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EVALUATION OF TWO PLANT OIL EXTRACTS ON COTTON LEAF WORM, *SPODOPTERA LITTORALIS* (BOISD) (LEPIDOPTERA: NOCTUIDAE).

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Abstract

Background: Oil extracts or isolated active compounds have been shown to act as potent acute or chronic insecticides and insect growth regulators. The aim of this study was to study the effect of Jojoba and Sesame oil extracts on cotton leaf worm, *Spodoptera littoralis*. Material and Methods: Fifty newly moulted 4th larvae of *Spodoptera littoralis* from the stock culture reared in the laboratory and kept individually in Jars and divided into three groups. The larva was fed on discs of castor leaves dipped in water controlled daily. Two groups of insect larvae fed on discs of castor leaves dipped in 2% and 3% jojoba oil and 2% and 3% sesame oil. Result: Jojoba and Sesame oil extracts on cotton leaf worm, *Spodoptera littoralis* caused prolongation in larval & pupal duration and accompanied with a reduction in pupal weight of the treated larvae. Larvae fed on jojoba and sesame oils Concentrations compared with control larvae. Pupal duration was not affected with regard to control ones except for larvae fed on castor leaves treated with 3% concentration of sesame oil as it lasted only 3.9 days while that of control lasted 10.2 days, there was also decrease in pupal weight as it was 185.01mg comparing to 271.2 mg of control. Jojoba and sesame oils extract reduced the food consumption of the larvae at 3% concentration of sesame, being 40.3% compared to that of the control larvae. This concentration affected of food by increasing the excretion of larvae to the amount of food ingested (60.2%). Conclusion: These results confirmed that Jojoba oil and sesame oil extracts are promising to *Spodoptera littoralis* control.

Key words: Jojoba oil, sesame oil extracts, *Spodoptera littoralis*.

Introduction

The cotton leaf worm, *Spodoptera littoralis* Boisd (Lepidoptera: Noctuidae) is the most common, serious and devastative pests which attack large scale of economic crops as cotton, clover, maize and different vegetable crops (Abo El-Ghar *et al.,* 1986; Issa *et al.,* 1984; Zaki and Abdel-Raheem, 2010).

In the recent years, control of agricultural pests by using natural insecticides of plant origin to increase. The toxic action of plant extracts was tested by many authors, (Abdel-Raheem *et al.,* 2020; Abdel-Raheem *et al.,* 2020; Abdel-Raheem *et al.,* 2019; Amr, 2001; Salem *et al.,* 2016, Abdel Aziz 2007; Colomaa, A.G. *et al.,* 2006), mentioned that oil extracts or isolated active compounds have been shown to act as potent acute or chronic insecticides and insect growth regulators, (Ahlam Gabarty Abd EL- Wahed Ali, 1992); Abdel-Rady and Osman, 2005; Mesbah *et al.,* 2006; Pavela, 2004; Emara *et al.,* 2002; Ismail *et al.,* 2014; Ismail *et al.,* 2015; Ismail *et al.,* 2016; Ismail *et al.,* 2016; Abou El-Ghar *et al.,* 1996) were studied the physiological and biochemical effect of some plant oil extracts on various insects. Botanicals are plant-derived materials and can be used as a major component in IPM for controlling insect pests. Botanical insecticides are fast biodegradable; have little or no harmful effect on the environment and non-target organisms, cheap, easily produced and may retard the development of resistance, (Malarvannan, *et al.,*2008).

Jojoba (*Simmodsia chinensis* (Clink), is an oil-producing industrial crop. Jojoba oil is liquid at room temperature, odorless, and resistant to turning rancid. One of the ways it acts as a pesticide is by forming a physical barrier between the insect pest and the leaf surface. Abdelgalil and El-Aswad (2005) mentioned that Jojoba oil caused an increase in larval and pupal durations of

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Agrotis ipsilon. (Mohamed Abdel-Raheem and Mohamed Youssif, 2020; Mohamed Abdel-Raheem *et al.*, 2018; Mohamed Abdel-Raheem *et al.*, 2020; Mohamed Abdel-Raheem and Abd El-Rahman, 2020), sated that neem and sesame oils inhibited adult emergence and appeared to be most promising seed protectant against *C. chinensis*. Bailey, (1975) found that the lowest percentage of eggs hatchability occurred when seeds were treated with 0.25% sesame oil. (Hanan, 2012; Salem *et al.*, 2016; Salem *et al.*, 2017; Salem *et al.*, 2020; Salem *et al.*, 2017; Salem *et al.*, 2003; Abdel-Raheem, 2019; Abdel-Raheem, 2019), there was a significant reduction in the efficiency of larvae to convert digested and ingested food into body tissue.

The aim of the present study was tried to study the effect of Jojoba oil and sesame oil extracts on *Spodoptera littoralis* larvae that can be used in control programs at the future.

Materials and Methods

Biological Aspects

Fifty newly moulted 4th larvae of *Spodoptera littoralis* from the stock culture reared in the laboratory (pests & plant protection National Research Centre, Egypt) under constant temperature 26 ±1p C and 65 ± 5% R.H. , were kept individually in Jars and divided into three groups. The first one was fed on discs of castor leaves dipped in water controlled daily to observe larval duration, pupal duration and pupal weight.

The same criteria were observed and recorded in case of the other two groups of insect larvae, but fed on discs of castor leaves dipped in 2% and 3% jojoba oil and 2% and 3% sesame oil.

Metabolic Parameters

Fifty newly moulted 4th larvae of the same weight were divided into five groups, where each larva was kept individually. The 1st group (control), was fed on discs of castor leaves dipped in water of known weight, the 2nd and 3rd groups were fed on castor leaf discs dipped in 2% and 3% jojoba oil respectively the 4th and 5th groups were fed on 2% and 3% sesame oil. Both control and treated larvae were examined daily, feces were carefully separated from uneaten diet, weighed and dried to constant weight. The uneaten parts of discs (residual food) were collected daily and dried to constant weight. Twenty samples of identical weight of treated and untreated discs were dried to constant weight. Dry weight of exuviae and feces was estimated. Twenty newly moulted 4th instars larvae were dried to constant weight for calculation of initial dry weight of larvae. After seven days the experimental larvae were weighed and dried to constant weight. The metabolic parameters (AD = Approximate Digestibility, ECI = Efficiency of insect to Convert ingested food into body tissues, ECD = Efficiency of insect to Convert digested food into body tissues, RGR = Relative Growth Rate, RCR = Relative Consumption Rate), were calculated according to Slansky and Scriber (1982). All data were based on dry weight: AD = ((a-b)/a) × 100.

ECI = (c/a) × 100

ECD = (c/ (A-B)) × 100

(RGR) = c/ (T × A)

(RCR) = f / (T × A)

Where as

a = dry weight of food consumed

b = dry weight of feces

c = dry weight gain

T = feeding period in days

F = food consumption during feeding period.

A = Mean dry weight of larva during feeding period.

Estimation of Total Lipids

The total lipids from fresh ten 6 instar larvae of *S. littoralis* the of both treated and untreated larvae were extracted according to Sary, (1982) Known weight of fresh sample was put in cellulosicthymbol and well closed then introduced to soxhlet, using chloroform, methanol mixture (2: 1 V/V), the process was undergone for 24h. After complete lipid extract was dried under reduced pressure in rotavapor at 40 p C and the dry residual represents the total lipid content in the test sample.

Results and Discussion

Data in table 1 obtained that there is no effect on development of larvae fed experimental concentrations of jojoba and sesame oils compared with control larvae.

Table 1: Biological effect of Jojoba & Sesame oil on *Spodoptera littoralis* Larvae.

Treat-ments	Larval duration	Larval mortality	Pupal duration	Pupal weight	Pupal mortality
Jojoba 2%	7.2±0.30	16	7.0±3.0	220.1±4.9	23
Jojoba3%	9.9±2.2	32	9.2±2.2	132.1±30.9	56
Sesame 2%	10.2±2.2	20	12.4±2.3	265.2±4.1	26
Sesame3%	10.9±2.2	25	3.9±2.8	185.0±33.2	85
Control	11.9±2.2	0	10.2±0.2	271.2±9.3	
F. value	0.991		2.37	1.95	
LSD 5%	3.66		5.23	125.5	

Table 2: Effect of Jojoba and Sesame Oil Extracts on some Nutritional Parameters of *Spodoptera littoralis.*

Criteria	Control	Jojoba 2 %	Jojoba 3 %	Sesame 2 %	Sesame	F. 3 %	LSD 5 %	% with respect to control			
								Jojoba 2 %	Jojoba 3 %	Sesame 2 %	Sesame 3 %
Food consumption	100.8±2.3	67.2±5.5	55.33±2.1	45.3±2.3	40.3±3.3	3.5	19.2	69.2 %	58.7 %	46.3 %	41.4 %
Feces Dry weight	41.8±2.8	43.7±3.5	43.9±8.7	32.3±3.6	25.6±4.3	2.4	16.2	103.8%	103.8%	77.7 %	67.7 %
Feces % with respect	41.3%	63.5%	75.7%	68.3%	60.2%						
to food consumption											
Weight gain	22.2±1.3	12.6±0.4	26.3±2.7	25.8±2.4	12.2±0.9	2.5	4.4	55.2%	119.3%	121%	53.4%
AD	59.8±4.6	41.1±2.3	34.3±3.1	37.12±4.3	44.2±4.45	2.5	21.5	67.2%	58.3%	63.2%	75.5%
ECD	78.3 ± 3.2	55.2±2.2	203.2±13	168.3±2.2*	88.8±9	2.7	34.2	147.2	57.7	468.9	245.2
ECI	34.0±2.2	17.8±2.3	64.4±11	58.2±4.2	38.4±8.9	2.7	22.4	734.4	250.4	223.7	148.4
RGR	0.55±0. 5	0.13±0.607	0.13±0.2	0.13±0.2	0.13±0.3	0.8	0.04	1	111	119.9	111.2
RCR	0.12±0.3	0.65±0.4	0.29±0.4	0.3±0.2 *	0.3 ± 0. 2	12.3	0.12	119.4	52	447	40.8

*Significant at 5%, - Non significant

Pupal duration was not affected with regard to control ones except for larvae fed on castor leaves treated with 3% concentration of sesame oil as it lasted only 3.9 days while that of control lasted 10.2 days, there was also decrease in pupal weight as it was 185.01mg comparing to 271.2 mg of control larvae. Sesame oil has a latent effect on larvae up to certain limit while pupal mortality was affected with jojoba and sesame oil extracts at 3% concentration, being 51% and 82% respectively.

Effect of Jojoba and Sesame Oils on Metabolic Parameters of *Spodoptera littoralis* Larvae

Table 2 showed that jojoba and sesame oils extract reduced the food consumption of the larvae at 3% concentration of sesame, being 40.3% compared to that of the control larvae. This concentration affected of food by increasing the excretion of larvae to the amount of food ingested (60.2%). The approximate digest ability (AD) and the conversion of ingested food (ECI) were not affected greatly compared to those of control when used Concentration 3% of jojoba and sesame oil on the 4th instar larvae of S. *littoralis*. while the ability of insect to convert the digested food (ECD), was significantly higher. The relative consumption rate (RCR), showed a significant reduction than those of control for all concentrations of the two experimented oils except 2% jojoba oil as it was higher, on the other hand the relative growth rate (RGR), did not affect in all concentrations.

Table 3: The total lipids of *Spodoptera littoralis* Larvae fed on castor leaves treated with Jojoba and Sesame oils extract in dry weight basis.

Sample	Total Lipids (%g/g)
Jojoba 2%	29.7
Jojoba3%	45.8
Sesame 2%	22.2
Sesame3%	14.2
Control	19.2

Jojoba and sesame oil extracts at concentration 3%, were antifeedant to 4th instar larvae of *S. littoralis*.

Effect of Oil Extracts on Total Lipids

Table 3 showed that feeding 6th instar larvae of S. *littoralis* on treated leaves with jojoba and sesame oil extracts. Lipids were increased for those treated with 3% sesame oil as it was 14.2% only in respect to control.

When 6th instar larvae of S. *littoralis* feeding on treated leaves with jojoba oil extracts concentrations 2% & 3% the total lipids were 29.7 and 45.8, respectively but when it feeding on treated leaves with sesame oil extracts concentrations 2% & 3% the total lipids were 22.2 and 14.2, respectively while the control was 19.2.

Discussion

The present results confirmed that Pupal duration was not affected with regard to control ones except for larvae fed on castor leaves treated with 3% concentration of sesame oil as it lasted only 3.9 days while that of control lasted 10.2 days, there was also decrease in pupal weight as it was 185.01mg comparing to 271.2 mg of control larvae according with (Abdel Aziz *et al.,* 2007; Mohamed Abdel-Raheem *et al.,* 2018; Abdel-Raheem, 2019; Abdel-Raheem, 2019; Slansky and Scriber, 1982; Sary, 1982; Marei *et al.,* 2009), Sesame oil has a latent effect on larvae up to certain limit while pupal mortality was affected with jojoba and sesame oil extracts at 3% concentration, being 51% and 82% respectively. These results are according with (Mesbah *et al.,* 2006; Mohamed Abdel-Raheem and Youssif, 2020; Mohamed Abdel-Raheem *et al.,* 2020; Abdel-Raheem, 2019; Ali *et al.,* 2017; Nadia *et al.,* 2019; Naglaa *et al.,* 2020), This result agreement with Hanan, (2012), mentioned that there was a significant reduction in the efficiency of larvae to convert

digested and ingested food into body tissue. Tahany and Abd El-Zaher (2017) mentioned that Jojoba oil in the form of Nano-proved that it come in the first category recording 100% mortality at 5% and 2.5% concentration and the minimum mortality % was 86.6% at 0.625% concentration after 7 days of treatment. The relative consumption rate (RCR), showed a significant reduction than those of control for all concentrations of the two experimented oils except 2% jojoba oil as it was higher, on the other hand the relative growth rate (RGR), did not affect in all concentrations. These results are agreement with the findings of Salem *et al.,* (2003); Mohamed (1986); Mohamed *et al.,* (2003). Jojoba and sesame oil extracts at concentration 3%, were antifeedant to 4th instar larvae of *S. littoralis*. Most of essential oils are toxic and were as a feeding deterrent to different larval stages of S. *littoralis*, (Pavela, 2004; Marei *et al.,* 2009). Lipids are considered to be an essential source of metabolic energy of cell maintenance, reproduction, embryogenesis and metamorphosis (Bailey, 1975; Slansky and Scriber, 1982; Dutkowski and Ziajka, 1972). When 6th instar larvae of S. *littorali*s feeding on treated leaves with jojoba oil extracts concentrations 2% & 3% the total lipids were 29.7 and 45.8, respectively but when it feeding on treated leaves with sesame oil extracts concentrations 2% & 3% the total lipids were 22.2 and 14.2, respectively while the control was 19.2. Ali, *et al.,* 2017, mentioned that the total protein, carbohydrate and lipid content of the midgut tissues of the larvae treated with the LC30 of garlic and lemon essential oils. Marei *et al.,* (2009); Abou El-Ghar *et al.,* (1996); Rawi *et al.,* (2010), recorded a decrease in the total protein and lipid in *S. littoralis* larvae fed on methylene chloride extract of *A. indica* and *Citrullus colocynthis*.

Conclusion

Generally, the present results clearly indicate that the tested plant oils exhibit insecticidal and antifeedant activities against larval and pupal stages of cotton leaf worm insect. The Plant extract oils are the promising materials which can be used as alternative components at integrated pest management programs to reduce as possible the harmful of usage chemical pesticides at the future.

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