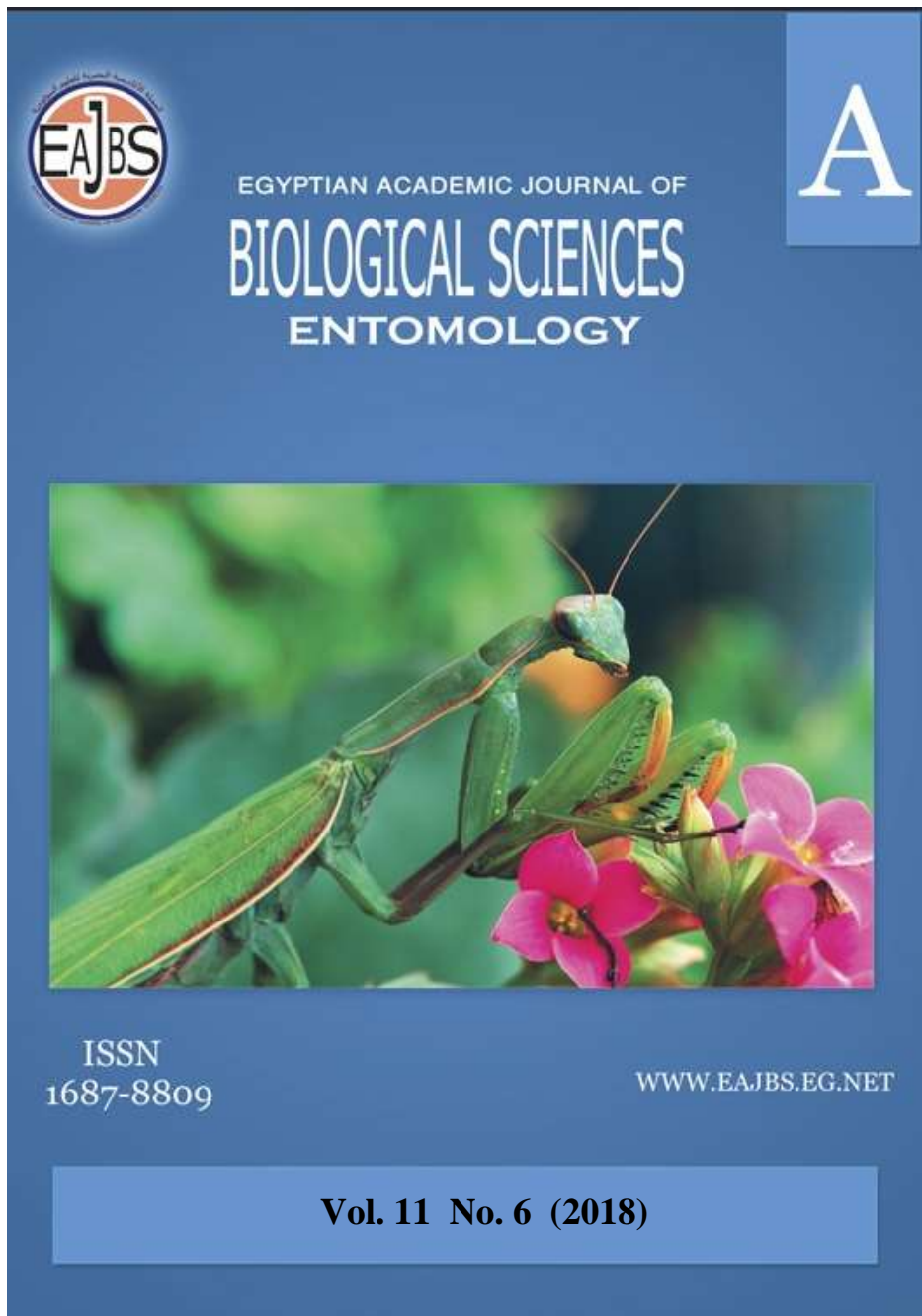


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Effect of Magnetic Power and Radiant Compound on Some Biological and Biochemical Aspects of *Earias insulana* (Boisduval) (Lep.: Noctuidae)

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ABSTRACT

Under laboratory conditions, the spiny bollworm, *Earias insulana* (Boisd.) pupal stage of laboratory strain were exposed to three magnetic levels (2.0, 10.0 & 24 mt) and half recommended compound of radiant, to study some aspects of the pest act in biological and biochemical assays as affected by the treatments used.

The results showed that the exposed of one-day old pupae for the three MFs and Radiant (compound) elongated the pupal duration of *E. insulana* compared with control. The pupal durations were 9.6 , 12.6 and 11.3 days/ pupae when exposed to three magnetic levels (2.0, 10.0 & 24.0 mt), respectively, and 12.6 days/ pupae with Radiant, compared with 8.3 days in control. The adults' emergence percentages were decreased to 89, 86, 77.0 and 67 % for three magnetic fields (MFs) and Radiant, respectively, compared with 98% for control.

Data obtained of *E. insulana* adult resulted from pupal stage treated with MFs or Radiant, revealed that increasing in pre-oviposition and post-oviposition period in the all treatments used; but the vice direction happened with oviposition period. It were 9.3, 7.3 5.6 and 8.2 compared with 12.5 days in control.

At the same times, the total eggs laid /female and hatchability percentages in adults resulted from all treatments were highly significantly affected compared with the untreated adults. These data indicated that the high decreased in number of eggs laid by females was estimated by 116.0, 79.9 and 132.0eggs, when exposed to magnetic power (MF2 &3) (10.0 & 24.0 mt), and radiant, respectively, compared to 216.0 eggs in control. In addition to the above, when sequence treatment adult resulted from pupal stage treated with 10.0mt (MF1) to a same power magnetic or fed on sequence fed on half recommend radiant cussed high reduction in number of eggs laid by females approximately from 2 to 4 times than control. some biochemical analyzes were performed to determine the som biochemical effect of the magnetic field on adults of *E. insulana*. The results showed high decreased estimated in levels of some key biochemical such as total proteins, total lipid and total carbohydrates contents that may be reflect the decrease in activities, also led to reduction in total eggs laid and decreasing in longevity adults.

INTRODUCTION

Earias insulana Boisduval. (Lep.: Noctuidae) is a major insect pest it causes a threat to cotton and is considered as mid-late season pest. The larvae mainly feed on fruiting parts of the cotton plant and okra, the soft and growing tissues especially the terminal buds and cause “top boring” and later on they attack the flower buds and bolls which ultimately shed (Khan, *et al.* 2007, Amer (2015) and Amer, *et al.* 2015), resulting in considerable losses in quantity and quality Gaaboub, *et al.* 2016)

Our previous investigations on the role of the magnetic field system in response and adaptation to stressful conditions (physical and chemical stressors) in the insects studied by (Mrd a ković *et al.* 2004). It is well known that a magnetic field effects on some insect orientation, development, behaviour (Proljic *et al.* 2003, Saiyed *et al.*, 2017 and Kandil *et al.*, 2018),.

The changes by the power or methods used the level of electro - magnetic fields with different stages of insects and behaviour studies by some authors' such as - When adults of *E. kuehniella* were magnetized, the longevity of the adults decreased at increasing levels of MFs. at LD₅₀ doses. Also (Jia *et al.* (2009 and pandir *et al.* (2013) they have recorded the effects of different the electromagnetic on all stages of insects and its behaviour, (Said *et al.*, 2017) recorded that the pink bollworm high reduction in total eggs laid when exposed to three levels of magnetic. Also, (Wan *et al.*, 2014) Recorded that the egg and nymph development of the brown plant hopper, *Nilaparvata lugens*, was delayed by exposure to the near-zero magnetic field

Radiant is a natural bio-insecticide offered a new mode of action and relatively safe on natural enemies, it play a significant role in control of different insect in field as a result of its novel mode of action (Bret *et al.*, 1997 and Temerak 2003), many authors' studied the effect of Spinosad or Radiant on different stages of insects such as *E. insulana*, *Spodoptera litturals* and *P gossypiella* (Al-Shannaf,. 2007, Al-Shannaf and Kandil, 2005 and Aydin and Gurkan, 2006

The aim of the present work was to examine the effects of three power magnetic fields and Radiant on pupal stage and latent effects on some biological and biochemical aspects of *Earias insulana* pest.

MATERIALS AND METHODS

Insect Used: *Earias insulana* Boisduval:

The pupal susceptible laboratory strain of spiny bollworm, *E. insulana* (SBW) have resulted from several generations rearing on diet described by (Amer, 2015) without any insecticides under the laboratory conditions at 26±1⁰C and 75±5 RH at Bollworms Research Department, Plant Protection Research Institute, Agriculture Research Center.

Materials Used:

Radiant SC12%:-

Common Name: - Radiant SC12% (Spinetoram), it is a new product from the spinosyns group with the same mode of action. It is a trademark of Dow Agro Science Co.

Paces of Magnetic:

Adjusting and Creating the Magnetic Power Used:

The magnetic field created by using a small similar magnet pieces as shown in (Fig. 1) which were arranged and fixed around the rearing cages (as demonstrated

below) with the strength of mile Tesla (mlt), which was measured with mile Tesla meter apparatus (Fig., 2) (Faculty of Engineering Menofiya University).



(Fig.,1)



(Fig.2)



(Fig., 3)

(Fig.,1) Pieces of magnetic (Fig. 2) apparatus of Mille Tesla meter (Fig. 3) the rearing cages

Treatment of *Earias insulana* Pupae:

In the experiment (one day old) of *E. insulana* pupal stage (180 individual) (divided to three groups each group 60 individuals) in 9 jars every jar 20 individual. The first group; three jars exposed to low magnetic flux (2.0 mlt in lower and 1.36 mlt in center jars), the 2nd group; three jars exposed to magnetic flux (10.00 mlt in lower and 2.33mt in center) and the 3rd group; three jars exposed to high magnetic flux (24.0 mlt in lower and 1.33mt in center) the pupal were inspected daily until adults emergence. The percent of adult emergence and sex ratio were determined. Newly emerged adults resulted of three treatments as well as the control were sexed and transferred to chimney glass cage (5pairs/cage). Each treatment was replicated three times.

Steps for Exposure Adults Resulted from Pupal Stage Magnetized (Exposed to Static Magnetic Fields):

The procedure for performing the magnetic experiment, the newly emergence adults resulted from the pupal stage exposed to magnetic flux (10.00 mlt in lower and 2.33mt in centre) were caged in pairs (male and female). 15 pairs of a newly emerged adult were replicated three times in glass cage and sequence exposed to the same magnetic pour (MFs) (10.0 mlt in lower and 3.33mt in centre) and kept under the previously mentioned rearing condition. Another, the group used as control (without any treatments). Each cage treated or untreated was examined daily to recorded the pre-oviposition, oviposition, post- oviposition periods and time required for longevity females and males for all treatment. Also, the number of eggs laid per female daily and the eggs hatchability percentages were estimated as follows:

No. hatched eggs

- $\% \text{ Egg hatchability} = \frac{\text{No. hatched eggs}}{\text{No. deposited eggs}} \times 100$

No. deposited eggs

- Fecundity percentage was calculated according to (Crystal and Lachance 1963).
- All experiments were carried out under laboratory conditions at 26 ± 1 °C and 65-70% R.H.

Biochemical Analyses: Samples for Biochemical Analyses:

Samples of *E. insulana* pupal tested were collected after 5 days from different treatment in pupal stages of *E. insulana*, homogenized in distilled water. The homogenates were centrifuged at 5000 r. p. min. at 5C⁰ in a refrigerated centrifuge. The supernatants' were kept in the deep freezer at -20C⁰ till used for biochemical assays.

The analyzed chemically for each stage accord in Physiological Dept. of Plant Protection Researches Institute, (P.P.R.I.).

Analyses Technique:

1- The colorimetric determination of total soluble protein pupae was estimated by the method of Bradford (1976)

2-, total lipids and carbohydrate in total homogenate *E. insulana* pupae was estimated by the method of Knight *et al.* (1972).

3- Evaluation the total Lipids were estimated by the method of (Knight *et al*1972).

RESULTS AND DISCUSSION

Effects of Magnetic Field on *E. insulana* Pupal Stage:

Results showed that used magnetic field at (MF) majored (2.0 mt. in lower and 1.21 mt. in centre jars), (10.0 mt in lower and 1.3 mt in center), and (24.0 mt in lower and 1.23 mt in centre), caused mortality and prolonged in pupal stage and reduced of adult emergence percent and increased the malformation of adult, Table (1).

Mortality Pupal Stage:

The mortality of *E. insulana* pupae recorded 11, 14 and 23% when pupae exposed to 2, 10and 24 mt, respectively. While, that percent high increased to 33 % mortality when pupae treated with Radiant compared with 2% mortality in control. These resulted agree with Pandir *et al.*, (2013) recorded the effects of MFs on the survival of a serious stored-product insect, *E. kuehniella* and at the highest level of MF (10 mT) complete mortality was obtained.

The Time Required for Pupal Stage Development for Formed Adults:

It is clear that the high tested MF and Radiant significantly prolonged the duration of the pupal stage approximately 1.3 to 1.5 times than that of the untreated (check). Table (1) recorded that *E. insulana* pupal duration were 9.6, 12.3, 11.3 and 11.6 days when exposed pupal stages with three power magnetic (MF1, MF2& MF3) and Radiant, respectively, compared with 7.3days in control.(Said *et. al.*, 2017) recorded that high magnetic fled increased the development period pupal stage of *Pectinophora gossypiella*. Also,(Kandil *et. al.* 2018) found that when adult stage field strain *Earias insulana* were exposed to magnetic fields (28.6 mt) cussed increased in different immature stages resulted.

Percent of Adult Emergence:

Data n Table (1) recorded that the decreased in percentages of adult emergence compared to control, it were 89, 86 and 77% adults resulted from treated one day old pupal stage with MF1 (2mt), MF2 (10 mt)and MF3 (24 mt), respectively, while, the percentages high reduction to 67 % adults emergence in Radiant compared to 98% in control. Said *et. al.*, 2017) recorded that high magnetic fled reduced the adult emergence of *Pectinophora gossypiella*.

Adult Malformed:

Data in Table (1) showed that, the malformation in adult emergence estimated by 10, 15 and17 % in adult resulted from treated with three magnetic pours

MF1, MF2 and MF3, respectively, while this percentage increased to 23% when pupal stage treated with Radiant, compared to 2.0% in the control.

Sex Ratio:

Table (1) illustrated that the treated with high MF shifted the sex ratio as it decreased the male and increased the females' ratio with two magnetic MF1 & MF2 and **Radiant** than that of high treated with MF and control, this percent was 4.6 females result from MF1 and 5.5 ratios / female on MF2, compared to 6.4 in control, respectively. In contrast, the sex ratio as it high decreased the female 24 times with high magnetic (24mt) MF3. The increased or decreased in six ratios may be due to deferent in mortality and malformed accorded in pupae during exposed to MF.

Table (1): Effect of MFs power on some parameter of pupal stage of *E. insulana*

Pupal stage					
Items	Control	MF1 (2mt)	MF2 (10mt)	MF3 (24mt)	Radiant SC12t
Duration in days	7.3±0.6	9.6±0.5	12.3±1.4	11.3±1.2	11.6±0.8
%Pupal mortality	2.0	11	14	23	33
% Adult emergence	98	89	86	77	67
%Adult malformed	2	10	15	17	23
Sex ratio ♀♀:♂♂	51:49	54:46	65:35	24:86	52:48

Oviposition Periods of Emerged Females:

Pre-oviposition, oviposition and post-oviposition periods, a total number of deposited eggs (fecundity) and the total number of hatching to larvae from the eggs (fertility) for the adults resulted from pupal stage exposed to MF1 (2mt), MF2 (10 mt) and MF3 (24 mt), and Radiant in comparison to the control were recorded in Table (1). As shown clearly in Table (2) that the pre-oviposition period was highly significantly increased when exposed to magnetic fields. The three magnetic fields caused considerable increased in female pre-oviposition period, this periods were 3.9 4.1 and 4.9 days, respectively, when females exposed to 2.21, 10 and 24 mt), respectively, but in case of Radiant treatment this period nearly equal to control, it estimated by 2.9 days compared with 2.6 days in control.

Analysis of variance of the results arranged in Table (2) proved that oviposition period of females exposed to different three tested magnetic flux caused high significant shortage of the oviposition periods, 9.3, 7.3, 5.6 and 8.2 days resulted from treated females exposed to (MF1), (MF2), MF3 and Radiant, respectively, while, it high decreased to 5.6 days with MF3, compared with 12.5 days in control (Table, 2).

Table (2): Effect of Mg power on some biological changes in *E. insulana* adults result from pupal exposed to magnetic Power

Biochemical aspects	Treated			Radiant	Control 11.3±0.4	LSD
	MF1	MF2	MF3			
Pre- oviposition	3.9±0.1	4.1±0.2	4.9±0.4	2.9±0.5	2.6±0.2	0.314
Oviposition	9.3±1.2	7.3±0.5	5.6±0.3	8.2±1.2	12.5±1.1	1.913
Post- oviposition	0.9±0.1	0.30±0.01	4.2±0.01	5.3±0.2	2.1±1.3±1.3	0.116
Longevity times (days) ♀♀	13.1±1.3	11.7±1.4	14.7±1.4	17.1±1.2	16.9±1.3.	1.211
Longevity times (days) ♂♂	9.0±0.9	7.0±0.2	9.0±0.3	12. ±0.2	14.3±0.4	0.326

Analysis data arranged in Table (2) proved that post oviposition period of females exposed to three tested magnetic flux caused the high significant shortage of the oviposition periods to 0.9 and 0.3 days/female resulted from females exposed to (MF1) and (MF2), respectively. But, on the high MF3 (24.0mt) and **Radiant** treated the oviposition periods increased to 4.2 and 5.3 days/ female respectively, compared to 2.1 days in control.

Adult Longevity:

As clearly shown from the data in Table (2) that females and males longevity of *E. insulana* resulted from pupal stage exposed to 2.21 mt 10.0 mt and 24.0 mt and Radiant highly significant affected by all treatment. It was clear that shortening the longevity of females and males resulted from pupal stage exposed to three magnetic, (MF1, MF2) these periods were 13.1, 11.7 and 14.7 days for females and 9.0, 7.0 & 9.0 days for males resulted from pupae exposed to MF1 (2mt), MF2 (10 mt) and MF3 (24 mt) treated, respectively, compared with 16.5/♀ and 14.1/♂ days in control. In contrast, this period increased to 17.1 days/ female with Radiant treated. Said, *et al.* (2017) found that the high magnetic flux elongated the pre and post- oviposition period for females of *P. gossypeilla* Kandil et al (2018), recorded that the magnetic power high significant effected on longevity female and males of *E. insulana* .

Table (3): Effect of Mg_s power on Fecundity and fertility changes in *E. insulana* adults resulted from pupal stage exposed to magnetic Power

Fecundity and fertility						
Items	Control	MF1	MF2	MF3	Radiant	LSD
Total eggs laid/♀♀ (fecundity)	216.0±4.5	169.0±4.9	116.0±3.4	79.9±5.3	132.0±4.1	4.751
No. eggs daily/♀	18.0	23.15	20.7	19.8	23.0	0.893
% Hatchability (fertility)	95	84	76	66	72	---

Female Fecundity and Fertility:

The results showed a significant reduction of the number of deposited eggs per each female (fecundity) resulted from pupal stage exposed to magnetic or Radiant compound. The mean numbers of deposited eggs were 169.0, 116.0 and 132.0 eggs/ female resulted from pupal stage exposed to 2.21 mt (MF1) and 10.0 mt (MF2) and Radiant compound, respectively. While, in case of using the high magnetic, it caused high significant decreased in total eggs laid to 79.9 eggs/ female resulted from pupae exposed to 24.00 mt (MF3), compared to 216 eggs/ females' for control, (Table, 3). Said, *et al.* (2017) found that the high magnetic flux decreased the oviposition period for females of *Pectinophra gossypeilla* with the high reduction in total eggs laid. In our study, when exposing the adults of *E. kuehniella* to increasing levels of MFs caused the high reduction in daily and total eggs production with the reduction in progeny production Pandira *et al.* (2013).

Effect of the Magnetic Field and Radiant on Adults Resulted from Pupal Stage Exposed to MF (2.0 mlt) and Sequins Treated with the Same Pours and compound:

The data in Table (4) recorded that post-oviposition period of females resulted from the (MF, 2.0 mlt) power magnetic or Radiant and sequence exposed to the same tested magnetic flux or Radiant caused the high significant shortage of the oviposition periods to 6.4 days/ female and 7.6days/ female with Radiant treated the compared to 12.5 days/ female in control.

The Total Eggs Laid/ Female:

The results showed a significant reduction in the number of deposited eggs/day per each female (fecundity) resulted from pupal magnetized with 2.0 mt and sequences exposed to the same power magnetic or Radiant compound and control. The mean numbers of deposited eggs daily were 9.5 eggs/ female magnetic and 8.3/ female fed on Radiant compound, compared with 18.0 eggs daily /female in control and the total number of deposited eggs laid / female were 52.0 and 98 eggs/ female when treated with (MF, 2.0mlt) and Radiant, respectively, compared with 216.0 eggs/ females' for control, (Table, 4)

Table (4) Effect of sequence treatment adult resulted from pupal stage treated with 2.21mtMF to a same poure magnetic

Fecundity and fertility						
Items	Oviposition Time/♀	No. eggs daily/♀	Total eggs laid/♀ (fecundity)	% Hatchability (fertility)	Longevity	
					♀♀	♂♂
Adult treatment	6.4±0.5	9.5±0.4	52.0±3.1	61	10.1±1.2	7.3±0.4
Radiant	7..5±0.5	8.3±1.3	98.0±4.9	69%	12.6±0.8	9.3±0.4
Control	12.5±1.1	18.0±.3	216.0±4.5	96	16.9±1.3	11.3±0.4
	0.256		3.641		0.945	0.246

The magnetic field can not only have an effect on the insect's physiologic activities but also impact their behaviour, influence insect's life and ecology more or less. On the other hand, the effect of exposure to MF on *E. insulana* adults includes no direct death, but, shortened life expectancy, delayed eclosion, in fecundity, reduced eggs laid etc., when exposure of insects to a certain power.

Physiological Parameter:**The Reduction in Total Soluble Protein, Total Carbohydrate and the Total Lipids:**

It is clear from the present data in the Table (5) pupal of *E. insulana* treated with two magnetic power MF1 (2.0mt), MF2 (10.0 mt) caused highly reduction in the level of total soluble protein to 12.8 and 9.8 (mg/g.b.wt) when pupae exposed to 2.0 and 10 mlt), respectively, compared to 17.57 (mg/g.b.wt control).

At the same time, the total carbohydrate estimated by 14.0 and 11.0 mg/g.b.wt/ when pupae exposed to 2.00 and 10.0mt, respectively, compared to 27.0 (mg/g.b.wt in control. On contrast the total lipid no affected on low magnetic (39.9 mg/g.b.wt) , but, high decreased to half time (21.0 mg/g.b.wt) with high magnetic (10.0mt), on the other hand, the same trend, when pupae treated with Radiant the total protein (39.9 mg/g.b.wt), carbohydrate (21.0 mg/g.b.wt), and total lipid estimated by (31.0 mg/g.b.wt) compared with 41.0 mg/g.b.wt in control

Generally; considerable, the total protein, lipid and carbohydrate contents were necessary for energy, and fecundity of different stages of insect especially pupal stage which necessary to adults formed and the decreased in protein or lipid or carbohydrate contents that may be reflect the decrease in activities, reduction in content in adult during formed from pupae, also led to reduction in total eggs laid and decreasing in longevity adults, these resulted agreement with (Velide, 2012 and Kandil *et al* 2018) they recorded the significant decrease in the carbohydrate and total protein content in *E. insulana* due to degradation into amino acids as they contribute to energy in insect when also high reduction in eggs laid compared with the control. Yim and Jeong, (2006) demonstrated the effects of MFs on the

modulation of ion fowl interference with DNA synthesis and RNA transcription, also, high affected on protein formation. (Jia *et al.*, 2009) recorded the effect of MF on reduced total carbohydrate and α -amylase activity.

Table (5): Some biochemical changes in *E. insulana* pupal stage exposed two magnetic Power

Biochemical aspects	MF1 (2ml)	MF2 (10ml)	Radiant	Control
Total protein(mg/g.b.wt)	12.8±0.24	9.8±0.4	14.0	17.57± 0.26
Total carbohydrate(mg/g.b.wt)	14.0±1.9	11.0±1.2	19.3	27..0± 1.25
Total lipid(mg/g.b.wt)	39.9±2.1	21.0±0.9	31.0±1.6	41.0±1.3

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ARABIC SUMMERY

تأثير القوى المغناطيسية علي بعض الصفات البيولوجية و البيوكيميائية لدودة اللوز الشوكية

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تم استخدام المجال المغناطيسي الثابت و كذلك استخدام احدي المركبات الحيوية (الرادينت) لدراسة مدي تغير بعض القياسات البيولوجية و البيوكيميائية في دودة اللوز الشوكية عند استخدام ثلاث قوي (مستويات) مختلفه من المجال المغناطيسي:مستوي عالي (٢٤ مللي تسلا) و مستوي متوسط (١٠,٠ مللي تسلا) و اخرمنخفض (٢,٠ مللي) و ايضا استخدام الجرعه النصفية لمركب الرادينت.

و قد تمت الدراسة بتعريض العذارى عمر يوم للمعاملات المختلفه و متابعه الاثر المتأخر لهذا التعريض على الفراشات الناتجة. وعند تعريض العذارى تحت الدراسة للمستويات السابقه اظهرت النتائج تأثيرا واضحا و مباشرا على العذارى المعاملة حيث سببت زياده نسبة موت لعذارى و اطاله عمر العذارى كما ادي الي خفض في نسب الفراشات الناتجه الي ٨٩ و ٧٧ و ٦٧ % مقارنة بالكنترول (الغير معرضة) ثم تم متابعه الفراشات الناتجه من كل معاملة علي حدي لمعرفة التأثير المتأخر للقوى المغناطيسيه و المركب الرادينت فقد سجلت النتائج الاتي:

حيث انخفض عدد البيض و كذلك النسبة المئوية للفقس لكل الفراشات الناتجه من العذارى المعاملة لكلا المستويات المستخدمه (٢٤ و ١٠ و ٢ مللي تسلي) و مركب الرادينت و كان المستوي العالي من المجال المغناطيسي اكثر تأثيرا في خفض عدد البيض/انثي حيث انخفض البيض علي القوي ١٠ و القوي ٢٤ و كذلك الرادينت الي ١١٦ و ٧٩,٩ و ١٣٢ بيضه لكل انثي بالتالي ادت المعاملات الي انخفاض النسبة المئوية للفقس. كما اظهرت النتائج ايضا تاثيرا واضحا في طول عمر الاناث و الذكور الناتجه من العذارى المعرضه للقوي المغناطيسية (الممغنطه) مقارنة بالكنترول حيث انخفضت هذه الفترة بشكل عام في كلا من الذكور و الاناث و كان الانخفاض كبيرا لكلا الجنسين الناتجين من العذارى المعرضه للمجال المغناطيسي العالي . و بناءا علي النتائج السابقه تم اجراء بعض التحاليل البيوكيميائية لتفسير النتائج السابقه . حيث اظهرت النتائج انخفاضا واضحا في نسب كلا من البروتين الكلي الكربوهيدرات –الدهون الكلية –، وهذا يفسر الانخفاض الواضح في كميات البيض الموضوعه من الاناث الناتجه من العذارى الممغنطه و المركب المستخدم مقارنة بالكنترول.