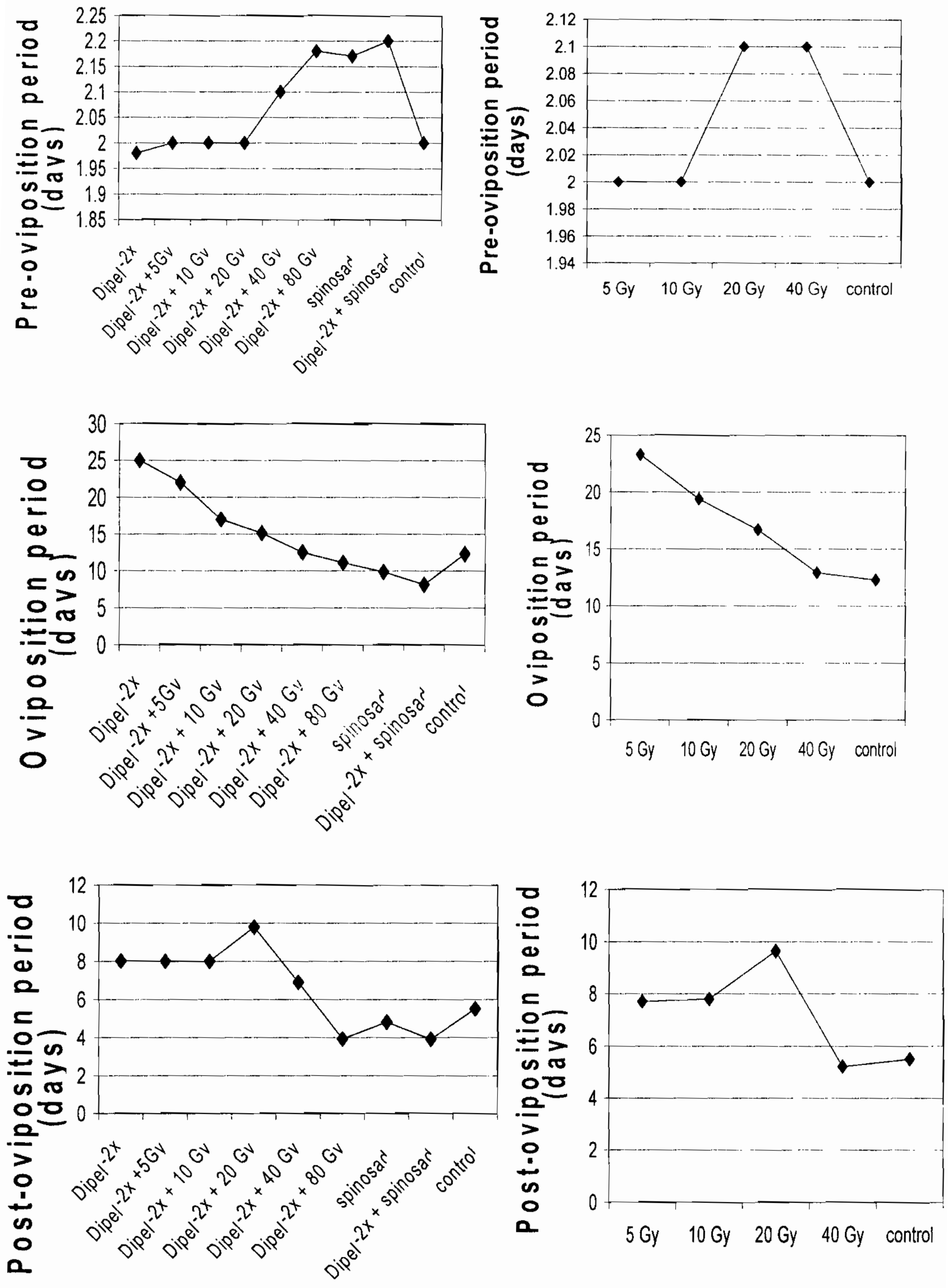

Fig. 3 Pre-oviposition, oviposition and post-oviposition periods of *P.gossypiella* treated as newly hatched larvae with LC_{50}'s of tested bio-insecticides and gamma irradiation doses.

7- Pre-oviposition period

This period increased to 2.2 days in Dipel-2x +Spinosad treatment, followed by Dipel-2x +80 Gy (2.18 days), Spinosad (2.17 days) and Dipel-2x +40 Gy which was 2.1 days, this value was similar to that of gamma doses, 20 & 40 Gy as compared with the control as well as the effect of gamma doses of 5 & 10 Gy and Dipel-2x combined with gamma irradiation of 5,10&20 Gy where the pre-oviposition period exhibited 2.0 days.

8- Oviposition period

Gamma doses treatments caused increasing effect on oviposition period especially with Dipel-2x combined with gamma doses of 5,10&20 Gy. Dipel-2x treatment had twice increase as compared with the control value (12.3 days). which near from the value of Dipel-2x + 40 Gy. Opposite with Dipel-2x + 80 Gy, Spinosad and_Dipel-2x +Spinosad decreased this period compared with the control.

9- Post-oviposition period

The obtained results had the same trend approximately was noticed to the oviposition period. All the treatments increased this period except Dipel-2x + 80 Gy, Spinosad and Dipel-2x +Spinosad as compared with the control value (5.5 days).

10- Life cycle

All the treatments estimated used elongated the life cycle of the pink bollworm treated as newly hatched larvae (this cycle estimate from egg stage until adult emergence) as shown in Table (1) and figure (2) as compared with the control (30.3 days). However, Dipel-2x +Spinosad treatment shortened the life cycle (28.6 days).

11- Egg laying rate

The untreated females were deposited 188.2 eggs/female (egg laying rate) as shown in Table (2) and figure (4). This value decreased with all treatments used. especially Dipel-2x +Spinosad (86.0 eggs/female) and gamma treatment of 40 Gy (96.33 eggs/female).

12- Egg hatching rate

Table (2) and figure (4) illustrated that all the treatments decreased the number of hatched egg/female (egg hatching rate) especially Dipel-2x +Spinosad and gamma doses of 40 Gy that had drastically decrease in egg hatching rate compared with untreated value (167.0 hatched egg). This result confirmed by Sallam and Mohamed (2003 & 2004) who showed that adult female of *E.insulana* when irradiated for 24 hour with 80 & 100 Gy, the egg hatching was significantly reduced than untreated.

13- Egg hatchability percentage

The percentage of egg hatchability was 88.7% for control. This value near from egg hatchability percentage recorded by Dipel-2x treatment (87.7%) (Table 2) and figure (4). On the other hand, the other treatments decreased the egg hatchability percentage.

14- Control of hatchability percentage

Dipel-2x +Spinosad (73.05%), followed by gamma dose of 40 Gy (70.16%) and Spinosad (64.07%) treatments caused the highest values. On the contrary, Dipel-2x had the lowest value (5.389%). The other treatments had control of hatchability percentage ranged between 16.17% to 58.08%).

15- Fecundity Percentage

Table (2) and figure (5) showed that Dipel-2x +Spinosad gave the fecundity percentage of adult females (45.7%) of the pink bollworm initiated from the newly hatched larvae treatments. Gamma doses of 20 & 40 Gy had a high reduction as well as Spinosad and ranged between 51.18 to 57.97%. These result could be confirmed by Sallam and Mohamed (2004) who showed that female fecundity of *E .insulana* when irradiated as 24h. with 80 & 100 Gy was significantly reduced.

16- Observed sterelity percentage

As shown in Table (2) and fig. (5), the untreated (check) had 11.3% observed sterility, this value near from Dipel-2x treatment which had the lowest observed sterility compared with the other treatments. Opposite trend with dose of 40 Gy (48.1%), followed by Dipel-2x + Spinosad (47.7%) and Spinosad (44.9%) had the highest observed sterility percentage. Another treatments had values ranged between 18.2 to 38.7%.

17- Corrected sterility percentage

Both of gamma dose (40 Gy) and Dipel-2x + Spinosad had the highest values of corrected sterility percentage of the adult female initiated from newly hatched larvae treatments of the pink bollworm (Table 2 and figure 5). On the contrary, Dipel-2x alone (1.127%) and its combination with gamma dose of 5Gy (7.779%) had the lowest percentage of corrected sterility. Another treatments had moderate values which were ranged between 13.19 to 37.88%.

Generally, the tested bio-insecticides and gamma irradiation doses could be classified into four categories depend on their latent effect on the biological aspects of the pink bollworm treated as newly hatched larvae as follows:

1- Dipel-2x had the lowest delayed effect.
2- Gamma irradiation doses of 5,10,20,40 & 80 Gy had a moderate delayed effect.
3- Dipel-2x exposed to gamma doses selected had a high delayed effect.
4- Dipel-2x + Spinosad, followed by Spinosad and Dipel-2x +80 Gy had the highest delayed effect on the most biological aspects.

Table 2. Egg production of *P.gossypiella* treated as newly hatched larvae with LC_{50}'s of tested bio-insecticides and gamma irradiation doses.

Bioinsecticides	Egg laying rate (No. of egg/ female)	Egg hatching rate(No. of hatched egg / female)	Egg hatchability %	Control of hatchability %	Fecundity %	Sterelity observed %	Corrected sterility %
Dipel-2x	180.2 ^{b}	158.0 ^{b}	87.7 ^{a}	5.389 ^{k}	95.7 ^{a}	12.3 ^{k}	1.127 ^{k}
Dipel-2x + 5 GY	171.1 ^{c}	140.1 ^{c}	81.8 ^{b}	16.17 ^{j}	90.9 ^{b}	18.2 ^{j}	7.779 ^{j}
Dipel-2x + 10GY	155.8 ^{d}	120.1 ^{d}	77.0 ^{c}	28.14 ^{i}	82.8 ^{c}	23.0 ^{i}	13.19 ^{i}
Dipel-2x + 20GY	153.4 ^{e}	115.0 ^{e}	74.9 ^{d}	31.14 ^{h}	81.5 ^{c}	25.1 ^{h}	15.56 ^{h}
Dipel-2x + 40GY	127.3 ^{hg}	85.0 ^{h}	66.8 ^{g}	49.1 ^{e}	67.6 ^{e}	33.2 ^{e}	24.69 ^{e}
Dipel-2x + 80GY	114.1 ^{i}	70.2 ^{i}	61.3 ^{i}	58.08 ^{d}	60.6 ^{f}	38.7 ^{c}	30.89 ^{c}
Spinosad	108.8 ^{j}	60.0 ^{j}	55.1 ^{j}	64.07 ^{c}	57.4 ^{g}	44.9 ^{b}	37.88 ^{b}
Dipel2x+Spinosad	86.0 ^{l}	45.0 ^{l}	52.3 ^{k}	73.05 ^{a}	45.7 ^{i}	47.7 ^{a}	41.04 ^{a}
Gamma irradiation doses							
5 Gy	132.1 ^{f}	95.0 ^{f}	71.9 ^{e}	43.11 ^{g}	70.2 ^{d}	28.1 ^{g}	18.94 ^{g}
10 Gy	129.8 ^{g}	90.1 ^{g}	69.3 ^{f}	46.11 ^{f}	68.97 ^{de}	30.7 ^{f}	21.87 ^{f}
20 Gy	109.1 ^{j}	70.1 ^{i}	64.2 ^{h}	58.08 ^{d}	57.97 ^{g}	35.8 ^{d}	27.62 ^{d}
40 Gy	96.33 ^{k}	50.0 ^{k}	51.9 ^{k}	70.16 ^{b}	51.18 ^{h}	48.1 ^{a}	41.49 ^{a}
Control (Check)	188.2 ^{a}	167.0 ^{a}	88.7 ^{a}	00.00	00.00	11.3 ^{k}	00.00
L.S.D. $_{0.05}$	1.6117	1.6117	1.6117	1.5485	1.5485	1.6117	1.5485

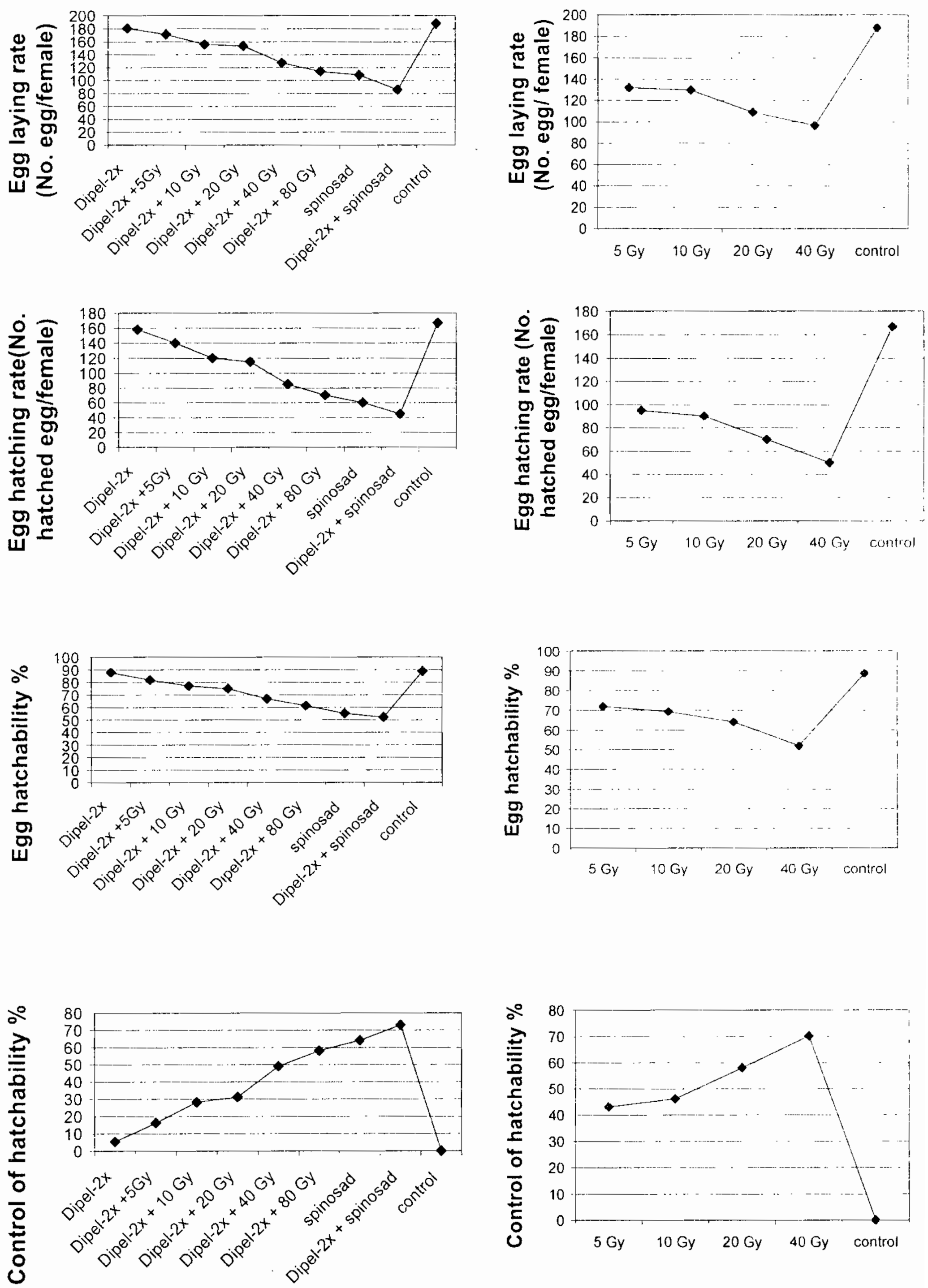

Figure 4. Egg production of *P.gossypiella* treated as newly hatched larvae with LC_{50}'s of tested bio-insecticides and gamma irradiation doses.

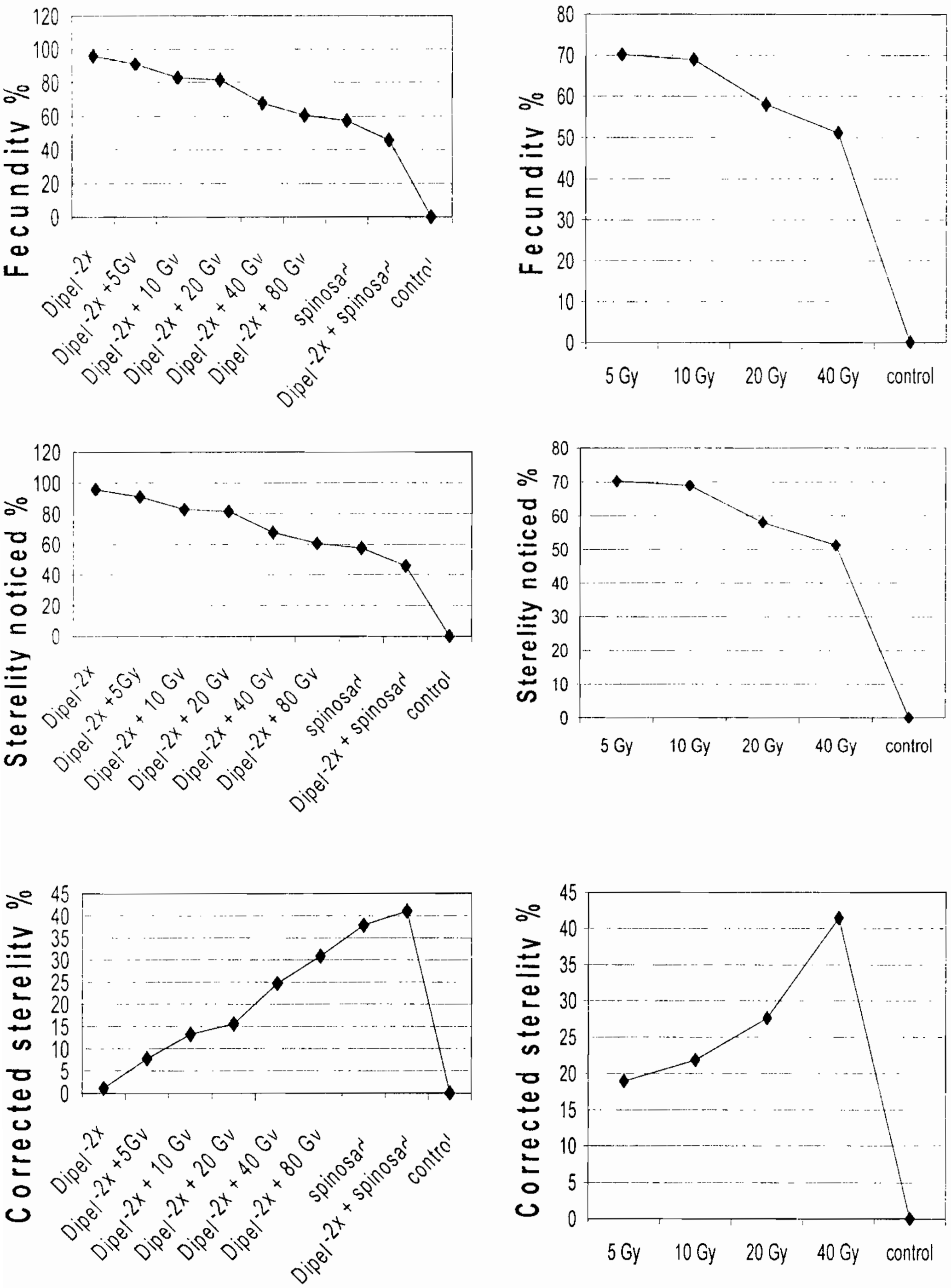

Figure 5. Fecundity and sterility (observed & corrected) of *P.gossypiella* treated as newly hatched larvae with LC_{50}'s of tested bio-insecticides and gamma irradiation doses.

REFERENCES

1. Abbott, W. S. 1925. A method of computing the effectiveness of an insecticide. *J. Econ. Entomol.,* 18: 265-267.
2. Amer, R. A. 2006. Combination of gamma irradiation with *Bacillus thuringeinsis* (Kurs.) and the synergestic effect of two bioinsecticide mixture for controlling the pink bollworm, *Pectinophora gossypiella* (Saund.) in cotton bolls. *J. Egypt. Ger. Soc. Zool. Vol. (51E):* Entomology 1-13.
3. Crystal, M. M. and L. E. Lachance. 1963. The modification of reproduction in insects treated with alkylating agents. Inhibition of ovarian growth and egg reproduction and hatchability. *Biol. Bull.,* 25: 270-279.
4. Deniz, S.and S. Kornosor. 1987. Determination of the effectiveness of *Bacillus thuringiensis* Berl. Against larvae of the corn earworm, *Heliothis armigera* Hon. (Lepidoptera: Noctuidae) damaging cotton. *Turkiye-I-Entomoloji-Kongresi-Bildirileri* 13-16.
5. El-Tantawy, M. A., A. M. Rashad, D. A. Ragheb and K. A. sabry. 2002. Resistence of the pink bollworm, *Pectinophora gossypiella* (Saund.) to the microbial pesticide *Bacillus thuringiensis. Egyptian Journal of Biological Pest Control,* 12 (2):119-123.
6. Ingram, W. R. 1994. *Pectinophora* (Lepidoptera: Gelechiidae). *Eds., Insect pest of cotton,* pp. 107. [illegible] wallingford, U. K.: CAB International.
7. Mohamed, H. F. 2002. Further studies on the effects of gamma irradiation on the spiny bollworm, *Earias insulana* (Boisd.). *Ph.D. Thesis, Ain Shams Univ., Plant protect. Dep.*
8. Rashad, M. A. and E. D. Ammar. 1985. Mass rearing of the the spiny bollworm, *Earias insulana* (Boisd.) on semi artificial diet. *Bull.Soc.Ent.Egypt,* 65: 239-244.
9. Sallam, H. A. and H. F. Mohamed. 2004. Inherited sterility induced in progeny of gamma irradiation males and females of spiny bollworm, *Earias insulana* (Boisd.), effect on fecundity, fertility and mating. *Proceedings of the Eighth Conference of Nuclear Sciences and Applications,* Vol II: 712-723.
10. Suharyono, S. and S. Sutrisno. 2002. Radiation induced sterility in the F1 generation. *Proceeding of Scientific Meeting on Research and Development of Isotops and Radiation Technology, Jakarta (Indonesia).* 401: 367-371.
11. Temerak, S. A. 2005. Spinosad, A new natural organic bioinsecticide to combat cotton leaf worm and bollworms in Egypt. *Egypt-J.Agric.Res.,* 83 (1).
12. Willcocks, F. C. 1916. The insect and related pests of Egypt. *Vol.1* The insect and related pests injurous to the cotton plant. *Part II.* The pink bollworm. *Cairo: Sultanic Agricultural Society.*

تأثير بعض المبيدات الحيوية و آشعة جاما على بعض الظواهر البيولوجية لدودة اللوز القرنفلية

رضا عبد الجليل محمد محمد عامر

معهد بحوث وقاية النباتات – مركز البحوث الزراعية – دقي– جيزة .

تهدف هذه الدراسة إلى تقييم بعض الظواهر البيولوجية لدودة اللوز القرنفلية بتعريض يرقات الفقس الحديث لجرعات من أشعة جاما ٥, ١٠, ٢٠, ٤٠، ٨٠ جراى و كذلك المعاملة بالتركيز النصفى المميت للمركب الحيوى دايبل منفردا أو بعد التعرض لجرعات أشعة جاما السابقة بالإضافة إلى المركب الحيوى سبينوساد منفردا و مرة أخرى مخلوطا مع الدايبل.

وقد إشتملت دراسة الظواهر البيولوجية على: فترة كل من الطور اليرقى و العذارى– النسبة المئوية لموت كل من الطور اليرقى و العذارى – فترة حياة الطور البالغ لكل من الذكور و الإناث – النسبة المئوية لموت الطور البالغ – دورة الحياه – فترات ما قبل وضع البيض ووضع البيض و ما بعد وضع البيض – معدل وضع البيض (عدد البيض/أنثى) – معدل فقس البيض (عدد فقس البيض/أنثى) – النسبة المئوية لكل من فقس البيض والتحكم فى الفقس و الخصوبة والعقم (الملاحظ – المصحح).

حققت معاملة الدايبل أقل تأثير متأخر لمعظم الظواهر البيولوجية و قد سجلت قيم قريبة من قيم المقارنة فى معظم الأحيان. و لكن عند تعريضه لجرعات أشعة جاما ٥, ١٠, ٢٠, ٤٠, ٨٠ جراى حدث زيادة فى التأثير المتأخر للظواهر البيولوجية خاصة عند تعريض مركب الدايبل لجرعات ٤٠ و ٨٠ جراى من أشعة جاما .

سببت جرعات أشعة جاما تأثيرا متأخرا متوسطا خاصة جرعات ٤٠ و ٨٠ جراى مقارنة بباقى الجرعات الإشعاعية المختبرة ٥, ١٠, ٢٠ جراى .

يعتبر مركب الدايبل + السبينوساد أفضل المعاملات التى سببت أعلى تأثير متأخر على الظواهر البيولوجية التى تم دراستها يليه فى ذلك معاملة السبينوساد.