Research Journal of Agriculture and Biological Sciences, 5(1): 103-107, 2009

Effect of Some Plant Oils on Biological, Physiological and Biochemical Aspects of *Spodoptera littoralis* (Boisd.).

S.S. Marei, E.M. Amr and N.Y. Salem

Pests and Plant Protection Department, National Research Centre, Cairo, Egypt.

Abstract: Jojoba and Sesame oil extracts were used in this work to evaluate their effects on biological, physiological as well as biochemical changes of the cotton leafworm *Spodoptera littoralis* (Boisd.). Both extracts caused pronounced prolongation in both larval and pupal duration. This prolongation was accompanied with a reduction in pupal weight of the treated larvae. The physiological changes were obvious on estimation of metabolic parameters, where there was a significant reduction in the efficiency of larvae to convert digested and ingested food into body tissues, hence a reduction in total body weight gain of treated individuals. The failure of insect to utilize digested and ingested food lead to a remarkable decrease in percentage of total lipids in larvae treated with the extracts.

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

INTRODUCTION

During the recent years, intensive research has been carried out to control agricultural pests by using natural insecticides of plant origin to decrease hazards in the environment. The toxic action of plant extracts was tested by many workers[20,7]. Several oil extracts or isolated active compounds have been shown to act as potent acute or chronic insecticides[21,1,9] and insect growth regulators[3,14,17]. Also the physiological and biochemical effect of some plant oil extracts on various insects were studied by[11,4].

Jojoba (*Simmodsia chinensis* (Clink); family Buxaceae), is a new oil- producing industrial crop that has attracted much attention in recent years. Jojoba oil, which is commonly known as liquid wax, is colorless and odorless with unique physical and chemical properties, unlike most other vegetable oils, which are triglycerides, jojoba oil is made of long -chain fatty acids and fatty alcohols with no side branching. The physical properties of jojoba oil are similar to those of other vegetable oils, although jojoba oil has a chemical structure that is somewhat different than that of most vegetable oils. 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. Jojoba oil caused an increase in larval and pupal durations of *Agrotis ipsilon* (HUFN),[2].

For sesame (Sesamum indicum L.)[6] found that neem and sesame oils completely inhibited adult emergence and appeared to be most promising seed protectant against C. chinensis.Rahman and Taulkader[8] found that The lowest percentage of eggs hatchability occurred when seeds were treated with 0.25% sesame oil.

The objective of this work is to study the effect of two extracts of both jojoba and sesame oils on some biological aspects, and some physiological criteria (nutritional parameters and total lipids) of *Spodoptera littoralis* (Boisd.).

MATERIALS AND METHODS

Biological Aaspects: Fifty newly moulted fourth instar larvae of *S. littoralis* from the stock culture reared in the laboratory under constant temperature (25±2^{0}C0) and relative humidity of 65 ± 5%, were kept individually in vials and divided into three equal groups. The first one was fed on discs of water treated castor leaves and controled 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 by offering discs of castor leaves dipped in 1% and 3% jojoba oil and 2% and 3% sesame oil.

Metabolic Parameters: Fifty newly moulted fourth instars larvae of the same weight were divided into five equal groups, where each larva was kept individually. The first group (control), was fed on water treated castor leaf discs of known weight, the second and third groups were fed on castor leaf discs dipped in 1% and 3% jojoba oil respectively the fourth and fifth 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

Corresponding Author: Shahira S. Marei, Pests and Plant Protection Department, National Research Centre, Cairo, Egypt.

estimated. Twenty newly moulted fourth 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 Waldbauer 1968, Slansky and Scriber 1982 and. All data were based on dry weight:

AD = ((a-b)/a) x100
ECI = (c/a) x 100
ECD = (c/ (A-B)) x 100
(RGR) = c/ (T x A)
(RCR) = f / (T x 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 6th instar larvae of *S. littoralis* of both treated and untreated larvae were extracted according to Sary,[22]. Known weight of fresh sample was put in cellulosic thymbol and well closed then introduced to soxhlet apparatus, 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 40^0C and the dry residual represents the total lipid content in the test sample.

RESULTS AND DISCUSSION

Effect of Jojoba and Sesame Oils on Some Biological Aspects of 4th Instar Larvae of *S. Littoralis:* Data in Table (1) clarified that there is no remarkable effect on development of larvae fed experimental concentrations of both jojoba and sesame oils 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 3.6 days while that of control lasted 9.9 days, there was also a remarkable decrease in pupal weight as it was 183.31mg comparing to 268.3 mg of control larvae. These results showed that 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 50% and 80% respectively. These results are in agreement with those obtained by meshel *et al*.[14], who mentioned that both essential sesame oil and clove volatile oil showed a weak toxic effect on the 4th instar larvae of *S. littoralis*. While a mixture of both oils increased the percentage of larval mortality in comparison with their use individually.

Effect of Jojoba and Sesame Oils on Metabolic Parameters of *Spodoptera Littorlais* Larvae: To evaluate the effect of jojoba and sesame oil extracts on the utilization of food and their effects on body tissues of the experimental larvae, metabolic parameters were presented in Table (2). The data obtained clarified that the two oil extracts reduced the food consumption of the tested larvae at a significant manner, especially at 3% concentration of sesame, being 42.6% compared to that of the control larvae. This concentration also affected the assimilation of food by increasing the excretion of larvae to the amount of food ingested (63.1%), this disturbance in relation between food consumption and the amount of feces led to a significant reduction in final body weight of the treated larvae as they gained only 52.3% as much weight as the control.

When testing the effect of 3% concentration of jojoba and sesame oil extracts on the utilization of food by 4th instar larvae of S. *littoralis*, data obtained showed that the approximate digestability (AD) and the conversion of ingested food (ECI), were not affected greatly compared to those of control, 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 1% jojoba oil as it was higher, on the other hand the relative growth rate (RGR), did not affect pronouncedly in all concentrations. These results are in agreement with the findings of Salem *et al*.[20,16,1,5], who found that some plant extracts e.g., *Peganium harmala*, Neem azal T/S and suneem oil when tested at different concentrations on 2nd, 3rd and 4th instar larvae of *S. littoralis*, had a detrimental effect on the food intake and consumption and all assimilated metabolic parameters were less than those of control larvae.

Results showed that jojoba and sesame oil extracts at higher concentration (3%), acted as an antifeedant to 4th instar larvae of S. *littoralis*. In general some essential oils are toxic and act as a feeding deterrent to different larval stages of S. *littoralis* e.g. *Origanum majorana* and *Ocimum basilicum* which significantly affected the growth index (RGR) and the efficiency of conversion of ingested and digested food (ECI & ECD)[17]. The low consumption rate (RCR), in larvae

Table 1: Biological effect of Jojoba and Sesame oil extracts on *Spodoptera litoralis* Larvae.

Treatments	Larval duration	Larval mortality	Pupal duration	Pupal weight	Pupal mortality
Control	10.5±0.16	0	9.9±0.1	268.8±10.39	0
Jojoba 1%	7.5±0.84	10	7.9±2.9	233.3±7.4*	10
Jojoba3%	9.2±1.09	30	8.2±2.8	127.02±83.9*	50
Sesame 2%	9.6±1.07	10	10.7±1.2	260.3±6.9	10
Sesame3%	10.2±2.23	20	3.6±2.41	183.3±42.4*	80
F. value	0.855		2.34	1.94	
LSD 5%	3.62		5.11	122.8	

* Significant at 5%, - Non significant.

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

Criteria	Control	Jojoba 1%	Jojoba 3%	Sesame 2%	Sesame 3%	F.	LSD 5%	% with respect to control			
								J1%	J3%	S.2%	S.3%
Food consumption	100.13±3.8	68.6±8.4*	57.03±11*	47.2±3.5*	42.6±7.2*	3.9	21.1	68.3 %	57.4 %	47.1 %	42.6 %
Feces Dry weight	40.9±2.8	42.9±6.2	42.7±9.3	31.4±4.0	26.9±5.2	2.6	17.1	104.9 %	104.4 %	76.7 %	65.8 %
Feces % with respect to food consumption	40.9%	62.5%	74.9%	66.5%%	63.1%						
Weight gain	21.4±1.6	11.6±0.9*	25.3±2.6	25.7±0.1	11.2±0.7*	2.6	4.8	54.2%	118.2	120.	52.3
AD	58.9±7.7	39.1±2.98	33.5±4.2*	36.1±6.7*	43.3±4.4	2.6	20.9	66.4%	56.9%	61.3	73.5
ECD	76.83 ± 5.1	52.3±9.2	200.9±17*	167.9±20*	86.8±11*	2.8	35.8	145.3	55.8	466.4	241.1
ECI	36.0±3.1	18.9±2.5	63.7±12*	56.7±4.9*	37.5±10.4	2.6	23.8	73.8	248.8	221.5	146.5
RGR	0.56±0.06	0.11±±.008	0.12±0.01	0.13±0.01	0.12±0.006	0.7	0.03	1	109	118.2	109.1
RCR	0.11±0.010	0.62±.08*	0.28±.06*	0.2±0.02*	0.2 ± 0.02*	11.6	0.18	118.7	50	42.9	39.3

*Significant at 5%, - Non significant.

treated with the two oils at 3% concentration may be attributed to the deleterious effect of allelochemics of the essential oils that passed through the peritrophic membrane of insect and damaged the epithelium of the insect mid gut, the inhibition of utilization of food may be due to the activity of some extracts which inhibit digestive enzymes or may combine with some amino acids in the mid gut and cause a decrease in the final body weight of the treated insects[13].

Effect of Oil Extracts on Total Lipids: Lipids have been recognized to occupy a central place in insect physiology. They are considered to be an essential source of metabolic energy of cell maintenance, reproduction, embryogenesis and metamorphosis[8]. During vitellogensis appreciable quantities of lipids are deposited in eggs[10].

From the data presented in Table (3), it is clear that feeding 6th instar larvae of S. *littoralis* on treated leaves with different concentrations of jojoba and sesame oil extracts for three days remarkably increased the percentage of total lipids except for those treated with 3% sesame oil as it was 14.3% only in respect to control. This reduction leads to the conclusion that sesame oil caused a disturbance in the process of digestion and assimilation of food as represented in Table (2), these findings are in agreement with that found by Schoonhoven and Meerman[23].

Table 3: Effect of Jojoba and Sesame oils extract on the total lipids of *Spodoptera littoralis* Larvae on dry weight basis

Sample		Total Lipids (%g/g)
Control		19.1
Jojoba	1%	28.6
Jojoba	3%	44.8
Sesame	2%	20.42
Sesame	3%	14.84

On the contrary, larvae treated with 3% concentration of jojoba showed an increase in the percentage of total lipids, this is confirmed by increasing the efficiency of larvae to convert both

ingested and digested food (ECI & ECD) into body tissues (Table 2). The reduction in total lipids led to a reduction in pupal weight. The data obtained were confirmable to the findings of Abou El-Ghar *et al.*[3] who observed that 6th instar larvae of *A. ipsilon* when treated with ethanol extract of *Melia azedarach* caused high reduction in the total lipids and pupal weight .

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