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THE TOXICOLOGICAL AND BIOLOGICAL EFFECTS OF SOME COMPOUNDS ON THE COTTON LEAFWORM, *SPODOPTERA LITTORALIS* (BOISD.) (LEPIDOPTERA: NOCTUIDAE)

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ABSTRACT: The present studies were conducted to evaluate toxic and biological effects of some formulation compounds; XenTari, Biovar, NeemAzal, (biocids) and Jojoba oil, Orange oil (oils) against cotton leafworm, *Spodoptera littoralis* (Boisd.). Results clear that all compounds had toxic effect on the 2nd instar larvae of *S. littoralis*. Increasing the concentration of compounds and days post-treatment caused increase in larval mortality percentage. Jojoba oil had the highest mortality percentage (33, 42, 46, 47and 50%) and (41, 49, 53, 45 and 57%) after 1, 3, 5, 7 and 10 days from treatment by recommended and double recommended concentration as compared with 5% for control after 10 days. While the lowest mortality percentages were (13, 16, 18, 20 and 21%) and (19, 25, 28, 31 and 32%) recorded with Orange oil, respectively. 2nd tested instar larvae were affected more than 4nd instar larvae. These compounds showed the different effects on some aspects of *S. littoralis* treated as 2nd and 4th instar larvae and caused decrease in larval & pupal mortality percentage, larval & pupal weight, pupation & adult emergency percentage, deposited eggs/ female and hatchability percentages as compared with control. While, Dursban (O.P. Insecticide) showed the highest effects on these biological aspects as compared with previous all compounds.

Key words: *Spodoptera littoralis* , biology, Toxicology , insecitides

INTRODUCTION

Cotton has significant importance in Egypt. It has faced challenges in recent years, including some pests affect cotton quantity and quality as; the cotton leafworm *S. littoralis* that is the most significant pest that infest cotton crops. This pest is posing challenges to cotton growers. Efforts are continuously made to develop new control strategies, research is focused on understanding their biology, behavior and resistance mechanisms to improve management practices and minimize the economic impact on cotton production (Khawas and Abd El-Gawad, 2002).

Insecticides has been used in the past for controlling pests in various crops, including cotton especially Dursban that acts by inhibiting the activity of an enzyme called acetylcholinesterase, which is essential for proper nerve function in insects. Gaaboub *et al.* (2012). However, it's worth noting that the use of Dursban has banned in several countries due to concerns about its potential environmental and health impacts. Bioinsecticides and plant extracts insert in integrated pest management (IPM) approaches, are being promoted as more sustainable and environmentally friendly options for pest control in cotton.

Bio insecticides, especially *Bacillus thuringiensis*, produces proteins toxic to specific groups of insects, while fungi as *Beauveria bassiana* penetrate externally cuticle and internally midgut (Abd-ElAzeem *et al*., 2019). Plant extract as neem (*Azadirachta indica*) used for its insecticidal properties, including its efficacy against pests in cotton crops (Khedr, 2002). Also, Orange oil and Jojoba oil are natural plant-based oils that have been used for various purposes; including pest control (Bakkali *et al.*, 2008 and Ismail and Shaker, 2014). They can provide specific recommendations based on the pest species, local conditions and available

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research in your region. Additionally, always guidelines provided by manufacturer.

In this study we evaluated toxic and biological effects of XenTari, Biovar, Jojoba oil, NeemAzal, orange oil and Dursban on the cotton leafworm, *S. littoralis*

MATERIALS AND METHODS

Rearing technique of *S. littoralis*

The laboratory strain of *S. littoralis* reared at the laboratory of leafworm Research Department, Plant Protection Research Institute, Sharkia branch without any exposure to chemicals for many generations under controlled conditions in an incubator at 26 ± 1°C and 65 ± 5 % RH. The larvae were reared on castor bean leaves, *Ricinus communis* L. (as a source of food which was provided daily) as described by El-Defrawi *et al.* (1964). The adults were sexed and placed in glass gars (500 mL volume) supplied with leaves of Tafla, *Nerium oleander* L. for eggs laying. Adults were fed on 10% sugar solution and changed by new one daily. The eggs were obtained and kept in glass gars (500 mL volume), incubated at the same previous conditions until hatching. The newly hatched larvae were used directly in experiments.

Tested compounds

Organophosphorus

Dursban ®: used the rate of IL/feddan. Dow Agro science

Bioinsecticides

XenTari DF 54% ®: recommended rate is 200 gm / 100 L water.

Biovar®: applied at rate of 200 g/100 L water.

Plant extracts: Top Perfect 80% EC

Jojoba oil: used formulation at the rate of 500 ml/feddan.

NeemAzal TS 1%: The recommended rate is 325 ml/Feddan.

Orange oil: used formulation at the recommended rate is 40 cm / 100 L water.

Toxic effects of some compounds against 2nd instar larvae of *S. littoralis*.

To evaluate the toxic effect of XenTari, Biovar, Jojoba oil, NeemAzal, and orange oil on 2nd instar larvae of *S. littoralis*. Leaves of castor bean were dipped for 10 seconds in the recommended construction and double construction of previous compounds and left to dry and then placed in glass gars (500 mL volume). Twenty-five 2nd instar larvae of *S. littoralis* were added to each glass gars. Four replicates were used for each treatment and control. Control leaves dipped in water only. Glass gars covered by a pieces of cloth and incubated at the constant conditions of 26±1ºC and 65±5% RH. Larvae were allowed to feed on treated leaves for 48 hrs. then provided with untreated clean castor bean leaves. The dead larvae were recorded after 1, 3, 5, 7 and 10 days of exposure and the percentage of mortality were estimated.

Biological effects of some compounds against 2nd instar larvae of *S. littoralis*.

To study the biological effects of the recommended constructions of XenTari, Biovar, Jojoba oil, NeemAzal, orange oil and LC_{50} of Dursban on 2nd and 4th instar larvae of *S. littoralis*. Leaves of castor bean were dipped for 10 seconds in the recommended construction of previous compounds and left to dry then placed in glass gars (500ml volume). 25 2nd or 4nd instar larvae of S. *littoralis* were added to each glass gars. Four replicates were used for each treatment and control. Control leaves dipped in water only. Glass gars covered by a pieces of cloth and incubated at previous conditions. Larvae were allowed to feed on treated leaves for 48 hrs. then provided with untreated clean castor leaves. Larvae were examined daily to record the biological parameter; larval duration, larval mortality, larval weight, pupation percentage and adult emergence parcentage. The pupae were transferred to clean gars and incubated until moth emergence. Pupal duration, pupal mortality percentages and pupal wight were recorded. The emerged adults were sexed and placed (3 pairs /

replicate) in glass gars (500 ml volume) supplied with Tafla leaves for eggs laying. Adults were fed on 10% sugar solution and changed by new one daily. Four replicates were used for each treatment and control. Adult emergence percentage, sex ratio, pre oviposition, post oviposition, oviposition periods, male and female longevity were recorded. The eggs were obtained and kept in glass gars (250 ml volume), incubated at the same previous conditions until hatched. The number of deposited eggs/female and hatchability percentages were recorded.

Statistical analysis

Data obtained were statistically analyzed according to completely randomized design. The appropriate methods were used for the analysis of data according to Little and hills (1975) and the proper "F" value was calculated as described by Fisher (1950) and Snedecor (1957). By CoStat

RESULTS AND DISCUSSION

Toxic effect of some compounds against 2nd instar larvae of *S. littoralis*

Results in Table (1) clear that all compounds had toxic effect on the 2nd instar larvae of *S. littoralis*. Increasing the concentration of compounds and days post-treatment caused increase in the larval mortality percentage. Jojoba oil had the highest mortality percentage (33, 42, 46, 47 and 50%) and (41, 49, 53, 45 and 57%) after 2, 4, 6, 8 and 10 days from treatment by recommended concentration and double recommended concentration as compared with 5% for control after 10 days. While the lowest mortality percentages were (13, 16, 18, 20 and 21%) and (19, 25, 28, 31 and 32%) recorded with Orange oil, respectively. XenTari field concentration 20,31,37,38,40. and Double field concentration 27, 40, 42,48, 49 while Biovar field concentration15,25,29,30,30 and Double field concentration 20, 34, 36, 38, 40 but NeemAzal field concentration 17,21,25,28,29 and Double field concentration 28, 36, 38, 41, 41.

Khedr (2002) found that neemazal, soyabean and garlic extracts showed a high larval mortality and neemazal caused the highest mortality, especially the highest concentration, while garlic extracts recorded the lowest mortality of *S. littoralis*. Hewady *et al*. (2002) studied the effect of neemazal T/S 1% NeemAzal (AZA) on mortality, pupation, adult emergence and malformation when the newly hatched larvae of pink bollworm exposed to treated diet as well as latent effect of AZA on fecundity, fertility and longevity of adult moths derived from treated larvae. Results revealed that AZA adversely affect larval mortality and a dose and time, when the impeditive larval mortality increased to 85.77% at 130 ppm after 20 days. Neemazal also influence larval and pupal development resulted morphological deformation, reduction larval and pupal weight and sever reduction in fecundity, fertility and longevity.

Jojoba oil investigated by many scientists as bioactive control agent, Marei *et al.* (2009) found that Jojoba oil extract caused pronounced prolongation in both larval and pupal duration of the cotton leafworm *S. littoralis.* This prolongation was accompanied with a reduction in pupal weight of the treated larvae. Gaaboub *et al*. (2012) studied that the toxicity of Jojoba oil against the 2nd and 4th instar larvae of *S. littoralis* after a feeding period 24 hrs. on treated leaves caused prolongation in larval and pupal periods. The female fecundity and fertility also showed significant reduction of the number of eggs deposited by each female developed from 4th instar larvae treated compared with the control.

Salama *et al*. (2013) recorded that NeemAzal and *B. thuringiensis* caused slight and moderate reduction in bollworms (the reduction rates ranged between 34.18 and 52.43%). El-Geddawy *et al*. (2014) evaluated toxicity of NeemAzal 0.03% EC against 2nd and 4th instar larvae of *S. littoralis*, found that NeemAzal can used as biocontrol agents for controlling the cotton leafworm provides a promising alternative to conventional insecticides in Egypt.

Table (1). Larval mortality percentage of some compounds on cotton leafworm *S. littoralis* post-treatment.

N	*Compounds*	**Mortality percentages %**									
		After 1 days		**After 3 days**		**After 5 days**		**After 7 days**		**After10 days**	
		field concentration	***Double field concentration***	***field concentration***	***Double field concentration***	***field concentration***	***Double field concentration***	***field concentration***	***Double field concentration***	***field concentration***	***Double field concentration***
1	XenTari	20	27	31	40	37	42	38	48	40	49
2	Biovar	15	20	25	34	29	36	30	38	30	40
3	NeemAzal	17	28	21	36	25	38	28	41	29	41
4	Jojoba oil	33	41	42	49	46	53	47	54	50	57
5	Orange oil	13	19	16	25	18	28	20	31	21	32
Control		4		5		5		5		5	

Ismail and Shaker (2014) and Ismail *et al*. (2022) evaluated the toxicity of Jojoba oil; were the most potent than peppermint oil, garlic oil and ginger oil. Generally, essential oils enhance the toxicity of some compounds against newly hatched larvae of this pest and conserve the role of beneficial insects while reduce the cost of pest control. Abdel-Razik and Mahamoud (2017) indicated that the LC_{50} of the jojoba extract on the 2nd instar larvae of *S. littoralis*, was less than that on the 4th instar larvae, as well as it was decreased by increasing the period after treatment indicated that the larval mortality was higher on 2nd instars than 4th ones. Larval duration was shortened at all treatments of the 2nd instars. Pupal mortality was highly effective on the 2nd instar treatments compared with 4th, also, the pupal duration was shortened at all treatments of the two instars. The percentages of emerged moths were decreased by increasing the extract concentrations. There were significant differences in the egg laid per female.

Biological effects of some compounds against 2nd instar larvae of *S. littoralis*

1- Immature stages

Data in Table (2) demonstrated that there was significant difference with larval duration between the treated larvae and control. The lowest duration was 12.5 days for Dursban while, NeemAzal, Jojoba oil and orange oil recorded 15.5 days as compared with control (14.0 days). Also results of larval weight showed non-significant differences between the tested compounds and control. The lowest larval weight was 0.380 g for Dursban as well as highest weight was 0.470g for orange oil as compared with control (0.608 g). Larval mortality percentages demonstrated the highly significant differences between all treatments and control. The lowest larval mortality was 20% for orange oil but the highest larval mortality was 50% with Jojoba oil compared with control (5%).

Pupation percentage showed very highly significant differences between tested compounds and control. The highest pupation percentage was 80% with orange oil while the lowest was 50% for Jojoba oil compared with 95% for control. On the other hand, pupal duration showed significant differences between tested compounds and control. The lowest duration for pupa was 7.0 days with Dursban while, Jojoba oil caused the highest pupal duration 12.0 days compared with 8.5 days for untreated larvae. Results of pupal weight showed non-significant differences between the tested compounds and control. The lowest pupal weight was 0.300g for Dursban but the highest pupal weight was 0.340 g for Biovar compared with 0.350 g for control. Pupal mortality percentage data showed highly significant differences between tested compounds and control. The highest pupal diformed was 60% with Dursban as well as the lowest was 12.5% for XenTari compared with 0.00% for control.

Table (2). Effect of some compounds against immature stages treated as 2nd instar larvae of cotton leafworm *S. littoralis*.

Treatments	Larval duration (days)	Larval weight (gram)	Laval mortality %	Pupal weight (gram)	Pupal duration (days)	Pupation %	Pupal diformation %
Dursban	12.5[b]	0.3800	45.0b	0.3000	7.0 c	55.0000 [d]	60.0a
XenTari	15.25[a]	0.4100	40.0c	0.3200	8.5bc	60.0000 [cd]	12.50e
Biovar	14.5 [a]	0.4300	30.0 d	0.3400	9.5b	70.0000 [bc]	25.0 cd
NeemAzal	15.5 [a]	0.4500	28.0d	0.3200	8.5bc	72.0000 [b]	27.43c
Jojoba oil	15.5[a]	0.3860	50.0 a	0.3100	12.0a	50.0000 [e]	23.0 d
Orange oil	15.5 [a]	0.4700	20.0e	0.3320	8.5bc	80.0000 [b]	54.06 b
Control	14.0[ab]	0.6080	5.0 f	0.3500	8.5bc	95.0000 [a]	0.00 f
P	0.018*	0.1953	0.000***	0.3948	0.001**	0.000***	0.000***
$LSD_{0,05}$	1.75	NS	3.50	NS	1.75	11.8686	3.09

In each column, means followed by the same letter are not significant at the 5% level.

2. Adult stages

Data in Table (3) indicated that there is significant difference with emergence percentage between the treated larvae and control. The lowest percentage was 40% for Dursban while the highest XenTari was 87.5% as compared with control (100.0 %). Male sex ratio percentages in table showed non-significant differences between all treatments and control. The lowest percentage was 51.14% for Dursban but the highest was 52.38% with orang oil compared with control (50.53%). Also, results of female sex ratio showed non-significant differences between the tested compounds and control. The lowest was 47.62% for orange oil but the highest was 48.86% for Dursban compared with 49.47% for control. Male longevity showed non-significant differences between tested compounds and control. The lowest male longevity recorded for orange oil (7.0 days) while Dursban caused the highest longevity (11.0 days) compared with 9.5 days for untreated larvae. On the other hand, the lowest female longevity demonstrated for orange oil and Biovar was (7.0 days) as well as Dursban caused the highest female longevity 10.0 days compared with 8.5 days for untreated larvae in control.

There were significant differences with pre-oviposition duration between the treated larvae and control. The lowest pre-oviposition was 1.5 days for Biovar while the highest for Dursban was 4.5 days as compared with control (2.0 days). Oviposition showed significant differences between all treatments and control. The lowest period was 2.5 days for orange oil but the highest Oviposition period was 4.0 days with Biovar, NeemAzal, Jojoba oil and orange oil compared with control (4.5 days). Also results of post-oviposition showed significant differences between the tested compounds and control. The lowest duration was 1.0 % for orange oil and Jojoba oil but the highest weight was 2.5 days for Dursban compared with 2.0% for control.

The significant differences for No. of eggs between tested compounds and control was demonstrated. The lowest no. of eggs achieved by Dursban (610 eggs) while Biovar caused the highest eggs number (700 eggs) compared with 810 eggs for untreated larvae in control. On the other hand, hatchability percentages showed significant differences between tested compounds and control. The lowest percentage recorded for Dursban was 20.0 % as well as orange oil caused the highest hatchability 55.0% compared with 90.0% for untreated larvae in control

Our Data showed that the biopesticides and plant extracts gave the lowest larval weight and larval mortality from XenTari, pupal mortality and pupation percentage from orange oil. While Dursban evaluated the lowest larval duration, pupal weight and pupal duration. IPM is the ideal solve for pest control according to Helalia *et al*. (2006) who investigated the effects of Dursban ethyl with Xentari and Dipel 2x against the 2nd instar larvae of *S. littoralis*; the use of low rates of conventional insecticides proved to be suitable to control *S. littoralis* to reduce the insect resistance. Also, our study showed similarity with Shetawy *et al*. (2022) who demonstrated the effect of orange oil on the *S. littoralis* under laboratory conditions. There were significant differences between tested compounds and control on pre- pupal period, pupation percentage and pupal weight (g) of second and fourth instar larvae of cotton leafworm, also on adult emergence percentage, sex ratio and male longevity.

Effect of some compounds against 4th instar larvae of cotton leafworm

1. Immature stages

Data in Table (4) illustrate there was significant difference with larval duration between the treated larvae and control. The lowest duration was 13.5 days for Dursban while, the highest was for Jojoba oil (15.25 days) as compared with control (14.0 days). Also, larval weight showed significant differences between the tested treatments and control. The lowest weight was 0.395 g for Dursban as well as highest weight was 0.467 g for orange oil as compared with control (0.618 g). Larval mortality percentages demonstrated significant

Table (3). Effect of some compounds against adult stages of cotton leafworm *S. littoralis* treated as 2nd instar larvae.

Treatment	Emergency %	sex ratio%		longevity (days)		Pre-ovi position	Ovi position	Post-oviposition	No. of eggs	Hatchability%
		♂	♀	♂	♀					
Dursban	40.0f	51.14	48.86	11.0a	10.0a	4.5 a	3.0bc	2.5a	610e	20.0f
XenTari	87.50b	51.42	48.58	9.0b	8.0 b	3.0bc	3.0bc	2.0ab	730b	35.0d
Biovar	75.0cd	51.42	48.58	8.5b	7.0 b	1.5e	4.0ab	1.5bc	700c	30.0e
NeemAzal	72.57d	51.19	48.81	9.25b	8.0b	2.5cd	4.0ab	1.5bc	685d	40.0c
Jojoba oil	77.0 c	51.30	48.70	9.0 b	8.0 b	3.0bc	4.0ab	1.0c	680d	38.0c
Orange oil	45.94e	52.38	47.62	7.0c	7.0b	3.5bc	2.5c	1.0 c	605e	55.0b
Control	100.0a	50.53	49.47	9.5b	8.5 ab	2.0de	4.5a	2.0a	810a.	90.0a
P	0.000***	NS 0.526	NS 0.526	0.0001***	0.028*	0.000***	0.010*	0.002**	0.000***	0.000***
$LSD_{0.05}$	3.0925	--	--	1.16	1.72	0.90	1.11	0.71	13.42	2.56

In each column, means followed by the same letter are not significant at the 5% level.

Table (4). Effect of some compounds against immature stages treated as 4th instar larvae of cotton leafworm *S. littoralis*.

Treatment	Larval duration (days)	Larval weight (gram)	Laval mortality %	Pupal weight (gram)	Pupal duration (days)	Pupation %	Pupal diformation %
Dursban	13.5c	0.3950e	35.0a	0.2750 e	8.75bc	65.0 c	50.0 a
XenTari	14.5abc	0.4150d	30.0 b	0.300 c	9.50 ab	70.0 bc	12.50 d
Biovar	14.5abc	0.4350c	15.0d	0.3170b	9b	85.0 ab	37.35 b
NeemAzal	15.25a	0.4600 b	18.0c	0.2950 cd	8.75bc	82.0 abc	31.41 c
Jojoba oil	15.25 a	0.4000e	20.0c	0.2850 de	10.25 a	80.0 ab	50.0 a
Orange oil	15.0ab	0.4670b	6.0e	0.3110b	9.0b	94.0 a	37.50 b
Control	14.0 bc	0.6180a	2.0f	0.3400 a	8.75bc	98.0 a	3.0e
P	0.123*	0.000***	0.000***	0.0000***	0.004**	0.001**	0.000***
$LSD_{0,05}$	1.2428	0.0130	2.26	0.010	0.98	17.19	2.19

In each column, means followed by the same letter are not significant at the 5% level.

differences between all treatments and control. The lowest larval mortality was 6% for orange oil but the highest larval mortality was 35% for Dursban compared with control (2%). Pupal weight showed very high-significant differences between the tested compounds and control. The lowest weight was 0.275 g for Dursban but the highest was 0.317 g for Biovar compared with 0.340 g for control.

Pupal duration showed non-significant differences between tested compounds and control. The lowest duration for pupa was 8.75 days when larva treated with Dursban and NeemAzal while Jojoba oil caused the highest larval duration 10.25 days compared with 8.75 days for untreated larvae. On the Other hand, pupation percentage showed very highly significant differences between tested compounds and control. The highest pupation percentage was 94% with orange oil as well as the lowest was 65% for Dursban compared with 98% for control. Pupal mortality percentage data showed significant differences between tested compounds and control. The highest pupal morality was 50% with Dursban and Jojoba oil as well as the lowest was 12.5% for XenTari compared with 3% for control.

2. Adult stages of cotton leafworm *S. littoralis*

Data in Table (5) demonstrated that there was significant difference between adult moths emergency percentages resulted from treated larvae and control. The lowest percentage was 50.0% for Dursban and Jojoba oil while the highest emergency percentage for XenTari was 87.5% as compared with control (97.0 %). Male sex ratio percentages showed the non-significant differences between all treatments and control. The lowest male sex ratio was 50.61% for XenTari but the highest was 50.78% with Dursban compared with control (50.0%). Also, results of female sex ratio showed non-significant differences between the tested compounds and control. The lowest one was 49.22% for Dursban but the highest was 49.39% for XenTari compared with 50% for control. Female longevity showed significant differences between tested compounds and control. The lowest female longevity period recorded for Dursban (8.0 days) as well as XenTari caused the highest female longevity 9.0 days compared with 9.5 days for untreated. On the other hand, male longevity showed significant differences between tested compounds and control. The lowest male

Table (5). Effect of some compounds against adult stages of cotton leafworm *S. littoralis* treated as 4th instar larvae.

Treatment	Emergency %	sex ratio%		longevity (days)		Pre-ovi position	Ovi position	Post-ovi position	No. of eggs	Hatchability%
		♂	♀	♀	♂					
Dursban	50.0 [e]	50.78	49.22	8.0c	7.0	4.0	2.0 [c]	2.0	553f	27.0 e
XenTari	87.50 [b]	50.61	49.39	9.0b	8.0	3.0	4.0 [a]	2.0	687b	41.0d
Biovar	62.65 [d]	50.71	49.29	8.25ab	7.25	3.0	4.0 [a]	1.25	668c	38.0d
NeemAzal	68.59 [c]	50.65	49.35	8.5b	7.5	4.0	3.0 [b]	1.5	614d	47.0c
Jojoba oil	50.0 [e]	50.71	49.29	8.0c	7.0	4.0	3.0 [b]	1.0	592e	45.0c
Orange oil	62.50 [d]	50.63	49.37	7.75d	7.0	3.75	3.0 [b]	1.0	550f	65.0b
Control	97.0 [a]	50.0	50.0	9.5a	8.5	4.0	4.0 [a]	1.5	860 a	92.0a
P	0.000***	0.99NS	0.99NS	0.000***	.73NS	.96NS	0.000***	.90NS	0.000***	0.000***
$LSD_{0,05}$	2.19	NS	NS	0.48	1.59	NS	0.59	NS	14.04	3.15

In each column, means followed by the same letter are not significant at the 5% level.

longevity was 7.0 days for Orange oil, Jojoba oil and Dursban while XenTari caused the highest male longevity 8.0 days compared with untreated male 8.5 days. There is non-significant difference with pre-oviposition period between some of the treated larvae and control. The lowest pre-oviposition 3.0 days for Biovar and XenTari while the highest pre-oviposition period for Dursban wase four days as equally with control (4.0 day).

Data also recorded the oviposition period that revealed the significant differences between all treatments and control. The lowest oviposition period was 2.0 days for Dursban but the highest oviposition period was 4 days for Biovar and XenTari compared with control (4.0 days). Also, results of post-oviposition period showed non-significant differences between the tested compounds and control. The lowest post-oviposition period was one days for Orange oil and Jojoba oil but the highest post-oviposition was 2.0 days for Dursban and XenTari compared with 1.5% for control. Number of deposited eggs showed significant differences between tested compounds and control. The lowest deposited eggs number recorded for Dursban (553.0 eggs) while Biovar caused the highest eggs number (668.0 eggs) compared with 860.0 eggs for untreated. Hatchability percentages showed significant differences between tested compounds and control. The lowest hatchability percentage recorded for Dursban was 27.0% as well as orange oil caused the highest hatchability percentage 65.0% compared with 92.0% for untreated larvae.

There is similarity between our results and Farag (2008) who studied susceptibility of 3rd instar larvae of *S. littoralis* against Biovar under simulated field conditions in Egypt. he found that Biovar induced the highest percentage mortality followed by Neemzal.

Also, our data in harmony with Sciortino (2021) who reported that orange oil take great attention as bioactive agent against different kind of insects. An ultralow amount of sub-micron spherical SiO_2 particles encapsulating 7 wt % crude orange oils (SiliOrange) suspended in water shows surprisingly high insecticidal activity against the cotton leafworm, *S. littoralis*, and significantly reduces the progeny of cotton aphid *Aphis gossypii* under laboratory testing conditions. Considering the ease of reproducible preparation of the material and the biocompatible nature of both silica and orange essential oil, these results may open the route to sustainable pest control using new bio pesticide water-based formulations based on sol-gel microencapsulated orange oil. Shetawy *et al*. (2022) demonstrated the effect of orange oil on *S. littoralis* under laboratory conditions. There were significant differences between tested compounds and control on pre-pupal period, pupation% and pupal weight (g) for second and fourth instar larvae of *S. littoralis*, also on adult emergence (%), sex ratio and male longevity.

CONCOLSION

These compounds XenTari, Biovar, NeemAzal, (biocids) and Jojoba oil , Orange oil (oils) and Dursban (O.P. Insecticide) have toxic and latent effects against cotton leafworm, *Spodoptera littoralis* (Boisd) and may be included it in IPM to control this insect pest.

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التأثيرات السمية والحيوية لبعض المركبات على حشرة دودة ورق القطن

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الملخص العربي

أجريت هذه الدراسات لتقييم الآثار السامة والحيوية لبعض المركبات وهي " زنتاري ، بيوفار ، نيمازال ، زيت الجوجوبا وزيت البرتقال" ضد دودة ورق القطن ، *Spodoptera littoralis* (Boisd.). أظهرت النتائج أن جميع المركبات لها تأثير سام على يرقات العمر الثاني من *S. littoralis*. وقد أدى مضاعفة التركيز من المركبات المستخدمة وزيادة عدد الأيام التالية لإجراء المعاملات إلى زيادة نسبة موت اليرقات. حيث سجل زيت الجوجوبا أعلى نسبة موت (33، 42، 46، 47 و50٪) و (41، 49، 53، 45 و57٪) بعد 2، 4، 6، 8 و10 أيام من المعاملة بالتركيز الموصي به وضعف التركيز الموصي به مقابل 5٪ بعد 10 أيام. بينما كانت أقل نسب موت عند المعاملة بزيت البرتقال (13، 16، 18، 20، 21٪) و (19، 25، 28، 31، 32٪) على التوالي. وقد تأثرت يرقات العمر الثاني أكثر من يرقات العمر الرابع. كما أظهرت المركبات المستخدمة تأثيرات مختلفة على بعض الخصائص الحيوية لليرقات المعاملة من دودة ورق القطن *S. littoralis* في العمر الثاني والرابع وتسببت في انخفاض نسبة موت اليرقات والعذارى وانخفاض وزن اليرقات والعذارى وكذلك انخفضت نسبة التعذير وقل عدد الفراشات الناتجة وانخفض عدد البيض الذي تضعه الإناث ونسب فقس البيض مقارنة بالأفراد غير المعاملة. وقد أظهر مبيد دورسبان أعلى تأثير على هذه العمليات الحيوية مقارنة بجميع المركبات السابقة.