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Toxicological and Biological Effects of Jojoba and Flaxseed oils against Pink Bollworm *Pectinophora gossypiella* (Saund.) and Spiny Bollworm *Earias insulana* (Boisd.)

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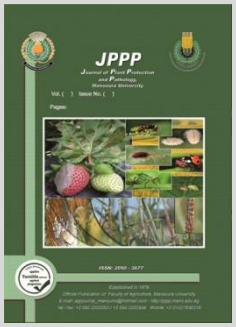

ABSTRACT

Toxicity of Jojoba and Flax oils against laboratory strains of pink bollworm, *Pectinophora gossypiella* (Saund.) and spiny bollworm, *Earias insulana* (Boisd.) newly hatched larvae was tested. Moreover, influence of these oils on some biological parameters was studied. In current investigation, Jojoba oil proved as the most effective compound against the newly hatched larvae of *P. gossypiella* and *E. insulana* and LC_{50} values were 0.9770% and 8.2059% of Jojoba on both pests, respectively. Feeding neonate larvae of both insects on treated artificial diet withLC50 of tested oils led to a complex symptom which proved as higher prolongation for larval and pupa durations than the untreated check (control). Larval duration in *P. gossypiella*, reached 18.67, 19.67 &14.17 days for Jojoba, flax oil and control, respectively. However, for the pupal duration it reached 11.33, 12.67and 8.8days, in the same respectand this led to marked prolongation in the total immature stages. The resulted showed same performance for *E. insulana*. Significant reductions in the number of deposited eggs and hatched eggs by each female, which was developed after treating the larvae with the tested oils compared with the control.

Keywords: Toxicity, biological studies; Jojoba oil; Flaxseed oil, Pink bollworm, *Pectinophora gossypiella;* Spiny bollworm, *Earias insulana.*

INTRODUCTION

Cotton, *Gossypium barbadence* L. is an economical fiber crop used in many industries as textile, food oil, soap and seedcake in different countries of the world. In Egypt, cotton plants like most field crops attacked by a lot of lepidopterous pests (Gaaboub *et.al*, 2012). The pink bollworm, *Pectinophora gossypiella* (Saunders) is considered as mid-late season pests cause dangerous threats to cotton (El Hamaky *et al*., 1990). PBW larvae damage squares, flower buds, flowers and bolls of cotton, and this leads to significant decreases in the quality and quantity of lint and oil yields. On the other hand, larvae of the spiny bollworm, *Earias insulana* (Boisd.) mainly feed on fruiting parts, and the soft growing tissues of cotton plants, especially the terminal buds and then lead to "top boring" and later on the attacked flower buds and bolls, which are ultimately shed, and finally shows considerable losses in oil and lint quantity and quality (Ahmad, 1980; Atwal, 1994; Khan *et.al*., 2007) .

Over the past three decades, efforts of the researchers have been made and are still being made to develop control methods to those pests, because of the high speed in acquiring resistance to conventional pesticides and the high cost in control in cotton producing countries.

Natural plant extracts play an important effective role as alternatives to pesticides due to the concern for reducing health hazards, environmental pollution (Sharma *et al*., 2006). There aremany families containing more than 2400 plant Jojoba oil is a natural compound derived from the jojoba crop, *Simmondsia chinensis* L. In Egypt, several laboratory studies have been conducted on the oil of Jojoba seeds to evaluate itspesticidal effects on different economic pests such as *P. gossypiella*, *Bemisia tabaci*and *Schistocerca gregaria* (Rofail *et al.*, 2000; Salem *et al*., 2003, and Halawa *et al.*, 2007). They declared that Jojoba oil has a toxic effect and be considered as an antifeedant, growth and oviposition inhibitors.

Flaxseed oil is obtained by pressing ripened seeds of the flax plant (*Linum usitatissimum*). It is a drying oil, meaning it can polymerize into a solid form.

However, more of plant extracts are non-toxic to humans, and have more importantroles inthe natural controlling process with highly efficient toxicity, anti-feeding activity and growth inhibition for some pests (Badr, *etal.* 1995, Isman and Machial, 2006, , Adel and Abd El- Hakim, 2007 and Halawa *et al*, 2007). Also, mineral oils have effective results against eggs and neonate larvae of the Pink bollworm in laboratory and field experiments (Hewady *et. al*., 1993 and Rofail *et al*. 2000).In addition, tar oil has high ovicidal and larvicidal effect against pink bollworm when prepared as soluble liquid (Amer and El-Sisi, 2011).

The objective of the present work is to evaluate the toxic and subsequent biological effects of Jojoba and Flaxseed oil sagainst *P. gossypiella* and *E. insulana*, treated as newly hatched larvae.

MATERIALS AND METHODS

The experimental Insects:

The newly hatched larvae of pink bollworm were obtained from a susceptible laboratory colony established in Bollworms Department, Plant Protection Research Institute, Dokki, Giza. This colony was reared on a semi artificial diet as

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described by Rashad and Ammar (1985). Rearing conditions were controlled at 27±1°C and 65-75% R.H. Spiny bollworm larvae were obtained from susceptible strain established in Bollworms Department, Plant Protection Research Institute, Al-Sharkiya Branch, (ARC) Zagazig Governorate. This strain was reared on a modified artificial diet as described by Amer (2015) under laboratory conditions of 26 ± 1 °C and 70 ± 5 % R.H.

Tested oils:

1-Jojoba oil: Is the liquid produced in the seeds of the *Simmondsia chinensis*shrub, (Fam.: Simmondsiaceae) which is native to southern western United States.

The Chemical Structure: CH_3 $(CH_2)_7$ CH=CH-(CH_2)11 CH_2-O-CO $(CH_2)_9$ CH=CH$(CH_2)_7$ CH3[$C_{22}H_{43}COOC_{19}H_{37}$]. The jojoba oil contains a high proportion of mono-unsaturated fatty acids, primarily 11-Eicosenoic acid (Gondoic acid) Wisniak (1987).The experimental oil wasobtained by cold mechanical pressingfrom Oils Press Unit in National Research Center.

2-Flaxseed oil (Linseedoil):

Common name: Flaxseed oil, also known as Linseed oil.

Structure and composition: It is a colorless to yellowish oil obtained from the ripened seeds of the flax plant (*Linum usitatissimum:* Fam Linaceae.) by cold mechanical pressing seeds, sometimes followed by solvent extraction. This oil contains principally glycerides of linoleic, oleic and palmitic acid. It is considered as a source of α-Linolenic acid (an omega-3 fatty acid). The oil was obtained from Oils Press Unit in National Research Center.

Chemical Structure: [$C_{78}H_{11}O_{11}$].

The two oils were selected for the present study, as they have been reported as an effective alternative botanical insecticide, assayed against economically important insect pest species.

Toxicity tests:

To evaluate the toxicity of the Jojoba and Flaxseed oils against newly hatched larvae of *P. gossypiella* and/ or *E. insulana*, serial concentrations of the two tested oils (0.5,1.0,2.0,4.0,7.0 %)for jojoba and (10,20,30,40,50%) for flax oil on *P. gossypiella* & (3.75,7.53,15.30 %) for jojoba and (10,20,30,40,50%) for flax oil on *E. insulana* were prepared using droplets of Triton as emulsifying agent. Ten grams of artificial diet was laid in a Petri-dish (9 cm in diameter) and one ml of the tested concentration was sprayed on the surface of the diet and left until dryness. Three replicates/conc./treated oil. Each replicate 50 newly hatched larvae of the *P. gossypiella* and/or *E. insulana* were allowed to feed on the treated diet and kept under constant conditions of 26 ± 1°C and 65±5 % RH. Similar number of larvae was transferred into untreated diet used as control (check)at the same conditions. Mortality percentages were recorded after 24,48 and 72 hours from treatment and corrected using Abbott's formula (1925).

$$\%\text{Corrected mortality} = \frac{T - C}{100 - C} \times 100$$

Where; T: %mortality in treatment C: %mortality in check

The LC_{50}, LC_{90} and the slope values were calculated by Probit (proban) analysis software according to Finny (1971).

Biological Studies:

The calculated LC_{50} of each tested oil was sprayed on the surface of an artificial diet in tubes containing 2.0 grams. All tubes were held uncapped for an hour to allow dryness. the neonate larvae of PBW and/or SBW were placed singly into each tube using soft hair brush and capped by cotton wool and incubated under the previous control conditions. All larvae were allowed to feed for 24 hours on the treated diet and then transferred to untreated diet to complete their life-cycle. Some biological aspects such as: larval mortality%, larval malformations, larval duration, pupal duration, adult's emergence%, adult's malformation adult's longevity, sex ratio, fecundity and fertility were estimated.

Statistical analysis:

The results were expressed as mean ± SD and statistically analyzed, using Costat Statistical Program Software (1990) and then Duncan's Multiple Range Test (Duncans, 1955) at the 5 % probability level.

RESULTS AND DISCUSSION

1.Toxicity of the tested oils:

Newly hatched larvae of *P. gossypiella and E. insulana* were treated with serial concentrations of Jojoba oil and Flaxseed oils to evaluate their toxicity against .Data presented in Table (1) & Fig. 1 showed that Jojoba oil proved as the most effective compound against the newly hatched larvae of pink bollworm followed by Flaxseed oil, where the LC_{50} values were 0.9770, 23.6195 %, respectively, and their toxicity indexes were 100 and 4.1364 (based on LC_{50} of Jojoba oil), respectively.

Table 1. Toxicity of Jojoba and Flaxseed oils to newly hatched larvae of *P. gossypiella* after 24 hour under controlled conditions (26 ±1°c and 75±5 % R.H.).

Oils	LC_{50} (%)	LC_{90} (%)	Confidence limits for LC_{50}		Slope	Toxicity index %*	
			Lower	Upper		LC_{50}	LC_{90}
Jojoba oil	0.9770	5.1054	0.6983	1.3669	1.7824	100	100
Flaxseed oil	23.6195	167.0185	17.1377	32.5528	1.5068	4.1364	3.0568

***Toxicity index was calculated according to Sun's equation (Sun, 1950)**

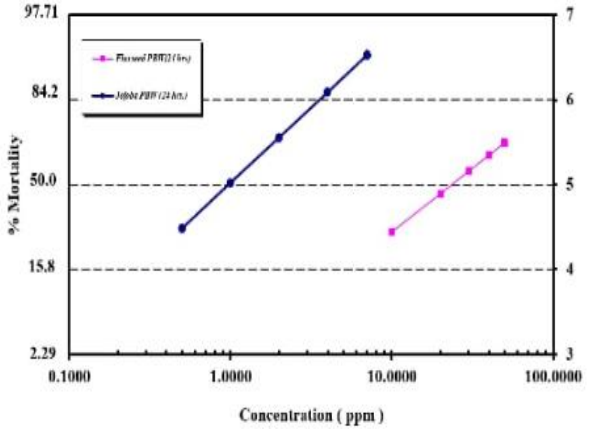

Fig. 1. Ldp line of the 1st larval instar of *Pectinophera gossypiella* responded to Jojoba and Flaxseed oil after 24hour.

Also, data in Table (2)& Fig.2 detected that the newly hatched larvae of *E. insulana* were highly susceptible to Jojoba oil than Flaxseed oil according to LC_{50} values (8.2059% and 13.5692% respectively), where the corresponding LC_{90} reached 52.1686 for Jojoba oil and 57.7936for Flaxseed oil. These results confirmed that Jojoba oil was more effective than Flaxseed oil on both PBW and SBW. Results are matching with findings of Gaaboub *et al.* (2012) which indicated that Jojoba oil had a toxic against the 4th larval instar of *Spodoptera littoralis*. Also, Amani *et al.* (2015) reserved that LC_{50} and LC_{90} values of *Ocimum basilicum* oil (basil oil) against newly hatched larvae of

spiny bollworm were 41.34 and 178.76 % after 24 hours from starting the treatments. In addition, the effects of four aromatic oils; garlic, mint, eucalyptus, and lavender oils were evaluated against 2nd and 4th instar larvae of *S. littoralis* (Suzan and Sara,2018).Results provide that all oils have efficiency especially garlic oil LC50 (0.32%) and they have insecticidal and antifeedant effect and can applied in IBM program for the cotton leaf worm control. Also, Morey and Khandagle (2020) they assay three plant oils on potato tuber moth (*Cinnamomum verum*, Cupressuss sempervirens and Cymbopogon nardus.) to evaluate the larvicidal and adulticidal. The results showed that oil of C. verum has exhibited toxic effect (larvicidal LC50 = 110.10 µg/cm2, adulticidal LC50 = 49.78 µg/cm2).Obviously, Sharaby and Asma (2015) cleared that some plant essential oil had atoxic contact than stomach poison on 3rdlarval instar of *A. ipsilon* when treated with LC_{50} of tested oils.

Table 2. Toxicity of Jojoba and Flaxseed oil to the newly hatched larvae of *E. insulana* after 24 hours under controlled conditions (26 ±1˚c and 75±5 % R.H.).

Oils	LC_{50} (%)	LC_{90} (%)	Confidence limits for LC_{50}		Slope	Toxicity index %*	
			Lower	Upper		LC_{50}	LC_{90}
Jojoba oil	8.2059	52.1686	5.3075	12.6872	1.5935	100	100
Flaxseed oil	13.5692	57.7936	9.9248	18.5518	2.0339	60.4745	90.2670

***Toxicity index was calculated according to Sun's equation (Sun, 1950).**

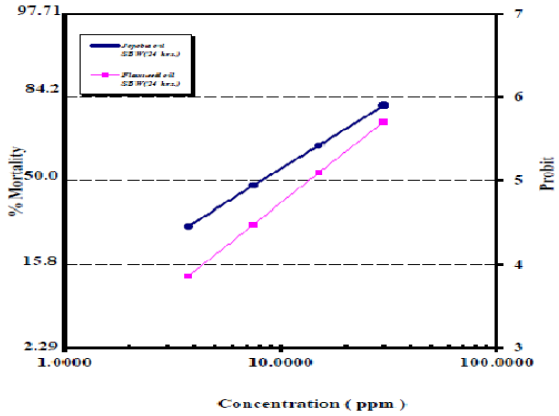

Fig. 2. Ldp line of the 1st laraval of *Earias insulana* responded to Jojoba oil and Flaxseed oil after 24hour.

2. Effect of tested oils on some biological parameters:

Effect of tested oils on the development of immature stages of *P. gossypiella*

Data in Table (3) clearly show that the percentage of larval mortality increased when the larvae fed on diet treatedwithLC_{50} of Jojoba oil (**0.9770**)by 72.22% and by 62.67% after using Flaxseed oil compared to control. All tested oils caused prolongation of larval and pupa durations than of untreated check (control) as shown in Table (3). It was 18.67 days at Jojoba and19.67 days at Flaxseed oil for larval duration and recorded 11.33 days and12.67 days, respectively for pupa duration. In the untreated check the larval and pupal duration recorded14.167±0.601&8.8±1.65 days, respectively. The total immature stages prolonged to reach 30.0&33.33 days in Jojoba oil and Flaxseed oil treatment, respectively, while it recorded 22.97±2.02 in control. These results are in agreement with Gaaboub *etal.* (2012) who indicated that Jojoba oil and some insecticides significantly prolonged the larval period. Also, El-Sayed (2001) reported that the tested concentrations of Nemazal-T/S caused high increases in the larval duration of SBW as compared with untreated check.

In addition, Senthil- Nathan *et al.*(2006) found prolongation of the duration of larval and pupal after using some extract

Latent effect of tested oils on adult stage of *P. gossypiella*:

Latent effect of the two tested oils on adult emergence, longevity, fecundity and fertility/female of *P. gossypiella* treated as newly hatched larvae were estimated and summarized in Table (4). The present results indicated that the percentage of adult emergence was reduced from 98.57% in untreated check to 93.4% and 91.41% in Flaxseed oil and Jojoba oil treatments, respectively. Also, the highest percentage of adult deformation appeared in Flaxseed oil treatment, it recorded 14.17% in comparison to 1.08% in control.

Treatment with Jojoba oil showed significant reductions in the female and male longevity. It consumes 16.0±1.53 and 11.0±1.155 days for females and males, respectively compared to (19.7±0.306 and 21.6±0.88) in control Table (4).

In contrast, Flax oil showed high and significant increase in the female longevity (24.6±14.0 days), while it was ineffective on the male longevity (21.0 days) compared to control (Table 4).

Table 3. Effect of LC_{50} concentration of Jojoba oil and Flaxseed oil on the development of immature stages of *P. gossypiella* under controlled conditions (27 ±1˚c and 75±5 % R.H.)

Treatment	Initial No. Larvae	% larvae mortality	% malformed larvae	Larval duration± SD(days)*	% Pupation	Pupal duration± SD(days)*	Total immature Stages± SD (days)*
Jojoba oil	120	72.22± 1.821a	14.16	18.67 ±2.027 ba	48.96	11.33±0.452a	30.0± 3.464ba
Flaxseed oil	100	62.67± 1.674b	12.02	19.67± 1.763a	88.35	12.67±1.452a	33.33 ±1.33a
Control	100	4.33± 0.882c	1.33	14.167± 0.601b	98.57	8.8±1.65a	22.97 ±2.02b
LSD 05	---	6.146	-----	4.551	---	4.301	6.951
F		292.72	-----	3,19	-----	2.12	4.12

***Means within the same column have the same letter are not significant different (ANOVA) Duncan's multiple rang tests, P<0.05.**

Table 4. Effect of LC_{50} concentration of Jojoba oil and Flaxseed oil on the adult stage of *P. gossypiella* under controlled conditions (27 ±1˚c and 75±5 % R.H.).

Treatment	% Adult emergence	% Adult Malformed	Pre ovipos (days)*	Ovipos. (days)*	Post ovipos (days)*	Longevity ♀(days)*	Longevity ♂(days)*	No eggs /♀±s.e*	No hatched eggs/♀±s.e*	% Hatchability	% Fertility
Jojoba oil	91.41	6.13	1.3± 0.33c	8.66± 1.33b	6.0± 0.577	16.0 ±1.53 c	11.0 ± 1.155 c	166.0 ± 11.55 c	94.34 ±8.52d	56.83 ± 1.166 c	64.09
Flaxseed oil	93.4	14.17	5.0±0.577a	12.0± 1.527ab	7.66± 1.453a	24.6 ± 14 a	21.0 ± 1.527 a	192.0 ± 6.93 b	116.08 ±9.96c	60.46 ±3.01 bc	74.13
Control	98.57	1.085	2.8± 0.153b	14.0± 0.557a	2.9± 0.153b	19.7 ±0.306 a	21.6 ±0.88 a	259.0± 0.577a	247.76 ±2.22a	95.66 ±0.667 a	100
LSD 05	---	---	1.13	3.47	2.56	2.77	3.44	22.06	7.27	----	-----
P<	---------	------	***0.003	*0.0435	**0.006	***0.007	0.003	***0.000	**0.000	0.000	***0.000

***Means within the same column have the same letter are not significant different (ANOVA, Duncan's multiple rang tests, P<0**

Results in table (4) show high reduction in the numbers of laid eggs /♀ and the hatchability % of *P. gossypiella* deposited eggs at both treatments. The reduction in hatchability rate was 56.83% in Jojoba oil treatment followed by 60.46% in Flaxseed oil treatment compared to the control (95.66%).In general, Jojoba oil & Flaxseed oil showed deterrent and infertility activities against the PBW. These results are in agreement with those of Gaaboub *et al.* (2012), who indicated that Jojoba oil caused marked reductions in fecundity and egg hatchability % compared to control. Also, Sharaby *et al.* (2012) found significant diminishes in the deposited eggs and egg fertility when they studied the toxic effect of Mint oil on (*Heteracris littoralis*). Kandil and El-Shenawy (2018), recorded highly reduction in total egg laid and hatchability (62.3%, 72%, 73.6%, 81%0 for thuia, orintalis, bug oil, α-pinene compared to 96% for control when treated newly hatched larvae of *P. gossypiella*

Effect of tested oils on the development of immature stages of *E. insulana*:

Results obtained in Table (5) indicated that the percentage of larval mortality increased when the neonate fed on treated diet with LC_{50} of Jojoba oil by 67.23% followed by 63.06% Flaxseed oil compared to the control (6.67%). Also, the two experimental oils caused prolongation in larval and pupal durations than the untreated check (control).The larval duration recorded (17.67±0.881& 15.67±1.201days)in Jojoba oil and in Flaxseed oil treatments compared to (13.26±0.405 days)in control. In the same trend pupal durations were registered as(12.0±1.54& 10.33±0.881 days, respectively), compared to (9.17±0.80days) in control. In general, the total immature stages were prolonged in Jojoba & Flaxseed oil treatments toreach (29.67& 26,0 days). This aspect may due to the antifeedant effect of the two testedoils. These results are agreement with Kandil and El-shenawy (2018) who found that sesame oil and α-piene caused prolongation in larval and pupal duration of *P. gossypiella* treated larvae.

Latent effect of tested oils on adult stage of *E. insulana*:

Results summaries' in Table (6) cleared the effect of Jojoba oil and Flaxseed oil on adult stage of *E. insulana* resulted from larvae treated byLC_{50} as neonate. Jojoba oil had high significant reductions on the percentage of adult emergence by 71.18%but it was 86.49% for Flaxseed oil which agreed those of El-Shewy (2108) who found that highly significant reduction in adult emergence and number of eggs laid per female of *A. ipsilon*. The percentage of reduction reach to 34.32% for jojoba oil (3%) compared to 15.30% for Nano oil (0.1%).

Table 5. Effect of LC_{50} concentration of Jojoba oil and Flax oil on the development of immature stages of *E.insulana.*

Treatment	Initial No. Larvae	% larvae mortality	% malformed larvae	Larval duration (days)*	% Pupation	Pupal duration (days)*	Total immature Stages (days)*
Jojoba oil	120	67.23± 2.458 a	1.67	17.67± 0.881 ba	100	12.0±1.54 a	29.67±1.201 a
Flaxseed oil	120	63.06± 0.556 b	0	15.67B± 1.201 c	100	10.33±0.881a	26±2.081ba
Control	100	6.67± 0.881 c	0	13.26±0.405 c	100	9.17±0.80 a	22.43±1.203 b
LSD 05	---	4.448	---	3.726	---	2.864	5.671

***Means within the same column have the same letter are not significant different (ANOVA) Duncan's multiple rang tests, P<0.05.**

Some deformed adults appeared at a rate of 28.69 % after using Flaxseed oil treatment. Also, the tested oils shortened female and male longevity compared to control. It decreased to reach 17.0 days in Jojoba oil treatment and to 21.3 days for Flaxseed oil treatment compared to the control (27.6 days).Whereas, Jojoba oil and Flaxseed oil did not affect the male longevity than control it reached (16.6, 20.0 &20.0 days, respectively as presented in Table (6)).

Table 6. Effect of LC_{50} concentration of Jojoba oil and Flaxseed oil on the adult stage of *E. insulana* under controlled conditions (26 ±1˚c and 75±5 % R.H.

Treatment	% Adult emergence	%Adult Malformed	Pre-ovipos (days)±SE	Ovipo. (days) ±SE	Post ovipos (days) ±SE	Longevity ♀(days) ±SE	Longevity ♂(days) ±SE	No eggs/♀ ±SE	No hatched Eggs/♀±SE	% Hatchability	% Fertility
Jojoba oil	71.18	13.41	4.0± 0.577a	10.33 ±1.202b	26.0± 0.33b	17.0 ± 1.856 b	16.6± 10527 a	118.0 ± 1.155 b	35.4± 3.56c	30 ± 2.887 d	59.62
Flaxseed oil	86.49	28.69	4.0± 0.577	10.0± 0.0b	6.0± 0.577a	21.3 ±1.55ab	20.0 ±1.764 a	48.27 ±1.185 c	28.48 ±0.97d	59 ± 0.577c	24.39
Control	95.4	0	2.0± 0.1166b	22.0± 1.0799a	3.6± 0.529b	27.6 ± 0.577 a	20.0 ± 1.124 a	197.92 ±1.228 a	187.43± 2.42a	94.7 ± 0.781 a	100
LSD 05	-----	-----	1.45	4.59	1.68	6.28	5.38	24.90	5.50	-----	-----
P<	-----	-----	* 0.0297	*** 0.0008	** 0.0070	*** 0.0047	ns 0.3225	*** 0.000	*** 0.000	*** 0.000	-----

***Means within the same column have the same letter are not significant different (ANOVA, Duncan's multiple rang tests, P<0.05.**

As shown in Table (6) both tested oils reduced the total number of eggs laid by females. Flaxseed oil was more effective than Jojoba oil. The number of eggs decreased from 197 in the control treatment to 118 eggs and 48.27 eggs in Jojoba oil and Flax oil, respectively. Also, it is clearly obvious reductions in the hatchability percentages of deposited eggs. The reduction in hatchability rate was 30% in Jojoba oil treatment followed by59%in Flax oil treatment compared with the control (94.7%). These results are confirmed the findings of the present results of *P. gossipiella* and of Khedr (2011) who stated that adult emergence percentages, fecundity and hatchability percentages decreased compared to control, when the 4th instar larvae of *S. littoralis* fed on oil of castor bean leaves at the recommended concentration. Hegab and Abd-El Atty (2013) studied the effect of three plant extract (Neem), (Hanzal) and (Zaatar) against 1st instar larvae of *E. insulana* and they found that the used extracts caused inhibition in the percentages of adult emergence and marked decreases in numbers of laid eggs and their hatchability percentages.

Amani *et al*. (2015) estimated the effect of pepper oil against 1st instars larvae of the cotton leaf-worm and newly hatched larvae of *E. insulana*. They found significant prolonged on the larval duration of spiny bollworm. Also, the pepper oil reduced the larval and pupal weight, and hatchability percentages.

The present results of the Lab. Experimental studies concluded that Jojoba oil and Flaxseed oil possessed significant pesticidal properties and could introduced as safe botanical alternatives for the management of PBW and/or SBW after field evaluations.

Fig. 3. Deformations of *P. gossypiella* larvae and adult emerged from larvae treated with LC_{50} of jojoba oil.

Fig. 4. Deformations of *E. insulana* adult emerged from larvae treated with LC_{50} of Flax oil.

Fig. 5. Deformations of *E. insulana* pupa and adult emerged from larvae treated with LC_{50} of jojoba oil.

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سمية زيت الجوجوبا وزيت بذرة الكتان ضد يرقات دودة اللوز القرنفلية ودودة اللوز الشوكية وعلاقتهما ببعض الجوانب البيولوجية

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تم دراسة سمية زيت الجوجوبا وزيت بذرة الكتان ضد يرقات حديثه الفقس لسلاله معمليه لدوده اللوز القرنفلية (PBW) ودودة اللوز الشوكية (SBW) علاوة على ذلك تم دراسة تأثيرهذه الزيوت على بعض النواحي البيولوجيه، وقد أثبتت الدراسة الحالية أن زيت الجوجوبا هو المركب الأكثر فاعلية ضد اليرقات حديثة الفقس لكلا من دودتي اللوزالقرنفلية والشوكية حيث كانت قيم التركيز القاتل ل50% من زيت الجوجوبا 0.9770 و 8.2059٪ لكلا الآفتين على التوالي . كما اثبتت النتائج أن تغذية اليرقات حديثة الفقس لكلاالحشرتين المختبرتين على بيئة صناعية معامله بالتركيز القاتل ل 50%من الزيوت المختبرة أدت إلى ظهورأعراض مركبه في صوره إطاله لمده الطوراليرقي والعذارى أكثرمن المقارنة الغير معاملة حيث بلغت مدة الطور اليرقي في حشره دودة اللوز القرنفليه (18.67 و 19.67 و 14.17 يوم) للجوجوبا وزيت الكتان والكونترول علىالتوالي. أما بالنسبة لمدة طور العذراء فقد بلغت (11.33 و 12.67 و 8.8 يوم) في نفس الصدد مما ترتب عليه إطالة ملحوظة في مراحل عدم النضج الكلية. كما أظهرت النتائج نفس التاثير لحشره دودة اللوز الشوكية. كما تم ملاحظه انخفاض معنوي في عدد البيض الموضوع والبيض الفاقس لكل أنثى حشرة كاملة ناتجه من اليرقات المعامله بالزيوت المختبرة مقارنة بالكونترول.