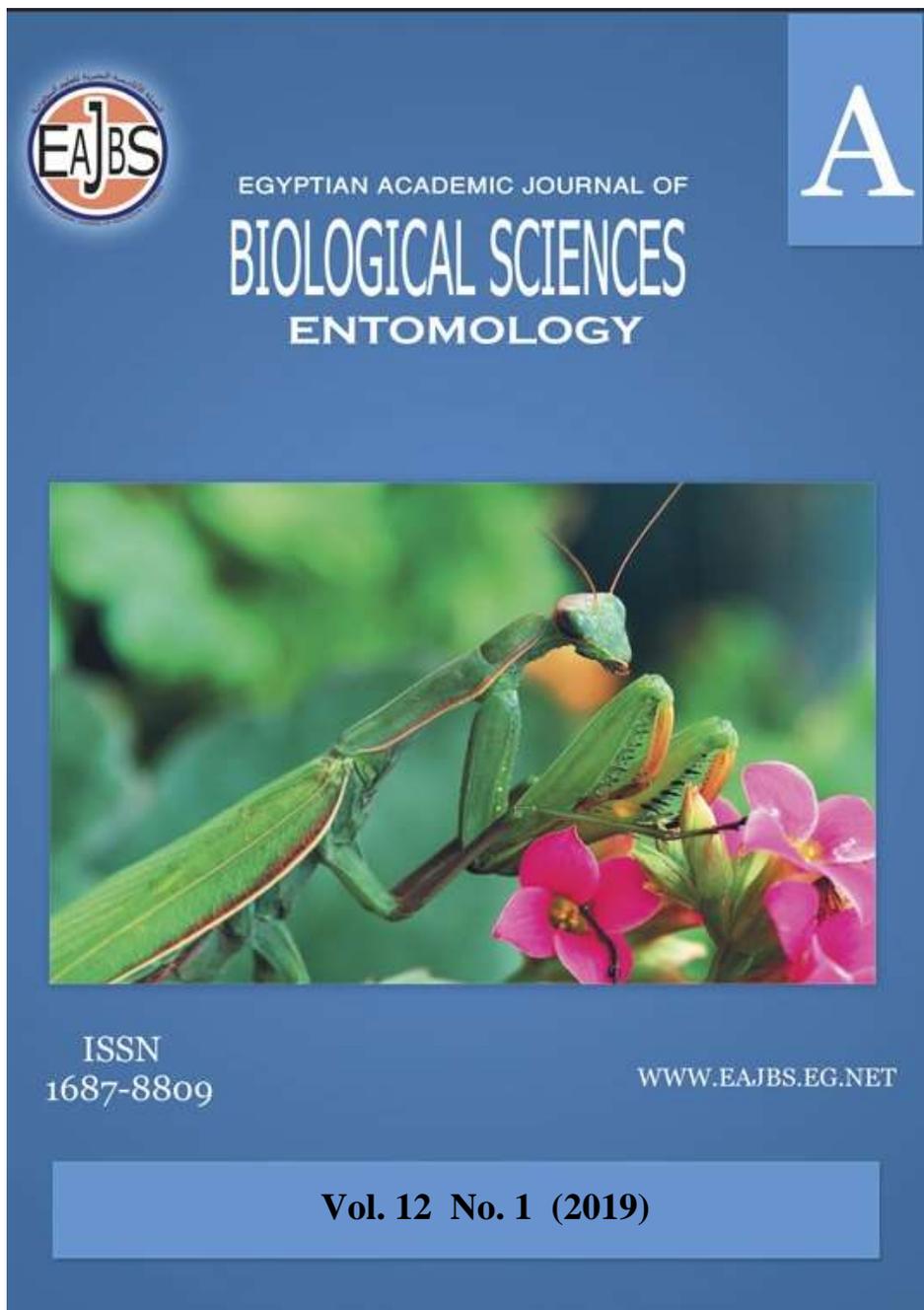


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Effect of Magnetic Ferro- Solution on Some Biological Aspects of *Pectinophora gossypiella* (Lepidoptera: Gel.)

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ABSTRACT

This study investigated the effects of four compounds included Sea- water (compound-1), Sea – water +magnetic + traces of (mixture) pure ferrous sulphate ($\text{FeSo}_4 \cdot 7 \text{H}_2\text{O}$) and ferric chloride ($\text{Fe cl}_3 \cdot 6\text{H}_2\text{O}$) 1:1 (compound-2), Sea – water +magnetic+ full saturation with mixture 1:1(compound-3), and match (IGR(compound-4), on survival, and reproductive parameters of *Pectinophora gossypiella*, The results showed that the mortality percentages and fecundity of *P. gossypiella* were significantly affected by all treatments. In females or male , the longevity was decreased when females were exposed to (compound-2 and 3) , while, this period prolonged when treated with Match. The treatments declined significantly the times of adults longevity to 13.3, 10.0, 8.0 and 18.9 days/ female and 9.6, 7.3, 4.3 and 13.0 days / male, respectively, when the adults of *P. gossypiella* treated with the different compounds of Sea- water, Sea – water +magnetic + traces of mixture 1:1, Sea – water +magnetic+ full saturation with mixture 1:1and match (IGR), respectively, compared to 14.5days/ untreated female and 11.3 days/ untreated males.

At the same times, the total eggs laid /female and hatchability percentages in adults fed on all treatments were highly significantly affected compared with the untreated adults. These data indicated that the high reduction in eggs laid by females was estimated by 68.57 and 60.73 % with Sea – water + magnetic+ full saturation with mixture 1:1 and Sea – water + magnetic+ traces of mixture 1:1, against, followed by 46.3% with IGR compared with control. At the same trend, was noticed in hatchability percentages.

INTRODUCTION

The pink bollworm (PBW) *Pectinophora gossypiella* (Saunders) (Lepidoptera: Gelechiidae) is a major cotton pest in different countries as well as the Arab Republic of Egypt. Electric magnetic fields are pervasively present in the environmental factors and through natural occurrence (Lohag and Nahyoon 1995).

The use of magnetic fields (MF) in some studied on insects are becoming increasingly important, thus, the number of experimental and theoretical research projects is continually increasing. The research laboratories studied by many authors

Such as; the percent of mortality (Ramirez, *et al.*, 1983), studies on development and viability (Biljana *et al.*, 2001), investigation on behavior and metabolism (Pan *et al.*, 2004) studies on longevity and fecundity (Said *et al.* 2017). Others have been studied for many years under the exposure of magnetic fields. Also several researchers have reported the effects of strong magnetic fields with different intensities on the flight behavior and malformed of insects. The intensity of the magnetic field varied in a big range. Redstarts, *Phoenicurus phoenicurus*, can orient in a true –zero magnetic field of ± 50 nT (Mouritsen, 1998). But, the feeding adults on some compounds treated with magnetic field didn't study until this time. But some authors effect of some menials on many insects such as; Zinc and copper connect to the cytosol metallothionein in the midgut of many organisms, but at high concentrations could be toxic (Jensen and Trumble, 2003) also, (Sun *et al.* 2011) recorded that the effect of a high concentration of nickel in *Spodoptera litura* Fabricus reduced IGR but a low concentration of nickel increased IGR. (Huang *et al.* 2012 and). Baghban, *et al.* 2014) Studied the effects of the heavy metal Cu²⁺ and Cd, Cu, and Zn on growth, development, and population dynamics of *Spodoptera litura* and *Helicoverpa armigera* (Lepidoptera: Noctuidae

The chitin synthesis inhibitor match (CSI) introduced as an insecticide was benzoyl- phenylurea was a potent compound against the arthropod. Most CSI is primarily used as larvicides. For example when the 1st instar larvae of *P. gossypiella* was treated; the larvae can develop until molting, but in some cases, the larvae failed to ecdyse due to inhibition of the synthesis of new cuticle or caused prolonged the larvae duration and inhibit the larvae to pupae ecdysis (Kandil *et al.* 2013), also, Said *et al.* (2017) recorded that Teflubenzuron (CSIs) caused high prolonged in larval with surprising the molting for *P. gossypiella*.

The objective of this study was to evaluate the effect of some magnetic ferro-solution on reproduction, fertility and behavior of *Pectinophora gossypiella*.

MATERIALS AND METHODS

Materials Used:-

- 1- Natural salt Sea- water.
- 2-Magnetic Sea – water with traces of mixture (2.5g/l) of Ferro- salts mixture 1:1
- 3- Magnetic Sea – water with traces of mixture (50g/L) of Ferro- salts mixture 1:11
- 4- IGR

Trade Name: Match (5% E.C.)

Chemical Name: N-[2,5 d:chloro-4-(1,1, 2,3,3,3- hexafluoropropoxy)phenyl] amino]carbonyl]- 2,6-difluorobenzamide.

- 5- Distilled water as a control

Insect Used:

The laboratory strain of *P. gossypiella* was reared for several generations under the laboratory conditions at $26 \pm 1^{\circ}\text{C}$ and 75 ± 5 R.H. at Bollworms Research Department, Plant Protection Research Institute, Agricultural Research Center according to Rashad and Amer (1985).

Procedure:

To study the activity of four materials; Sea- water 50mL, Magnetic Sea – water with traces of mixture (2.5g/l) of ferro- salts mixture 1:and Magnetic Sea – water with traces of mixture (50g/L) of ferro- salts mixture 1:1and Match (5% E.C.) (CSIs) against *P. gossypiella* adults. The concentrations were freshly prepared for the stock solution of each compound following as; 25 gm of pure ferrous sulphate

(FeSO₄. 7 H₂O) and 25gm of ferric chloride (Fe cl₃. 6H₂O) dissolved in 1 liter of sea water (of naturally contains 35 gm / liter salts, mainly 86% Nacl in addition to other different cation and anions: (Table,1). The solution then kept in a glass bottle; a static long magnet (22cm) was vertically fixed in the bottle through inside the water from up to the bottom. The magnet composed from 24 small similar magnet pieces each of (2cm long) with 14- 18 ml. tesla power. The solution was kept in the laboratory for 24 hours before using it for treatment. Control bottle was left without magnets and placed for 1 meter in distance far from the treatment.

Effect of Different Compounds on the *P. gossypiella* Adults:

The newly emerged moths resulted from the laboratory strain of *P. gossypiella* were sexed and transferred to chimney glass cage (15pairs /cage). It was replicated three times for each treatment.

The moths were fed on different treatment as a follows:

- 1- The 1st group fed on Sea- water 50ml for 48 hr.
- 2-The 2nd group fed on Magnetic Sea – water with traces of mixture (2.5g/l) of ferro- salts mixture 1:1 for 48hr.
- 3-The 3rd group fed on Magnetic Sea – water with traces of mixture (50g/L) of ferro- salts mixture 1:1 for 48 hr.
- 4- The 5th were fed on 20% sucrose solution.+1/2 recommend the Match (5% E.C.) equal 25 ppm for 48hr
- 5-The 5th group fed on 20% sucrose distilled water as a control.

Table (1): Sea water contents of cations and anions.

Items	cat ions and anions	Percentage (%)
Chloride	Cl ⁻	55.29
Sodium	Na ⁺	30.80
Sulphate	So4 ⁻	7.75
Magnesium	Mg ⁺⁺	3.67
Calcium	Ca ⁺⁺	1.18
Potassium	K ⁺	1.14
Bicharbonate	Hco ₃	0.36
Bromide	Br ⁻	0.19
Boron	B (OH) ₃	0.07
Stranchum	Sr ⁺⁺	0.02
Floride	F ⁻	0.004

Observation the Adults' Cages:

Cages were examined daily to record pre oviposition, oviposition and post-oviposition periods and the numbers of eggs laid/female, the percentage of hatchability (fertility) and calculated the females and males longevity for each treatment. Laid eggs were counted and incubated under controlled conditions to estimate the egg hatchability percentage and the times required to egg hatchability (incubation period).

The eggs hatchability percentages were counted as follows:

No. hatched eggs

- % Egg hatchability = ----- X 100

No. deposited eggs

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

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

All experiments were carried out under laboratory conditions at 26 ± 1 °C and 65-70% RH. (Relative humidity).

The recorded data values were statistically analyzed with one – way analysis of variance (ANOVA) ($P < 0.05$ %) (Snedecor, 1952) and Duncans multiple range test of means (Duncan, 1955) were used.

RESULTS AND DISCUSSION

Effects of Different Tested Compounds on the Adults of *Pectinophora gossypiella*:

Time of Observation:

Data recorded in Table (2) show that the time observation of the treated adults was varied by different the compounds used, these compounds reduced the adult longevity to half time (8 and 9 days) Sea – water + magnetic+ full saturation with mixture 1:1 against and Sea – water + magnetic+ traces of mixture 1:1, respectively. On contrast, match increased the longevity to 21 days compared to 17 days in the untreated check.

Morphological Distortions Adult:

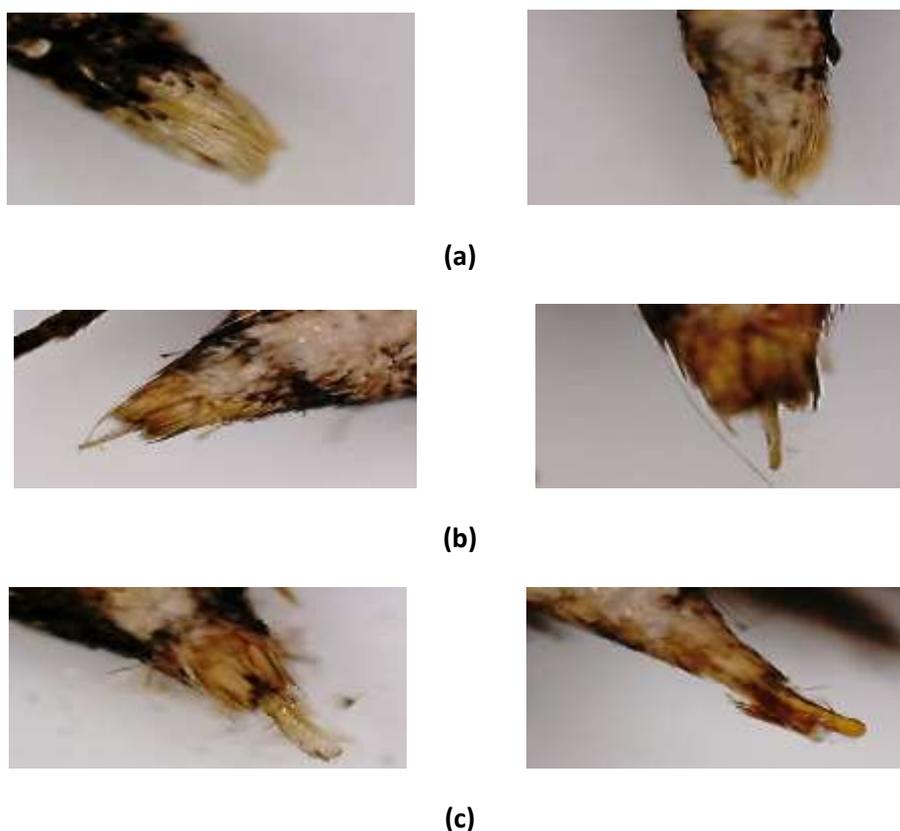
Data in Table (2) recorded that malformations of copulatory apparatus in adult males have occurred (Fig.1;b&) and increased to 33.3 -66.0 % in adult treated with Sea – water + magnetic+ full aturation with mixture 1:1 against.(From this mortality 26.6 % mortality during the mating ♀ x ♂) and decreased to 12- 20% in adult treated with Sea – water + magnetic+ traces of mixture 1:1, while, all malformation was disappear in adult males with sea water and match, compared with no malformed in control (Fig.1,a) but occurred resting to flight behavior for both adults females and males to elongated the period of observation to be 18 &19 days.

Adult Mortality Percentage:

Data are shown in Table (2) indicated that the adult mortality percentage was estimated from 1 to 7 days after treatment to be 13.3and 35.3 % when adult fed on Magnetic Sea – water with traces of mixture (2.5g/l) of ferro- salts mixture 1:1, respectively, and increased to 73.3 and 59.3 % in case of treating the adults with the 3rd group fed on Magnetic Sea – water with traces of mixture (50g/L) of ferro-salts mixture 1:1 and match, respectively, (Fig.1,c). Huang *et al.* (2012) demonstrated that lower concentrations of Cu in the diet (25 and 50 mg/kg) shorten the generation time by 4–5 days, while higher concentrations (100 and 200 mg/kg) increased the duration by 1–2 days. Cu, Fe, and Zn are considered as important and essential elements of nutrition for the organisms. But, they can be very toxic at higher concentration (Tian and Lu 2009; Lu *et al.* 2011; Zan *et al.* 2011 and Mouritsen, 1998). The magnetic field strength of 10 μ T may be close to the threshold of magneto reception for Chinese noctule, *Nyctalus plancyi* and high effect on flight behavior (Tian *et al.* 2015).

Table (2) Mortality and malformations percentages of treated *P. gossypiella* adults .

Tested compounds	Time observation (in days)	% Adult mortality percentages after Time from 1 to 7 days from treatment		Mortality percentages in cabling	Percent of Range of malformed in male
		(1-4)days	5- 7 days (accumulative)		
See-water 50mg	18.0	---	13.3±1.3	6.6±1.33	0.0
Magnetic Sea – water with traces of mixture (2.5g/l) of ferro- salts mixture 1:1	9.0	13.3±1.2	35.3±3.4	13. ±3.05	12- 20
Magnetic Sea – water with traces of mixture (50g/L) of ferro- salts mixture 1:1	8.0	33.3±0.88	66.6±2.31	26.6±0.69	33.3- 66.0
Match (25ppm)	21.0	26.6±1.2	59.0±2.1	--	0.0
Distilled Water (control)	17	----	7±0.57	---	0.0
LSD	0.587	1.549	3.874	1.354	-----

**Fig.(1)** (a) Control adult male , (b) malformation of adult male , (c) malformation of copulatory apparatus in treated adult male**Oviposition Period of *P. gossypiella*:**

Data Recorded in table (3) showed that the IGR, compound, match increased the oviposition period of *P. gossypiella* adult females to 11.0 days, while the high decreased recorded (4.3 and 6.4 days) with Sea – water + magnetic+ full saturation

with mixture 1:1 and Sea – water + magnetic+ traces of mixture 1:1 against, respectively, compared to 9.5 days/ female in control, but no different between the sea water treatment and control. The obtained data are in agreement with many authors tested different IGRs against Lepidopterous insects, e.g., *P. gossypiella*, (Kandil *et al.*, 2013 and Said *et al.*, 2017), *Spodoptera littoralis*, Sokar (1995 and Abdel-Aal (2003) they recorded that the CSIs cussed decreased the oviposition period. Also, Ramirez *et al.* (1983) found that 1 mT of MF reduced the oviposition rate and increased the immature mortality rate. Pan (1996) reported the biological effects of a 7 T MFs on egg hatching of *E. kuehniella*. The hatching of the eggs in the 7 T field was delayed and the hatching rate was reduced

From this data can be indicated that when the adults male and female feed on mixture with magnetic, or match (CSI); generally lead to the failure the reproductive of *P. gossypiella*, due to high toxic, did not mate or don't completed the cabling, also, may be no effectively transfer sperm to spermatheca of the female. Also, the females exposed to this compound high resting activity had reduced egg laying and egg viability.

Adult Female Longevity:

As clearly shown from the data in Table (3) that females longevity high significant affected when treated with all compounds. It was clearly that longest the longevity accord when female feed on IGR, this period was 18.9 days / female treated and 13.0 days / male, while the lowest period recorded with Magnetic Sea – ater with traces of mixture (2.5g/l) of ferro- salts mixture 1:1 (10 days/female and 7.3days/male) and Magnetic Sea – water with traces of mixture (50g/L) of ferro-salts mixture 1:1, (8.0 days/female and 4.3days/male against , respectively, compared with 14.5 / female and 11.3days/male in control. This result is supported by (Kandil *et al.*, 2013 and Said, et. at., 2017) recorded that CSISs caused the increased in longevity female and male *P. gossypiella* adults. Also, Walker and Bitterman, (1985) studied the effect of static magnetic fields (SMFs) on *S. avenae* , they found a significant negative effect, on life cycle of adults under the exposure of 0.176T for 30 min and 0.065 T for 60min, also, Kandil *et al* (2018) recorded that the the exposed of *Earias insulana* adults to MF 28mt increased the longevity of *Earias insulana* adults.

Table (3): Effect of different compounds on longevity of *P. gossypiella* (female and male)) adults stages under the laboratory conditions.

Tested compounds	Times in days ±SE			Longevity in days ±SE	
	Pre-oviposition	Oviposition	Post-oviposition	Female (♀)	Male (♂)
See-water 50mg	2.6±0.13	8.3±0.6	2.30 ± 0.27	13.3 ± 0.3	9.6± 0.4
Magnetic Sea – water with traces of mixture (2.5g/l) of ferro- salts mixture 1:1	2.1±0.31	6.4±1.2	1.5 ± 2..2	10.0 ± 1.5	7.3± 0.5
Magnetic Sea – water with traces of mixture (2.5g/l) of ferro- salts mixture 1:1	3.2± 0.6	4.3 ± 0.15	0.5 ± 0.5a	8.0± 1.1	4.3± 0.3
Match	4.6± 0.3	11.0± 1.1	6.3 ±0.2	21.9±0.9	13.0± 1.2
Distilled Water control	2.5 ± 0.2	9.5	2.5 ±0.3	14.5 ±0..3	11.3± 0.3
LSD	0.325	1.024	0.116	2.177	1.022
P**	*	**	***	***	***

Reproductive Potential:

Statistical analysis of data summarized in Table (4) demonstrated that highly significant differences between reproductive adults after fed on different compounds and the control. The average number of eggs deposited (fecundity) by females with the four compounds were 187.0, 96.6, 77.3 and 114.0 eggs/female treated, compared to 246.0 eggs/ female in control. These data indicated that the high reduction in eggs laid by females was estimated by 68.57 and 60.73 % with Sea – water + magnetic+ full saturation with mixture 1:1 and Sea – water + magnetic+ traces of mixture 1:1, against, followed by 46.3% with match compared with control. At the same trend, the treatment with Sea – water + magnetic+ full saturation with mixture 1:1 treated caused high reduction in percentage of hatchability (fertility) by 57 % followed by 46% with match and 41% on Sea – water + magnetic+ traces of mixture 1:1, against treated compared with 3 % in control. These results are in agreement with

Pandir , *et. al.* (2013) exposing *E. kuehniella* adults to increasing levels of MFs influenced their daily egg production; there was a significant reduction in progeny production, Mrdaković *et al.* 2004) who investigated the role of the IGRs and magnetic factors system in response and adaptation to stressful conditions as physical and chemical stressors in controlled the different insects. Walters and Carstensen (1987) recorded high reduction in fecundity and development in *Drosophila* when exposed to magnetic fields. In other experiment, Walker and Bitterman, (1985) investigated the effect of static magnetic fields (SMFs) on *S. avenae* , they found a significant negative effect on fecundity and fertility of adults under the exposure of 0.176T for 30 min and 0.065 T for 60min of SMF.

Table (4) Reproductive *P. gossypiella* adults affected by different compounds.

Tested compounds	Fecundity		Fertility	
	Total eggs / female	Reduction in eggs laid	% Hatchability	Reduction in eggs hatching
See-water 50mg	187.0 ± 6.4	23.98	77	23
Magnetic Sea – water with traces of mixture (2.5g/l) of ferro- salts mixture 1:1	96.6 ± 5.7	60.73	59	41
Magnetic Sea – water with traces of mixture (50g/L) of ferro- salts mixture 1:1	77.3.0± 2.1	68.57	43	57
Match	114.0 ± 4.6	46.3	54	46
Distilled Water control (control)	246.0± 9.31	-----	97	3
LSD	√.471	4.152	2.554	√.478

The data indicated that the adults male and female feed on the mixture with magnetic , or higher; generally lead to the reproductive failure of *P. gossypiella* if the exposure occurred in adult stages due to the male exposed to high concentration become highly toxic, did not mate or effectively transfer sperm to spermatheca of the female. Also, the females exposed to this compound high resting activity had reduced egg laying and egg viability.

Conclusion: The present data indicated that there was a significant negative effect on the reproduction process and sometimes lead to the failure of the reproduction process when the adults were exposed to the magnetic field or fed on materials exposed to the magnetic field. Thus, the effect of the magnetic field on the behavior of reproduction and lying eggs in adults of *P. gossypiella* and can use these results to be applied.

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ARABIC SUMMERY

تأثير المجال المغناطيسي مع بعض الأملاح وماء البحر على بعض النظم السلوكية والبيولوجية لدودة اللوز القرنفلية

مرفت عبد السميع قنديل* - علي مختار مطر* - عبد الخالق حسين* - سعدية محمد سعيد** - حسن محمد النعناعي*

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تمت هذه الدراسة، لدراسة تأثير المجال المغناطيسي بقوي مختلف (١٤-١٨ ملي تسلا) عند وضعها في وسط مقادير معينه من ماء البحر المحتويه على نسب محده من الكاتيونات و الانيونات وكذلك المضاف له كلوريد الحديدك و و كبريتات الحديدوز مقارنة بمركب الماتش كاحد مركبات مانعات الانسلاخ الممغنطه و المركب الكيماوي لمعرفة تأثير هذه المركبات على تغذيه الحشرات و فترة حياة الحشرة الكاملة و فترة وضع البيض و عدد البيض الناتج لكل انثي و قد اوضحت النتائج ظهور معنوى في نسب التشوه للذكور تصل الي نسبة ٦٦% بعد عمليه التزاوج مع موت نسبه من الذكور و الاناث اثناء عمليه التزاوج و قد ادت المعاملات ايضا الى قصر فترة حياة الحشرة الكاملة و فترة ووضع البيض و انخفاض عدد البيض الناتج لكل انثي مقارنة بالكنترول.

تم تسجيل انخفاض معنوي كبير في فترة حياة الحشرة الكاملة عند تغذيه الحشرات الكاملة بالمركبات السابقة مقارنة بمركب الماتش فعند تغذيه الاناث الكاملة علي كلا المستويين العالي و المنخفض من الاملاح الممغنطه كان المستوي العالي من المجال المغناطيسي مع الاملاح اكثر تأثيرا في خفض عدد البيض/انثي الي ٧٧,٣ بيضه/انثي كما انخفضت كذلك النسبة المئوية للفقس الي 43%. يليه المركب ذات المستوي المنخفض من المجال المغناطيسي مع الاملاح انخفاض عدد البيض/انثي الي 96.6 و النسبة المئوية للفقس الي 59 اما في حاله المعامله بمركب الماتش فزاد عدد البيض الموضوع /انثي الي الضعف مقارنة بالمركبين السابقين فقد سجل عدد البيض ب ٤٠ بيضه/انثي و النسبة المئوية للفقس الي ٥٤% مقارنة ب 246.0 بيضه/انثي و النسبة المئوية للفقس ٩٧% في الاناث الغير معامله (كنترول)