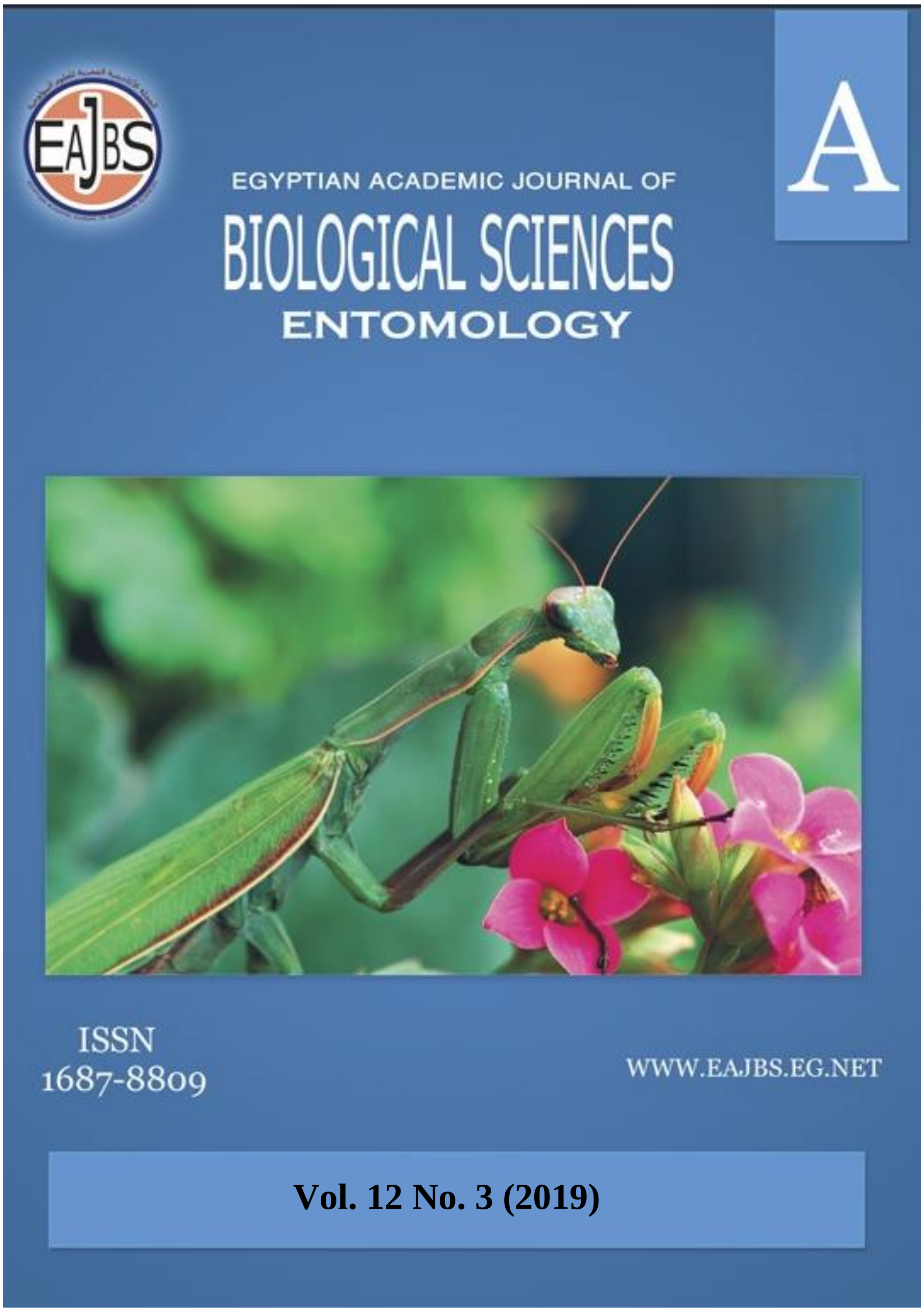

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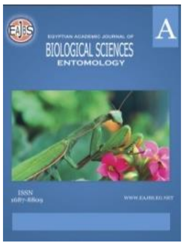

Comparison between Gamma Rays and Magnetic Flux Effects on Biological and Life Table Assays of *Earias insulan* (Boisd.) Eggs

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ABSTRACT

Under laboratory conditions, the spiny bollworm, *Earias insulana* (Boisd.) egg stage was exposed to two gamma rays (50&500 Gy) and magnetic flux (20&180 mlt) for studying some aspects of the pest act in biological and life table assays as affected by the treatments used. The results showed that:

Gamma rays dose of 500 Gy was the most efficacies on *E. insulana* egg compared with other treatments used. The aforementioned dose caused 19.3% egg hatchability and the larvae were completely dead at 1st or 2nd instar larvae of *E. insulana*. A dose of 50 Gy had a hatchability percentage (75%), but it caused the increasing larval mortality and completely pupal stage death. Meantime, magnetic flux of 180 mlt, followed by 20 mlt had many deleterious actions for biological and life table parameters in *E. insulana* treated as one day old egg, it caused the decreasing hatchability, larval & pupal weights, longevity, sex ratio and no. of egg/female; on the other hand, it caused larval and pupal mortalities increasing.

Life table parameters of *E. insulana* treated as egg affected by magnetic flux treatments. Female progeny/female (Mx), survival rate (Lx), net reproductive rate (Ro), intrinsic rate of natural increase (r_m) and finite rate of increase (e^{rm}) were decreased in both treatments. Meanwhile, generation time (T) and doubling time (DT) were increasing as affected by magnetic flux treatments as one-day old egg compared with untreated *E. insulana* eggs.

So, gamma-ray doses (50&500 Gy) treatments were the most efficacy against *E. insulana* egg stage than magnetic flux treatments (20& 180 mlt); but the magnetic flux caused severe deleterious on *E. insulana* biological and life table parameters.

INTRODUCTION

Earias insulana (Boisduval) (Lepidoptera: Noctuidae) is a serious insect pest, it causes a threat to cotton, okra, corn,. exc.). The larvae mainly feed on fruiting parts of many crops and vegetables causes top boring for the soft and growing tissues especially the terminal buds and later it attack the flower buds and bolls that ultimately shed (Khan, *et al.* 2007), resulting considerable losses in quantity and quality of crops.

Role of gamma irradiation and magnetic flux in response to stressful conditions (physical and chemical) in the insects studied by Amer (2016), Amer, *et al.* (2018) and Kandil, *et al.* (2018). It is well known that a magnetic field effects on some insect, development, behavior and life table were mentioned (Starick *et al.*, 2005, Said *et al.* (2017) and Kandil *et al*, 2018).

Radiation processing uses highly penetrating gamma radiation from sealed radiation sources traveling at almost the speed of light, the energy carried by the gamma radiation is transferred to the product being irradiated by collisions between the radiation and the atoms of the product. In these collisions, atoms lose their bound electrons in a process called ionization. It is this process that results in irreparable damage to the life-sustaining chemistry of living organisms and the initiation of cross-linking chemistry or main chair scission in polymeric materials (Aparecida and Aquino, 2012). Irradiating at doses of 5, 10, 20, 40 &80 Gy had efficiency against two stages of the harmful pink bollworm, *Pectinophora gossypiella* (Saund.); newly hatched larvae and eggs of 1-4 day old (Amer, 2016). Also, the newly hatched larvae of the pink bollworm, *P. gossypiella* exposed to aforementioned gamma doses caused many deleterious on all life table parameters compared to control (Amer, 2016).

Magnetic flux as a type of environmental pressure that consider affecting the number of biological systems (Starick *et al.*, 2005). The magnetic flux had an apparent effect on insect egg hatching; the hatching was delayed by the strong static magnetic fields and the delay non-Linearly increased with the intensity of the magnetic field. The larval development in the strong magnetic field was slower than in the geomagnetic field (Barrya *et al.*, 2017); meanwhile, the spiny bollworm, *Earias insulana* (Boisd.) adult stage field strain was exposed to two magnetic fields (28.6 & 2.21 mt). *E. insulana* adult female biological and life table aspects revealed that harmful on the most parameters compared to control (Kandil *et al*, 2018).

Aim of the present work is to examine the effects of two gamma-ray doses (50 & 500 Gy) and magnetic flux power (20 & 180 mlt) on some biological and life table parameters of *E. insulana* one day old egg.

MATERIALS AND METHODS

A. Insect Used: *Earias insulana* (Boisduval) (Lepidoptera: Noctuidae) egg stage susceptible laboratory strain of spiny bollworm (SBW) resulted from several generations rearing on artificial diet described by (Amer 2015) without any insecticides under the laboratory conditions at 26±10 ^{o}C and 75±5 RH at Bollworms Research Department, Plant Protection Research Institute, Agriculture Research Center.

B. Gamma Irradiation Treatments: Number of *E. insulana* eggs in vials was exposed to gamma irradiation doses of 50 & 500 Gy. Three replicate/ dose. All irradiations were done by a Cesium^{137} Hendy Cell Research, National Center for Radiation Research and Technology, delivered at a dose rate of 1.277 K.Gy/h.

C. Adjusting and Creating the Magnetic Flux:

1. Magnetic Power of 20 mlt. The magnetic flux as created by using small similar magnet pieces; 1.5 cm long for each (9 pieces mlt) that were arranged and fixed around the eggs inside the tubes with the strength of milli Tesla (mlt), that was measured with mille tesla meter apparatus (figure 1).

2. Magnetic Power of 180 mlt. The magnetic flux consists of two parts: Inside each of them eight magnetic pieces; each piece measured 30 milli-tesla power was arranged inside a row in an attractive position; the two rows were put together in parallel position (with 2 cm distance between) as shown in figure (1), that allows the magnetic power of 180 mlt. Insects (eggs stage) exposed to the magnetic flux power (180 milli-tesla) at 12 minutes. The adjusting and creating the magnetic flux used was measured in faculty of Engineering; Menofiya University using mille-tesla meters apparatus. Another, the group used as control (without any treatments).

Mille Tesla meter apparatus	Small similar magnet pieces	2 rows inside each row 8 magnetic pieces	Exposed *E.insulana* eggs to magnetic flux power

Fig.1. Adjusting and creating the magnetic field

D. Biological Aspects: Each egg treatment or untreated were examined daily to record the biological aspects as follows:

1. Egg stage: % hatchability, % mortality and egg duration (days).

Hatchability Percentage. It was calculated according to Zidan and Abdel-Megeed (1987) as follows:

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

Mortalities% were corrected according to Abbott's formula (1925).

2. Larval Stage: Duration (days), weight (g), % reduction in weight and % mortality.

Reduction %= % living in check-% living in treatment/ check X100 (Abbott, 1925).

3. Pupal Stage: % pupation, duration (days), weight (g), % reduction in weight and % mortality.

4. Moth Stage: Pre-oviposition (days), oviposition (days), post-oviposition periods (days), ♂ adult moth longevity (days), ♀ adult moth longevity (days), sex ratio (female/total), no. of egg/female, % hatchability, % fecundity and % sterility (observed and corrected).

Fecundity Percentage. It was calculated according to Crystal and Lachance (1963) as follows:

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

Sterility Observed and Corrected Percentages. Were calculated according to Zidan and Abdel-Megeed (1987) as follows:

% Sterility observed = 100 – Egg hatchability percentage

$$\% \text{ Corrected sterility} = \frac{\% \text{ Sterility observed - Check}}{100 \text{ - Check}} \times 100$$

The biological aspects were done in three replicate/ treatment and statistically analyzed with variance (ANOVA) [Costat satirical program, 1990] at least significant difference (L.S.D) test and the probability level P <0.05 was considered statistically significant by Duncan (1955).

E. Life Table Parameters: Data of life table were analyzed by using the life 48 basic computer program of Abou-Setta, *et al.*(1986). The program has output data include information for each interval of adult female age: Egg laying rate (M), number of females alive at age x (L), mean female age at each interval mid-point (X), female progeny per female produced during the day (Mx) and rate of survival (Lx). In addition, generation time (T), net reproductive rate (Ro), doubling time (DT), intrinsic rate of natural increase (r_m), finite rate of increase (e^{rm}) and a number of times that the population multiplies in a unit time (doubling time, DT).

RESULTS AND DISCUSSION

Earias insulana (Boisd.) one day-old egg stage was exposed to two gamma-ray doses of 50& 500 Gy and magnetic flux of 20&180 mlt to study the deleterious effects of treatments on some biological and life table parameters of *E. insulana* treated as eggs.

Egg Stage:

The percent of egg hatchability was 75 and 19.3% at both gamma-ray doses used (50 & 500 Gy), respectively; while, when exposed to magnetic flux of 20 & 180 mlt had 63.7 and 35% hatchability, respectively, compared with 91% hatchability in untreated. The dose of high gamma ray (500 Gy) was the most efficacy treatment followed by magnetic flux of 180 mlt used (Table 1).

Table (1). Impact of gamma ray and the magnetic flux on *E. insulana* 1-day old egg.

Treatments	Power used	Egg stage			
		Duration (Day)	Duration differences with control (day)	% hatchability	% Mortality
Gamma ray (Gy)	50	4^{ab}	+0.7	75.0^{c}	25^{c}
	500	6.3^{ab}	+0.7	19.3^{c}	80.7^{c}
Magnetic flux (mlt)	20	5^{ab}	+1.7	63.7^{b}	36.3^{b}
	180	6.6^{ab}	+3.3	35^{c}	65^{c}
Untreated	-	3.3^{b}	-	91^{a}	9^{a}
$L.S.D_{0.05}$		2.05	1.21	13.23	7.202

The egg mortality (unhatched eggs) was more highly percent in gamma radiation of 500 Gy (80.7%) followed by magnetic flux of 180 mlt (65%); meanwhile, the egg duration was elongated to double value nearly (6.3 and 6.6 days) at gamma radiation of 500 Gy and 180 mlt magnetic flux treatment, respectively compared with 3.3 days in untreated eggs.

Results indicated that gamma doses or magnetic flux influencing were the most drastic effects on one-day old egg of *E. insulana*. Amer (2016) showed that 2- day old eggs were more sensitive to gamma irradiation, the percent unhatched eggs ranged between 35.29-98.71% at 5- 80 Gy. Then the other ages of 1-day old and 3-day old eggs had moderate susceptibility to irradiation, the percent of unhatched eggs ranged between 14.89- 92.64% and 12.77- 90.76% for 5 - 80 Gy, respectively; while, 4- day old eggs had the least harmful effect ranging between 7.60- 20.28% for 5 - 80 Gy.

The previous data also could be confirmed by Sharabash (1996) who explained the mode of action by gamma irradiation effect on ATP compound consisting. In addition, gamma irradiation effect on phosphorylase oxidation. Pan (1996) reported that the biological effects of 7 T MFs on egg hatching of *Heliothis virescence* L. had delayed and hatching rate reduced.

Larval Stage:

That stage treated as one-day old egg had severe deleterious as a result of exposing to a dose of 50 Gy acts in elongation the larval duration (18 days) as well as 180 mlt treatment value (18.7 days). Also, dose of 50 Gy caused highly decreasing in weight (0.0057 g) reaching 87.6% and % mortality was 75.3%; followed by 180 mlt and then 20 mlt magnetic flux treatments (% reduction in weights were 36.7 & 30.4% and % mortality were 63.3 & 41.3%, for 180 &20 mlt, respectively) compared with untreated (8%) as in Table (2).

Table (2). Latent effect of gamma-ray and magnetic flux on *E. insulana* larval stage treated as a 1-day old egg.

Treatments	Power used	Larval stage				% Mortality
		Duration (day)	Duration differences with control (day)	Weight (g)	% Reduction in weight	
Gamma ray (Gy)	50	18[a]	+2.7[a]	0.0057[c]	87.6[a]	75.3[b]
	500	1.7[c]	-13.6[c]	-	-	100[a]
Magnetic flux (mlt)	20	16.7[ab]	+1.4[b]	0.032[b]	30.4[ab]	41.3[c]
	180	18.7[a]	+3.4[a]	0.0291[ab]	36.7[b]	63.3[ab]
Untreated	---	15.3[b]	-	0.046[a]	-	8[d]
$L.S.D_{0.05}$		2.49	1.31	0.0029	6.31	12.2

Amer (2012) showed that gamma-irradiation dose at levels of 0.5, 1.0 and 1.5 KGy caused hundred percent of mortality in diapauses larval mortality *P. gossypiella* (Saund.) larvae at the fifth day of treatment by 1.5 KGy and the tenth day in the infested cotton seeds exposed to 0.5 and 1.0 KGy. Also, the same author showed that a dose of 0.5 KGy was the best dose in decreasing the total protein of *P. gossypiella* larvae. Meanwhile, the same dose (0.5 KGy) increased acetylcholine esterase activation and gave the highest enzyme activity as compared to other doses used. In addition, Amer (2016) showed that γ- irradiation doses of 150, 250 and 350 Gy increased the newly hatched larval mortality of *P. gossypiella* to 52, 65 and 85% at zero-day, respectively. While, it was reached to 100% kill at third day for 350 Gy and the fifth day for 150 and 250 Gy. Larval mortality of *P. gossypiella* fourth instar was reached to 100% at eight and tenth days after radiation. Also, Wan *et al.*(2014), Said *et al* (2017) and Kandil *et al* (2018 &2019) stated that development stage of *P. gossypiella* , *E. insulana* larvae and/ or nymph of the brown *planthopper, Nilaparvata lugens*, were elongated and high increased the mortality when these insects exposure to the magnetic field.

Pupal Stage:

Pupal stage treated as one-day old egg by gamma-ray dose of 50 Gy had 58.8% pupation with a reduction of 90.9% in weight that had the lowest weight (0.0037 g); that pupae were very small and completely dead without any moth emergency as described in Table (3).

On the other hand, the magnetic flux of 180 mlt had 41.7% pupation; its weight was 0.024 g; in addition to 50% pupal mortality have occurred. Magnetic flux of 20 mlt effects on *E. insulana* pupal stage; the pupation was 62.7%; its weight was 0.030 g and 20% pupal mortality compared with untreated that had 92% pupation with a weight of 0.041 g and 8% pupal mortality as in Table (3). All the treatments elongated the durations as compared with normal pupae.

Said, *et al.* (2017) recorded that a high magnetic field increased the developmental period pupal stage of *P. gossypiella*. Also, Kandil, *et al.* (2018) found that when adult stage field strain *E. insulana* were exposed to magnetic fields (28.6 mt) caused increasing in different immature stages resulted. Matar, *et al* (2018) showed that when exposed of *E. insulana* pupal stage (1- day old pupae) to three magnetic levels (2.0, 10.0 & 24 mt) caused elongation in pupal duration and high reduction in adult emergence.

Table (3). Latent effect of gamma-ray and magnetic flux on *E. insulana* pupal stage treated as a 1-day old egg.

Treatments	Power used	Pupal stage					
		% pupation	Duration (day)	Duration differences with control (day)	Weight (g)	% Reduction in weight	% Mortality
Gamma ray (Gy)	50	58.8^{b}	11.3^{a}	+3.3^{a}	0.0037^{c}	90.9^{a}	100^{a}
	500	-	-	-	-	-	-
Magnetic flux (mlt)	20	62.7^{b}	9.6^{b}	+1.6^{b}	0.030^{a}	26.8^{c}	20^{ab}
	180	41.7^{c}	12.3^{a}	+4.3^{a}	0.024^{ab}	41.2^{b}	50^{b}
Untreated	-	92^{a}	8^{b}	-	0.041^{a}	-	8^{c}
L.S.D$_{0.05}$		5.99	1.61	1.12	0.0059	14.41	16.41

Moth Stage:

Table (4) showed that a normal adult moth pre-oviposition period was 2.97 days, it elongated to 3.9 and 6.33 days in 20 & 180 mlt magnetic treatments treated as one-day old eggs as mentioned in Table (4). The oviposition period of untreated was 13.13 days and closed to 8.33 and 6 days in two magnetic treatments (20 & 180 mlt). The post-oviposition periods were 5&3 days at 20 and 180 mlt magnetic treatments compared with check (1.67 days) as in Table (4). Male and female adult longevity were nearly close from untreated values nearly 1-2 days (Table 4). In addition, sex ratio (female/total) of normal moth was 0.48, the value decreased to 0.39 at 180 mlt and 0.44 at 20 mlt of magnetic flux as shown in the same table.

Table (4). Latent effect of magnetic flux on *E. insulana* moth stage treated as 1-day old egg.

Treatments	Power used	Moth stage					
		Pre-Oviposition period (day)	Oviposition period (day)	Post-oviposition period (day)	♂longevity (day)	♀longevity (day)	Sex ratio (♀/total)
Gamma ray (Gy)	50	-	-	-	-	-	-
	500	-	-	-	-	-	-
Magnetic flux (mlt)	20	3.9^{b}	8.33^{b}	5^{a}	12.93^{a}	17.23^{a}	0.44^{a}
	180	6.33^{a}	6^{b}	3^{a}	11.33$_{a}$	15.33^{a}	0.39^{a}
Untreated	-	2.97^{b}	13.13^{a}	1.67^{a}	13.87^{a}	17.77^{a}	0.48^{a}
L.S.D$_{0.05}$		2.08	3.46	3.329	7.941	7.629	0.106

Matar, *et al* (2018) showed that the adult stage of *E. insulana* exposed as pupal stage to three magnetic levels (2.0, 10.0 & 24 mt) were affected by increasing in pre-oviposition and post-oviposition periods in all treatments used; but the vice direction happened with oviposition period.

Table (5) cleared that normal no. egg/♀ was 220.7, it decreased to 176.3 egg/♀ at 20 mlt treatment when treated as 1-day old egg and had severely decreased to 60.67 egg/♀ at 180 mlt. The hatchability percent of a normal deposited egg was 91.7%; while, the hatchability percentages were 75.7 and 58.8% for 20 and 180 mlt of magnetic flux as in Table (5) that mean fecundity percent 79.88 and 27.49% for two magnetic treatments, respectively. Observed sterility was 24.3 & 41.2% and corrected sterility was 17.45 & 35.88% for aforementioned two treatments.

Table (5). Latent effect of magnetic flux on *E. insulana* fecundity and sterility treated as 1-day old egg.

Treatments	Power used	Moth stage				
		No. egg/♀	% Egg hatchability	% Fecundity	% Sterility observed	% Corrected sterility
Gamma ray (Gy)	50	-	-	-	-	-
	500	-	-	-	-	-
Magnetic flux (mlt)	20	176.3^{b}	75.7^{b}	79.88^{b}	24.3^{b}	17.45^{b}
	180	60.67^{c}	58.8^{c}	27.49^{c}	41.2^{a}	35.88^{a}
Untreated	-	220.7^{a}	91.7^{a}	100^{a}	8.3^{c}	-
L.S.D$_{0.05}$		38.77	5.028	4.159	3.996	4.894

Said, *et al.* (2017) recorded that a high magnetic field reduced the adult emergence of *P. gossypiella*. Also, the same authors found that high magnetic flux decreased the oviposition period for females of *P. gossypeilla* with the high reduction in total eggs laid. Whereas, when exposing the adults of *E. kuehniella* to increasing levels of MFs caused a high reduction in daily and total egg production with the reduction in progeny production (Pandir, *et al.* 2013). Moreover, Kandil, *et al.* (2018) found that *E. insulana* adult stage field strain when exposed to magnetic fields (28.6 & 2.21 mt) caused increasing in the pre-oviposition period as well as post-oviposition period; vice versa happened with oviposition period. The same trend found in adult female longevity and contrary in male adult longevity. Opposite, the eggs laying by treated adult female had severe reduction especially in high magnetic field treatment as well as fertility and fecundity. Moreover, Kandil, *et al.* (2019) indicated that there was a significant negative effect on the reproductive process and sometimes leads to the failure of the reproduction process when the adults of *P. gossypiella* exposed to a magnetic field of 14&18 mlt. Also, Matar, *et al* (2018), stated that total eggs laid /female had a high decreasing in the number to 116.0, 79.9 and 132.0 eggs, when exposed to magnetic power (2.0, 10.0 & 24 mt), respectively, compared to 216.0 eggs in untreated.

Life Table Parameters:

The relationship among the developmental responses and life table parameters was to clear for appearing the different responses and life history or eradication as affected by magnetic flux.

A.Female Progeny/Female (Mx) and Survival Rate (Lx):

Figure (2) demonstrated that normal *E. insulana* female progeny/female (Mx) ranged between 8 to 38.40; that value decreased between 4.40 to 33.27 and from 1.95 to 15.60 female progeny/ female at 20 and 180 mlt of magnetic flux when treated as one-day old egg.

Normal *E. insulana* rate of survival (Lx) ranged from 0.28 to 0.92 times as in figure (2). The Lx of *E. insulana* adult moths treated as 1-day old egg by exposing to 20 and 180 mlt of magnetic flux was from 0.15 to 0.76 and 0.17 to 0.58 times that observed sever decreasing than untreated.

B.Generation Time (T): *E. insulana* spent 32.73 and 39.36 days when treated as one-day old egg by exposing to 20 and 180 mlt magnetic flux as in Table (6) that showed increasing values compared with untreated (29.04 days).

C.Net Reproductive Rate (Ro): Magnetic flux at 20 and 180 mlt caused a high reduction in the female population in one generation (Ro: 58.85 and 13.79 females/female) when *E. insulana* treated as the 1-day old egg as described in Table (6) when compared with untreated value (96.8 females/female).

D. Increase Rate:

1. Intrinsic Rate of Natural Increase (r_m): The ability of inheriting increase in daily or intrinsic rate of natural increase (r_m) of untreated *E. insulana* was 0.157 times/female/day; that value decreased to 0.124 and 0.067 times/female/day when treated as 1- day old egg by exposing at two magnetic flux of 20 and 180 mlt (Table 6).

2. Finite rate of increase (e^{rm}). Normal of *E. insulana* daily population per female was 1.171 times/female/day as in Table (6). Magnetic flux treatment at 20 and 180 mlt impact on the finite rate of increase to reduce the daily population to 1.133 and 1.069 times/female/day (Table 6).

Table (6). Life table parameters of *E. insulana* treated as a 1-day old egg with magnetic flux power.

Treatments	Power used	T (days)	(Ro)	Increase rate		DT (days)
				r_m	e^{rm}	
Gamma ray (Gy)	50	-	-	-	-	-
	500	-	-	-	-	-
Magnetic flux (mlt)	20	32.73^b	58.85^b	0.124^b	1.133^b	5.590^b
	180	39.36^a	13.79^c	0.067^c	1.069^c	10.35^a
Untreated	-	29.04^c	96.8^a	0.157^a	1.171^a	4.415^b
L.S.D. $_{0.05}$		4.941	12.73	0.145	1.691	2.211

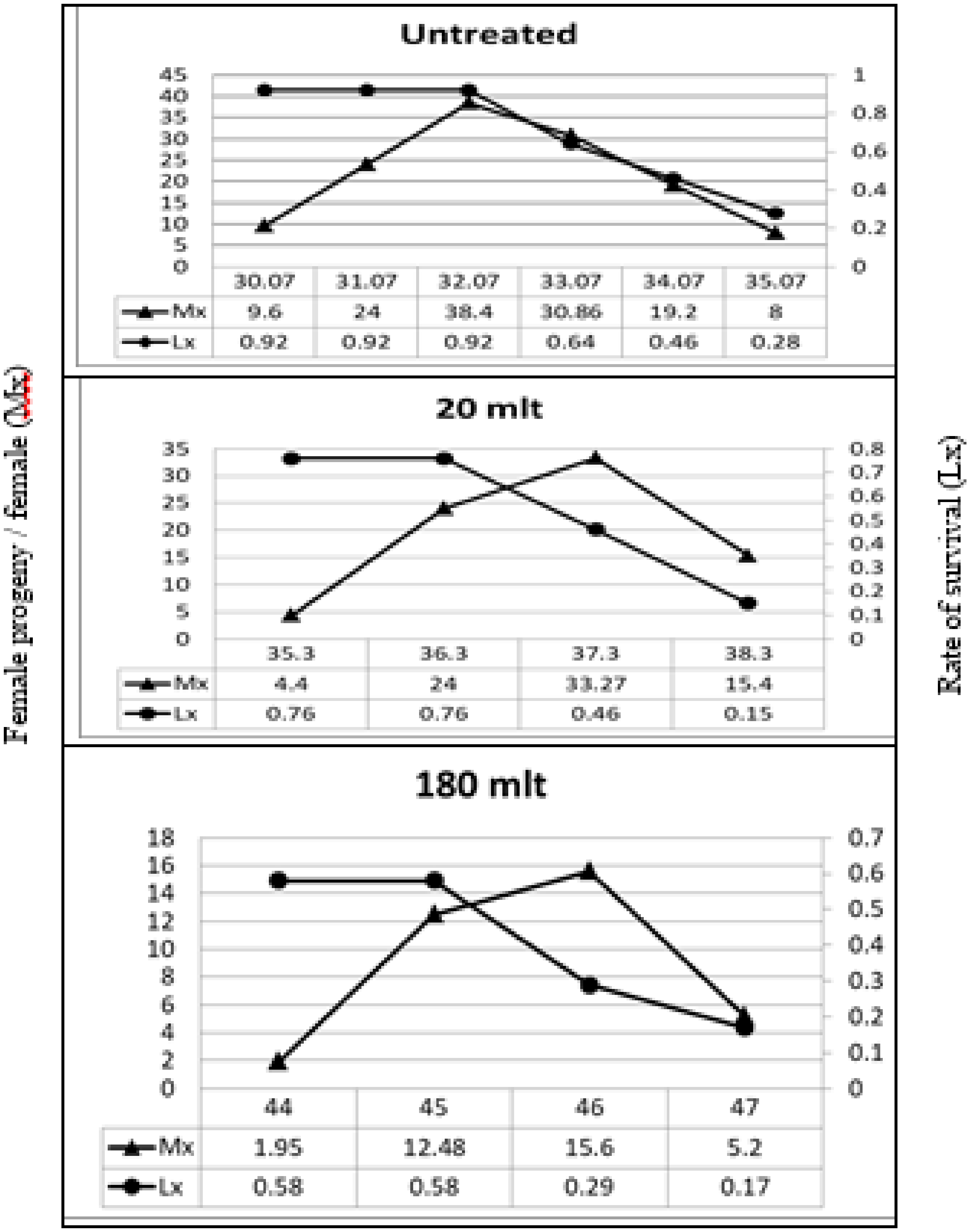
(T) = The generation time (Ro) =The net reproductive rate
(r_m) = The intrinsic rate of natural increase (e^{rm}) = The finite rate of increase
(DT) = The doubling time

E.Doubling Time (DT): Time that doubling the population or become twice (DT) was 4.415 days in normal *E. insulana*, while, the values were 5.590 and 10.35 days when treated as 1-day old egg by exposing to 20 and 180 mlt of magnetic flux.

Previous resulting adopted with Kandil, *et al.*(2018) who found under laboratory conditions, the spiny bollworm, *E. insulana* adult stage field strain were exposed to two magnetic fields (28.6 & 2.21 mt) to study some aspects of the pest acts in biological and life table assays as affected by the treatments used. Life table parameters of *E. insulana* affected by magnetic field treatments used. Female progeny/female (Mx), survival rate (Lx), net reproductive rate (Ro), intrinsic rate of natural increase (r_m), finite rate of increase (e^{rm}) and sex ratio had decreased in the most treatments. The contrary happened with generation time (T) and doubling time (DT) that had increased in the most treatments compared to control.

Generally, a dose of 500 Gy caused larval mortality at 1st and 2nd instars larvae; while, a dose of 50 Gy caused the delayed effect on *E. insulana* until pupal stage, causing the completely pupal mortality.

On the other hand, the magnetic flux of 20 and 180 mlt had a reduction in larval, pupal and adult moths in fecundity, fertility and longevity. Because of the magnetic field can not only affect the insect physiologic activities but also impact on their behavior, influence insect life and ecology more or less. On the other hand, the effect of exposure to MF on *E. insulana* includes no direct death, but shortened life expectancy, delayed exclusion in fecundity, reduced eggs laid exc., when exposure of insects to a certain power (Kandil, *et al*,.2018).



Untreated	30.07	31.07	32.07	33.07	34.07	35.07
Mx	9.6	24	38.4	30.86	19.2	8
Lx	0.92	0.92	0.92	0.64	0.46	0.28

20 mlt	35.3	36.3	37.3	38.3
Mx	4.4	24	33.27	15.4
Lx	0.76	0.76	0.46	0.15

180 mlt	44	45	46	47
Mx	1.95	12.48	15.6	5.2
Lx	0.58	0.58	0.29	0.17

Fig.2: Impact of magnetic flux power on the female progeny/ female (Mx) and rate of survival (Lx) of *E. insulana* moth treated as 1-day old egg.

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ARABIC SUMMARY

مقارنة بين تأثيرات آشعة جاما والمجال المغناطيس على القياسات الحيوية وجداول الحياة لبيض دودة اللوز الشوكية

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تحت الظروف المعملية عرض بيض دودة اللوز الشوكية إلى جرعتين من آشعة جاما (50 -500 جراى) واثنين من المجال المغناطيسى (20 -180 مللى تسلا) لدراسة بعض الظواهر الحيوية وجداول الحياة للآفة المتاثرة بالمعاملات السابقة.

أشارت النتائج أن جرعة آشعة جاما 500 جراى أظهرت أعلى تأثير على بيض دودة اللوز الشوكية مقارنة بالمعاملات الأخرى فقد سببت الجرعة سالفة الذكر فقس للبيض بنسبة 19.3% وموت يرقات دودة اللوز الشوكية بالكامل بعد يوم أو يومين من الفقس. أما الجرعة الإشعاعية 50 جراى أعطت نسبة فقس (75%) لكنها أدت إلى زيادة النسبة المئوية لموت اليرقات والعذارى بالكامل.

أظهرت مستويات المجال المغناطيس 180 مللى تسلا يليه فى ذلك 20 مللى تسلا تأثيرات مختلفة ظهرت فى القياسات الحيوية وجداول الحياة لدودة اللوز الشوكية المعاملة فى طور بيض عمر يوم تمثل فى خفض نسبة الفقس وأوزان الطور اليرقى والعذرى وفترة الحياة والنسبة الجنسية وعدد البيض/أنثى. كما حدثت زيادة ملحوظة فى موت الطور اليرقى والعذرى.

انخفضت بعض قياسات جداول الحياة المتمثلة فى عدد الإناث الناتجة/أنثى (Mx) وفترة البقاء (Lx)- معدل التناسل (Ro)- القدرة التناسلية الموروثة (r_m)- معدل الزيادة النهائى (e^{rm})- النسبة الجنسية وذلك فى معظم المعاملات. بينما زادت فترة الجيل (T) والفترة التى يتضاعف فيها الجيل (DT) وذلك بتأثرها بمعاملات المجال المغناطيسى (20 – 180 مللى تسلا) مقارنة ببيض دودة اللوز الشوكية الغير معامل.

لذلك حققت معاملات آشعة جاما (50 – 500 جراى) أعلى تأثير على بيض دودة اللوز الشوكية مقارنة بمعاملات المجال المغناطيسى (20- 180 مللى تسلا) ولكن الأخيرة أظهرت تأثيرات شديدة على الصفات الحيوية وجداول الحياة.