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TOXICOLGICAL AND BIOCHEMICAL EFFECTS OF SOME RECOMMENDED AND ALTERNATIVE COMPOUNDS ON COTTON LEAFWORM *Spodoptera littoralis* (BOISD) (LEPIDOPTERA:NOCTUIDE) IN COTTON FIELDS.

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ABSTRACT

Field and laboratory experiments were carried out to evaluate the two insect growth (IGRs), lufenuron and teflubenzuron, antifeedant compoundindoxacab, miniral oil(Kz oil), compound Protecto, *Bacillus thuringinsis*(Bt)and Dursban, chlorpyrifos against the larvae of cotton leafworm, *Spodoptera littoralis*(Boisd.).Field experiment conducted during 2013 and 2014 seasons at KafrSakrregion, SharkyiaGovernorate, Egypt. Results revealed that,chlorpyrifos recordedhighest initial reduction (89.38 and 88.39%), residual mean (88.52 and 87.72%) and annual mean (87.74 and 87.37%) on*Spodoptera littoralis* during the two successive seasons, respectively.

In regarding to the biochemical activites of treated larvae in laboratory the all tested compoundsdisruptedthe testedactivities. The highest effect on the total soluble protein as specific activity(SA) of 40.57 mg/g.bwt recorded for 4th instar larvae treated with LC_{50} concentration of chlorpyrifose and sampled after 3 days of treatment, while the highest reduction in relative activity (RA%) of - 54.15% recorded for larvae treated with LC_{50} concentration of Betavant and sampled after 3 days also. The tested compounds at selected concentrations of LC_{25} and LC_{50} also disrupted GOT and GPT activities of treated larvae where the highest GOT as SA (2574.33±30.4 u * 10^3g.sbwt) recorded for larvae treated with LC_{25} concentration and sampled after 3 days of treatment, while the highest relative activity RA% -43.36%was exhibited in case of after 7 days of treat.the larvae treated with chlorpyrifose and sampled . The highest effect on GPT as SA (711.33±5.2 u *10^3 g. bwt) was recorded for larvae treated with Komatch at concentration of $LC_{25}$and sampled at 3rd days of treatment, while the highest relative activity% -64.05 recorded for larvae treated with LC_{50} concentration of Betavant and sampled at 3rd day of treatment also. Inregarding to the effect of tested compounds on carbohydrate hydrolyzing enzymes;invertase, trehalase and amylase determined as µg glucose/min g.bwt/days. The highest values were 405.679±9.03, 222.33±7.26 and 123±3.31 recorded for larvae treated with $LC_{25}$of Kz oil, LC_{50} of Kz oil and LC_{25} of Betavant sampled at 3rd day of treatment for invertase, trehalase and amylase enzymes,respectively.On the other hand, the highest relative activity RA% of -0.53, -0.44 and -0.61 were recorded for larvae treated with LC_{50} of Nomult (at 3days of treatment), LC_{25} of Nomult (at 3rd day of treatment) and LC_{50} of Kz oil (at 7 days of treatment) that for invertase, trehalase and amylase, respectively.

Keywords: *Spodopteralittoralis*(Boisd.),Toxicity, Biochemical,IGRs, indoxacarb,mineral oil, *Bacillus thuringnsis*(Bt).

INTRODUCTION

In Egypt,Cotton leafworm, *Spodopteralittorlis* (Boisd.) (Lepidoptera: Nectuidae) is a serious lepidopteran pest of cotton through its different growth stages, where the larvae are heavily attacking cotton causing severe damage and consequently reduction in the obtained yield,(Pluschkell*et al*., 1998and Korrat*etal*.,2012) .Tocontrol cotton leafworm, many compounds use from different pesticides groups, biopesticides, oils and plant extracts. The antifeedantcompound, indoxcarb (Betavant 5% EC) was effected the newly ecdysed 2nd and 4th instars larvae of *S. littoralis* and the $LC_{50,}$ LC_{90} values, were 0.63 and 3.1 ppm for the 2nd instar and 2.0 & 18.75 ppm for the 4th instar larvae. That mean the 2nd instar larvae was more susceptible to indoxacarb more than the 4th one(Al-Shannaf*et al*. 2012).Al-Shannaf and Ammar (2011) stated that, the Radical(Avermectin)compound gave highest initial reductionpercentage against*S .littoralis* and *Helicoverpaarmigra* followed by Dursban (chlorpyrifose) , mixture of Consult (IGR) and Dursban only, where the lowest reduction percentage was recorded for Dipel DF(Bt). As results ofMohamed *et al.*(2006), the mineral oil Kapl-2 at rate of1.5 and 0.75% showed low effect on *S.littoralis*in comparison by the insecticide,Actellic (pirimiphose methyl).In the same trend, the mineral oil, Kemesol95% used as topical application reduced hemolymph fat body and total soluble protein of *S. littoralis*,(Khatter and Abuldahb,2010). The IGR compound, teflubenzoronaffected GOT enzymes activities and total soluble protein for *S. littoralis* larvae significantly, while its effect on GPT,was a significant reduction, (EL-Kordy*etal*., 1995) and Desuky, *et al*., 2005).The insecticide Betavant (Indoxacarb) caused slightly increasing in total protein content of *S. littoralis* 2nd instar larvae by 8.79%, while it decreased total soluble protein by24.9% in 4th instar and disrupted carbohydrate enzymes,as results of Gmail *et al*.(2011). Also, the bacterial insectbiocide*B.thuringensis* and Kz oil reduced the total protein content of treated *S. littoralis*(Zidan*et al*., 1996).

This work aimed to study the toxic (as field trials) and physiological (as laboratory trials) effects of some recommended and alternative compounds, i.e, Komatch,Nomult, Betavant, Kz oil, Protecto and Dursban against cotton leafworm, *S. littoralis*.

MATERIALS AND METHODS

Tested Compound:

1. Insect growth regulators (IGRs):

- Komatch, Lufenuron5% EC used at rate of 160 cm/feddan

- Nomult,Teflubenzuron 5% EC used at rate of 160 cm/feddan.

2. Antifeedant compound: Betavant, indoxacarb 14.3% SC used at rate of 110cm/feddan.
3. Meniraloil, Kz oil 95% EC used at rate of 1500 ml/100 litter water.
4. BactarialCompound: Protecto, *Bacillus thurinigiensis*9.4% WPat rateof300gm/feddan
5. Organphosphorus insecticide:Dursban, chlorpyrifos 48% E.C. used at rate 1000 ml/ Feddan.

Field trials:

Field experiments were carried out at KafrSakrregion, SharkyiaGovernorate, Egypt during two consecutive cotton growing seasons of 2013and2014.The experimentarea of two faddan was divided into 6 treatments and one as control (and each replicated three times). The experiment area was cultivated with the Egyptian cotton variety, Giza 86.Cotton plants treated once with each compound at 24th and 21th June during the considered seasons, respectively. Thesamplesof 100 plants/ replicate was inspected in field and 1st,2nd,3rd and 4th instars larvae were counted and recorded, Just before treatment and after 1,7 and 10days for Dursban treatment,while it examined at 3,7and10 dyes for each of Komatch, Nomult,Betavant, Kzoil and Protecto. The reduction percentages of cotton leafworm larvae were calculated use equationof Henderson and Tilton (1955).

1-Insect Rearing:

Cotton leafworm, *Spodoptera littoralis*larvae were obtained from a culture reared in cotton leafworm laboratory at Plant Protection Research Institute Sharkia branchwithout exposure history to insecticide. Larvae were reared on fresh castor bean leaves, *Ricinuscomnuis* L.All laboratory trials were kept under laboratory condition of 27±2C^{o}and RH% 70±5%.

2. Laboratory treatment:

10 individuals The cotton leafworm 4th instar larvae were put in glass Jar, replicated 4 time for each treatment and labeled as treatments and control.

Table (1): LC_{50} and LC_{25}values of the tested compounds

Compound	Komatch*	Nomult*	Betavant*	Kzoil*	Protecto**	Dursban*	Control*
LC_{25}	2.52	1.17	0.16	5521.01	82.24	6.66	0.00
LC_{50}	12.08	15.89	1.41	27734.36	303.42	31.24	0.00

*** Concentration in ppm ** Concentration as international unit**

Table (1) cleared that,the LC_{25} and LC_{50}concentrations were prepared aswater solution and the castor bean leaves were cleaned and dipped in each separately. The dipped castor bean leaveswere left for 30 min. to complete dryness on table under laboratory conditions. After that, the treated leaves of each concentration ofeach compound deliveredto the 4th instar larvae in glass jars as well as the leaves dipped in water only as control.The larvae were fed on treated castor leaves for three days for all treatment except of Dursban which fed for 24 h.only, then the all fed on untreated leaves tell the end of experiment.

3. Samples preparation:

The 4th instar larvae samples were collected at 3; 7 days post treatment with LC_{25} and LC_{50}concentrations of each tested compound as well as untreated one. Samples were homogenized in distilled water using a Teflonhomogenizer, the homogenates werecentrifugedat 5000 rpm for 10min. at 5^{o}C the supernatants were immediately assayed to determine the total soluble protein, the activities of aspartate amino transferase (Got) and a alanine amino transferase (GPT)and the carbohydrate hydrolyzing enzymes(Trehalase, Invertase and Amylase).

4. Determination of biochemical activities:

a- Carbohydrate hydrolyzing enzymes:

The method used to determine the activities of carbohydrate hydrolyzing enzymes (Trehalase, Invertase and Amylase) digesting sucrose Trehalase and starch, respectively, were illustrated by Ishaaya and Swiriski (1976). The free aldehydes group of glucose after starch, Trehalase and sucrose digestion was determined use 3, 5 dinitro salicylic acid regent.

b- Determination of total soluble protein:

Colorimetric determination of (TSP) total homogenized *S. littoralis* larvae was carried out as described by Bradford,M.M.(1976). Protein reagent was prepared by dissolving 100mg of Coomassie Brilliant blue G-250 in 50ml 85% (W/V) Phosphoric acid were added .The resulting solution was diluted to a final volume of 1liter.

c- Transaminase enzymes determination:

Aspartate amino transferase (GOT) and alanine amino transferase (GPT) enzyme activities were determined calorimetrically according to method of (Reitmin and Frankal 1957).

Statistical analysis:

One way ANOVA was used to determine the significance of differences between, means of values obtained in the field experiment.

RESULTS AND DISSCUION

1-Field evaluation of tested compounds on cotton leafworm:

The obtained results in Table (2) showed thatthe initial effect as reduction percentages of the cotton leafworm larvae in fields sprayed with recommended concentration of the tested compound at 2013 season were 81.71, 83.61, 41.18, 7.53 and 11.09%after 3 days of spray with lufenuron,teflubezuron,indoxacarb,Kzoil and BT respectively, while it was 89.53% after one day for chlorpyrifose. Asresidual effect, the reduction percentages were 87.66,85.07,45.94,8.54 and 13.52%after 7days and were 88.93,86.78,53.00, 14.21 and 18.29% after 10 days forlufenuron ,teflubezuron, indoxacarb, Kz oil and *B.thuringinsis* ,receptively,

recorded 87.66 and 86.38% forchlorpyrifosafter 7 and 10 days of application,respectively. The insecticide chlorpyrifos recorded the highest reduction percentage of 87.74% while Kz oil recorded the lowest one 8.87%.

Table (2): Reduction percentage of some alternative compounds against cotton leafworm, *Spodoptera littoralis* compared withDursban in cotton fields during 2013 season.

Treatments		Pre-count	Initial	Residual			Mean	Annual mean
			1day	3days	7days	10days		
Komatch	No.	121.25	-	17.93	17.08	22.56	19.82	19.19
	%	-	-	88.93	86.17	81.71	8.94	85.60
Nomolt	No.	147.61	-	20.20	22.78	25.05	23.92	22.68
	%	-	-	86.78	85.07	83.61	83.84	85.15
Betavant No.	No.	143.25	-	68.19	78.70	85.34	82.02	77.61
	%	-	-	53.00	45.94	41.18	43.66	46.71
KZ oil	No.	141.28	-	128.83	132.22	133.22	132.72	131.42
	%	-	-	14.21	8.54	7.53	8.04	8.87
Protecto	No.	136.97	-	113.75	120.53	123.78	122.16	119.35
	%	-	-	18.29	13.52	11.09	12.32	14.30
Dursban	No.	165.81	17.78	-	20.91	22.83	19.35	20.51
	%	-	89.38	-	87.66	86.53	88.52	87.74
Control	No.	153.97	151.77	156.70	159.61	162.89	161.25	159.73
F. test								**
$LSD_{0.05}$								6.17

During 2014 season, data in Table (3)showed that the initial effect as reduction percentages of cotton leafworm larvae after 3 days of field spraywere83.48,82.11,43.44,7.42and11.17%forlufenuron, teflubezuron , indoxacarb ,Kz oil and *B.thuringinsis*, respectively, while it was 88.39% for chlorpyrifose after one day of spray.The residual effect recorded after 7 and 10 days of application cleared that the chlorpyrifoserecorded highest reduction percentage of 87.06 & 88.36% followed descendingly by84.91,83.76,46.97,8.16 & 13.49%at 7 days and 83.48, 82.11,43.44,11.&.42% at10 days for lufenuron, teflubezuron, indoxacarb, *B.thuringinsis*and Kz oil, respectively; in the field population of the cotton leafworm larvae in sprayed fields. These results found in agreement with those of Mohamed *et al. (*2006); AL-Shannaf and Ammar (2011) and Barrania(2013).

Table (3): Reduction percentage of some alternative compounds against cotton leafworm, *Spodoptera littoralis* compared with Dursban in cotton fields during 2014 season.

Treatments		Pre-count	Initial		Residual		Mean	Annual mean
			1 day	3 days	7 days	10 days		
Komatch	No.	147.66	-	19.09	22.67	24.73	23.70	22.16
	Reduction %		-	86.75	84.91	83.48	84.49	85.04
Nomolt	No.	125.81	-	29.49	30.79	33.88	32.34	31.39
	Reduction %	-	-	84.45	83.76	82.11	82.94	83.44
Betavant	No.	-	-	83.86	93.88	97.80	95.84	91.85
	Reduction %	-	-	52.62	46.97	43.44	45.21	47.67
KZ oil	No.	174.11	-	162.17	171.46	172.83	172.15	168.82
	Reduction %	-	-	13.13	8.16	7.42	7.79	9.57
Protecto	No.	183.65	-	159.51	165.87	169.79	167.83	165.06
	Reduction %	-	-	16.65	13.49	11.17	12.34	13.77
Dursban	No.	188.17	19.73	-	23.32	24.64	21.53	22.56
	Reduction %	176.59	88.39	-	87.06	86.34	87.72	87.37
Control	No.	186.77	187.97	189.42	191.80	193.81	192.91	191.68
F. test								**
$LSD_{0.05}$								6.16

The statistical analysis results clearedthat there are significant differences between Dursban, Komatch and Nomult ashigh efficacycompounds, Betavant as moderateefficacycompound and the lowest efficacy group,Kz oil and Btcompound, that as initial effect (LSD= 6.16) and as residual effect after 7 days

(LSD=7.37).The same trend was noticed for general mean and residual mean with LSD = 6.46 and 6.16,respectively.

2-Laboratory trials: Biochemical responses of cotton leafworm, *S. littoralis* larvae to the tested compound:

The physiological changes of ***S. littoralis***4th instar larvae assessed at 3 and 7 days after treatment with LC_{25} and LC_{50} concentrations of the tested compoundswere determined as, effects on the activities of carbohydrate hydrolyzing enzymes (Invertase, Trehalase and amylase) ,the total soluble protein concentration and transaminase(GOTandGPT) were determined.

a- carbohydrate hydrolyzing enzymes activities:

Data presented in table (4) indicated that, the all tested compounds were effected the activities of amylase, Invertase and Trehalase enzymes in the treated 4th instar larvae of S. *littoralis.*

- **Invertase**

In case of the effect of LC_{25} concentration of tested compound on invertase activity in treated and untreated 4th instar larvae sampled after 3 days of treatment as SA and RA% in treated larvae in relation to untreated ones. The highest effect on Invertase was recorded in larvae treated with Kz oil (405.67±9.03 µ g glucose / min / g. bwt days) recorded increase in RA% of 0.25% in compared with untreated larvae while the lowest SA was recorded in larvae treated with Nomult (204±6.91 µg glucose / min / g. bwt days) recorded reduction of -0.37% in compared with (325±5.209 µg glucose / min / g. bwt days) for untreated larvae.

In the same trend, the result of LC_{50} treatment effect after 3 days cleared that the highest SA was recorded in larvae treated with Kz oil (365.67±6.39 µg glucose / min / g.bwt days) recorded relative increase of 0.13% in compared with untreated larvae while the lowest was recorded with Nomult (154.67±2.23 µg glucose / min / g.bwt) recorded reduction of -0.53% in compared with 325±12.04 µg glucose / min / g. bwt days) for untreated larvae.

Table (4): Changes in invertase,trehalase and amylase enzymes activities in *S. littoralis*treated with multiple compounds and chemical pesticide

Treatments	Con. ppm		Invertase (Ug glucose/min/g.b.wt/days		Trehalase Ug glucose/min/g.b.wt		Amylase Ug glucose/min/g.b.wt	
			3 days	7 days	3 days	7 days	3 days	7 days
Komatch	25	SA	260.00±3.78	270.67±4.34	121.33±4.54	212.33±6.24	88.33±2.23	91.67±4.18
		RA %	-0.20	0.09	-0.28	-0.07	0.11	-0.06
	50	SA	212.00±1.42	247±4.05	129.67±4.75	201.33±6.37	46.33±1.52	103.67±0.88
		RA %	-0.35	-0.01	-0.23	-0.12	-0.42	0.07
Nomolt	25	SA	204.00±6.91	236..33±3.18	95.67±3.14	243.33±3.39	82.00±2.63	115.33±3.72
		RA %	-0.37	-0.05	-0.44	0.07	0.03	0.19
	50	SA	154.67±2.23	244.00±3.61	72.67±1.79	251.67±5.79	57.33±3.20	104.67±3.85
		RA %	-0.53	-0.02	-8.57	0.10	-0.28	0.08
Betavant	25	SA	312.67±4.96	256.33±4.85	181±3.10	204.33±7.18	123.00±3.31	100.67±3.39
		RA %	-0.04	1.33	0.07	-0.11	0.54	0.04
	50	SA	310.67±.4.39.	250.00±5.52	155.33±1.66	218.00±4.73	102.67±2.33	92.67±1.77
		RA %	-0.05	0.01	-0.001	-0.05	0.28	-0.05
KZoil	25	SA	405.67±9.03	149.33±15.19	208.00±6.08	145.33±3.49	89.00±1.25	77.00±4.05
		RA %	0.25	-0.40	0.23	-0.37	0.11	-0.21
	50	SA	365.67±6.39	147.33±7.43	222.33±7.26	112.33±6.24	105.33±3.58	38.00±2.52
		RA %	0.13	-0.41	0.32	-0.51	0.32	-0.61
Protecto	25	SA	279.67±7.65	236.00±6.04	166.33±2.89	210.00±1.53	58.33±2.69	105.67±3.18
		RA %	-0.14	-0.06	-0.02	-0.08	-0.27	0.09
	50	SA	242.33±10.17	253.00±7.52	104.00±3..46	247.33±3.85	36.00±2.50	91.33±1.86
		RA %	-0.26	0.01	-0.39	-0.08	-0.55	-0.06
Dursban	25	SA	246.33±5.63	179.67±1.86	149.00±9.44	279.67±7.23	92.00±1.441	64.33±2.73
		RA %	-0.24	-0.20	-0.12	0.22	015	-0.34
	50	SA	215.00±6.39	189.67±6.07	154.67±6.55	258.67±4.10	93.00±3.88	43.00±3.52
		RA %	-0.34	-0.24	-0.09	0.13	0.16	-0.56
Control			325.00±12.09	249.67±11.85	169.00±5.72	222.67±12.72	80.00±4.33	97.00±4.71

SA= Specific activity

RA%= Relative concentration

$$RA\% = \frac{\text{Treatment} - \text{control}}{\text{Control}} \times 100$$

The effect of LC_{25} concentration of tested compound on Invertase activity in treated and untreated 4th instar larvae sampled at 7 days after treatment as SA and RA% in treated larvae in relation to untreated ones. The highest AS was recorded in larvae treated with Komatch (270.67±4.34 µg glucose / min / g.bwt days) recorded increase in RA% by 0.09% in compared with untreated larvae. While the lowest SA was recorded in larvae treated with Kz oil (149.33±15.19 µg glucose/ min/ g.bwt days) recorded reduction of -0.40% in

compared with 249.67±11.85 µg glucose / min / g.bwt days for untreated larvae.

In case of LC_{50} treatment after 7days, The highest effect was recorded on larvae treated by Betavant (250±5.52 µg glucose min g.bwt days) recorded increase in RA% by 0.01% in compared with untreated ones, while the lowest effect was recorded with Kz 0il (147.33±7.43 µg glucose / min / g.bwt days) recorded reduction of -0.41% in compared with 249.67±11.85 µg glucose / min / g.bwt days for untreated larvae.

The results above found agree those of Ahmed, *et al.* (1990); Kandil, (2005); EL-Kordy, *et al.* (1995); and Gamil,*et al.*(2011).recorded that the Kz oil effected invertase activity in *S. littoralis*.

- **Trehalase**

Data in table (4) showed the effect of LC_{25} concentration of tested compound on trehalase activity in treated and untreated 4th instar larvae after 3 days as SA and RA% in treated larvae in relation to untreated ones. The highest effect on trehalase was recorded in larvae treated with Kz oil (208±6.02 µg glucose / min / g.bwt days) recorded increase in RA% by 0.23% in compared with untreated larvae, while, the lowest SA was recorded in larvae treated with Nomult (95.67±3.14 µg glucose / min / g.bwt days) recorded increase in RA% by 0.44% in compared with 169±5.72 µg glucose / min / g. bwt days for untreated larvae.

In the same trend, the results ofLC_{50} treatment after 3 days cleared that the highest effect on Trehalase was recorded in larvae treated with Kz oil (169±5.72 µg glucose / min/ g bwt days) recorded increase in RA% by 0.32% compared with untreated larvae, while the lowest effect was recorded in larvae treated use Nomult (72.67±1.79 µg glucose / min / g. bwt days)recorded reduction of -8.57% compared with for untreated larvae

The effect of LC_{25} concentration of tested compound on Trehalase activity in treated and untreated 4th instar larvae sampled after 7 days of treatment as SA and RA% in treated larvae compared with untreated ones. The highest SA was recorded in larvae treated with Dursban (279.07±7.23 µg glucose/ min / g. bwt days) recorded increase in RA% by 0.22% in compared with untreated larvae, while the lowest effect was recorded in larvae treated with Kz oil (145.33±3.49 µg glucose / min / g. bwt days) recorded reduction of -0.37% in compared with (222.57±12.72 µg glucose / min / g bwt days) for untreated larvae .

The results of LC_{50} treatment after 7 days revealed that the highest SA was recorded in larvae treated with Dursban (258.57±5.09 µg glucose/ min / g. bwt days) recorded increase in RA% by 0.13% compared with untreated larvae, while the lowest SA was recorded in larvae treated with Kz oil (112.33±6.24 µg glucose / min / g. bwt days) recorded reduction of -0.51%in compared with (222.57-+12.72 µg glucose/ min/ g. bwt days) for untreated larvae

The results of these trial found in agreement with those of Ayyangar and Rao (1990); Kandill (2000); Desuky, *et al*. (2005);Omar *et al*. (2005) and (Sabry and Khedr, 2014) .The IGRs and chlorpyrifoseeffected Trehalase activity in *S. littoralis.*

- **Amylase**

Data in table (4) showed the effect of LC_{25} concentration of tested compound on amylase activity in treated and untreated 4th instar larvae after 3 days of treatment as SA and RA% in treated larvae in relation to untreated ones. The highest effect on amylase was recorded in larvae treated with Betavant (123±3.31 µg glucose / min / g. bwt days) recorded increase in RA% by 0.54% in compared with untreated larvae, while the lowest SA was recorded in larvae treated with Protecto (58.33±2.69 µg glucose / min / g. bwt days) recorded reduction of -27% in compared with (80.0±4.33 µg glucose/ min/ g. bwt days) for untreated larvae.

The results of LC_{50} treatment after 3days showed that The highest SA was recorded in larvae treated with Kz oil (105.33±3.58 µg glucose / min / g. bwt days) recorded increase in RA% by 0.32% in compared with untreated larvae, while the lowest SA was recorded in larvae treated with Komatch (46.33±1.52 µg glucose/ min / g. bwt days) recorded reduction of -0.42% in compared with (80.0±4.33 µg glucose / min / g. bwt days) for untreated larvae

In regarding to the effect of LC_{25} concentration of tested compound on amylase activity in treated and untreated 4th instar larvae tested at 7 days after treatment as SA and RA% in treated larvae in relation to untreated ones. the highest SA on amylase was recorded in larvae treated with Nomult (115.3380.0±4.333.72 µg glucose / min / g. bwt days) recorded increase in RA% by 0.19% in compared with untreated larvae, while the lowest SA was recorded for larvae treated with Dursban (64.3380.0±4.333.43 µg glucose/ min/ g. bwt days) recorded reduction of -0.34% in compared with 97.0080.0±4.334.64 µg glucose / min / g. bwt days for untreated larvae .

In case of the results of LC_{50} treatment after 7 days, the highest SA was recorded in larvae treated with Nomult (104.67±3.80 µg glucose/ min/ g. bwt days) recorded increase in RA% 0.08% in compared with untreated larvae, while the lowest effect was recorded in larvae treated with Kz oil (38±2.52 µg glucose/ min/ g. bwt days) recorded reduction of -0.61% in compared with 97.00±4.94 µg glucose / min / g. bwt days) for untreated larvae.

These results found in agreement with those of Wyatt (1957); Wiggles worth (1972);Nathon, *et al.* (2005) and EL-Sheikh, *et al.* (2013)stated that, the tested IGRs and Kz oil effected Amylase activity in *S. littoralis.*

b -Total soluble protein (TSP) assessment:

Data in Table (5) showed the effect of LC_{25} concentration of tested compound on TSP levels in treated and untreated 4thinstar larvae sampled after 3 days as specific concentration (SC)and relative concentration (RC%) in treated larvae in relation to untreated ones. The highest effect on TSP was recorded in larvae treated with Dursban (38.60±0.26 mg / g.bwt) recorded reduction of -0.18% in compared with untreated larvae while the lowest effect was recorded in

larvae treated with Betavant (21.20±0.56 mg/g.bwt) recorded increase of 45.18% in compared with 38.67mg/g.bwt for untreated larvae.

In thesame trend, the results of sampled larvae treated byLC_{50} after 3 days cleared that the highest effect on TSPwas recorded in larvae treated with Dursban (40.57±0.59mg/g. bwt) recorded increase of 5.17%in compared with untreated larvae while the lowest effect was recorded in larvae treated with Betavant (17.73±0.38mg/g. bwt) recorded increase of 54.15%in compared with 38.57±0.26mg/g.bwt for untreated larvae.

In case of the effect of LC_{25}concentration of the tested compoundon TSP levels in treated and untreated 4th instar larvae sampled after 7 days as SCand RC% in treated larvae in relation to untreated ones. The highest effect was recorded in larvae treated withProtecto (32.63±0.70mg/g. bwt) recorded increase of 4.82% in compared with untreated larvae, while the lowest effect was recorded in larvae treated with Kz oil (23.87±0.65mg/g.bwt) recorded increase of 23.32% in compared with 31.13mg/g.bwt) for untreated larvae.In the same trend the results of the effect on larvae treated with LC_{50} treatment after 7 days cleared that,the highesteffect on TSP was recorded in larvae treated with Protecto (33.37±0.54 mg/g.bwt) recorded increase of 7.20% in compared with untreated larvae while the lowest effect was recorded in larvae treated with Nomult (18.90±0.38mg/g.bwt) recorded increase of 39.29% in compared with31.13±1.56 mg/g.bwt for untreated larvae that after 7 days of treatment with LC_{50} concentration. These results found agree those of EL-Kordy*et al*.(1995); Zidan*et al*.(1996);Desuky, *et al*.(2005);Gamil*et al*.(2011) andBasiouny, *et al*.(2016)thattested compounds effected TSP in *S. littoralis*and other insects.

Table (5): Changes of total soluble protein levels in *S. littoralis* treated with multiple compounds and chemical pesticide

Treatments	Days post treatment	Determined parameter	Komatch		Nomolt		Betavant		Kzoil		Protecto		Dursban		control
			25	50	25	50	25	50	25	50	25	50	25	50	
Total proteins (mg/g. bwt)/days	3 days	SC	31.53 ± 0.59	23.03 ± 0.58	34.17 ±0.38	31.20 ±0.39	21.20 ±0.56	17.73 ±0.38	35.90 ±0.80	36.30 ±0.74	2577 ±0.55	25.57 ±0.24	38.60 ±0.26	40.57 ±0.59	38.67 ±0.85
		RC%	-18.46	-30.10	-11.64	-19.32	-45.18	-54.15	-7.16	-6.13	-33.36	-33.88	-0.18	5.17	
	7 days	SC	24.10 ±0.20	24.70 ±0.61	25.83 ±0.38	18.90 ±0.55	26.07 ±0.87	20.57 ±0.65	23.87 ±0.65	20.77 ±0.65	32.63 ±0.70	33.37 ±0.54	30.33 ±0.38	20.13 ±1.21	31.13 ±1.56
		RC%	-22.58	-20.66	-17.03	-39.29	-16.26	-33.92	-23.32	-33.33	4.82	7.20	3.13	-35.34	

SC= Specific concentration

RC% = Relative concentration

$$RC\ \% = \frac{\text{Treatment} - \text{control}}{\text{Control}} \times 100$$

c- Transaminase activities:

Data in table (5) showed the changes in GOT, GPT activities as the concentration of the formed pyruvate and the relative activity as a percentage of formed pyruvate for treated larvae in comparable with untreated ones. The obtained results cleared that the all tested compoundaffected the transaminase activities positively or negatively as follows:

- **The effect on Aspartate amino transferase (GOT):**

Data in table (6) showed the effect of LC_{25} concentration of tested compound onGOT activity in treated and untreated 4th instar larvae sampled after 3 days of treatment as specific activity (SA) and relative activities (RA%) in treated larvae in relation to untreated ones. The highest effect was recorded in larvae treated with Kz oil (2574.33±30.41u* 10^3 g.bwt) recorded increase of 0.33% in compared with untreated larvae while the lowest effect was recorded in larvae treated with Betavant (1441.67±24.56 u* 10^3 /g.bwt) recorded reduction of(-26.36%) in compared with (1957.67±29.19 u* 10^3 g.bwt) for untreated larvae.

In the same trend the results of the affected treated larvae withLC_{50} treatment after 3 days cleared that, the highest effect was inspected in larvae treated with Kz oil (2305±7.88 u* 10^3 g.bwt) recorded increase of 31.50% in compared with untreated larvae, while the lowest effect was recorded in larvae treated with Betavant (1266.67±4.25 u*10^3 g.bwt) recorded reduction of -35.30% in compared with (1957.67±29.19 u *10^3 g.bwt) for untreated.

In regarding to the effect of LC_{25} concentration of the tested compound on GOT activities in treated and untreated 4th instar larvae sampled at 7 days after treatment as SA and RA% intreated larvae in relation to untreated ones. The highest SA was recorded in larvae treated with Komatch (1615 ±9.88 u * 10^3 g. bwt) recorded increase in RA% by 9.86% in compared with untreated larvae, while the lowest effect was recorded in larvae treated with Dursban (832.57 ±19.40 u * 10^3 g. bwt) recorded reduction of -43.36% compared with 1470 ±65.65 u* 10^3 g.bwt) for untreated larvae.

In the same trend the results of LC_{50} treatment after 7 days cleared that, the highest SA was recorded in larvae treated with Komatch (1509±5.14 u * 10^3 g.bwt) recorded increase in RA% by 2.65% in compared with untreated larvae, while the lowest effect was recorded in larvae treated with Dursban (6o1.00±9.55 u*10^3g.bwt) recorded reduction of -59.12% in compared with (1470±65.65 u* 10^3 g.bwt) for untreated larvae.

The obtained results found in agreement with those of Ahmed,*et al*. (1990); EL-Kordy, *et al*. (1995);Zidan,*et al*. (1995);Kandil (2005) and Omar,*et al*. (2005)that the mineral oil affected GOT activities in *S. Littoralis*

Table (6):Changes of total soluble protein levels, GOT and GPT activities in*S. littoralis* treated with multiple compounds and chemical pesticide.

Treatments	Con. ppm		GOT (Ux 10^3 g. bwt) 3 days	GOT (Ux 10^3 g. bwt) 7 days	GPT (Ux 10^3 g. bwt) 3 days	GPT (Ux 10^3 g. bwt) 7 days
Komatch	25	SA	1951.00±11.73	1615.00±9.88	711.33±5.20	502.33±7.23
		RA %	-0.34	9.86	16.42	9.84
	50	SA	2044.67±22.65	1509.00±5.14	667.33±12.79	454.67±7.37
		RA %	0.05	2.65	9.22	-0.58
Nomolt	25	SA	1937.00±27. 04	1511.67±22.45	587.33±33.15	404.67±5.18
		RA %	-1.06	2.84	-3.87	-11.52
	50	SA	1900.67±20.90	1482.00±10.52	637.33±14.63	322.67±4.66
		RA %	-2.91	0.82	4.31	-29.45
Betavant	25	SA	1441.67±24.56	980.00±30.59	397.67±2.77	395.00±7.27
		RA %	-26.36	-33.33	-34.92	-13.63
	50	SA	1266.67±4.25	1046.33±27.54	219.67±7.85	305.67±5.18
		RA %	-35.30	-28.82	-64.05	-33.16
KZoil	25	SA	2574.33±30.41	1553.33±19.19	384.00±13.91	256.67±12.19
		RA %	0.32	5.67	-36.66	-43.88
	50	SA	2305.00±7.88	1489.67±9.18	241.00±12.11	221.67±11.48
		RA %	31.50	1.16	-60.06	-51.53
Protecto	25	SA	2002.67±11.07	1526.67±16.73	636.33±7. 01	457.67±8.46
		RA %	0.18	3.39	4.15	0.08
	50	SA	1863.33±56.90	1461.67±17.07	699.33±4.26	537±18.79
		RA %	-4.82	-0.06	14.46	17.42
Dursban	25	SA	1821.00±10.16	832.67±19.40	323.67±5.59	238.67±8.18
		RA %	-6.98	-43.36	-61.92	-47.81
	50	SA	1917.67±23.38	601.00±9.55	303.67±7.01	259.33±10.99
		RA %	-7.15	-59.12	-50.30	-43.30
Control			1957.67±29.19	1470.00±65.65	611.00±13.29	457.33±23.98

SA= Specific activity
RA%= Relative concentration

$$RA\% = \frac{\text{Treatment} - \text{control}}{\text{Control}} \times 100$$

- **-Alanine amino transferase (GPT)**

Data in table (6) showed the effect of LC_{25} concentration of tested compound on GPT activity in treated and untreated 4th instar larvae sampled after 3 days of treatment as specific activity (SA) and relative activity (RA%) in relation to untreated ones .The highest effect on GPT was recorded in larvae treated with Komatch (711.33±5.20 u *10^3g.bwt) recorded increase of16.42% incompared with untreated larvae, while the lowest SA was recorded in larvae treated with Dursban (323.60±5.39 u * 10^3g.bwt) recorded reduction of -61.92% in compared with 611.00±13.29 u* 10^3 g. bwt) for untreated larvae.

In the same trend, the results of LC_{50} treatment after 3 days cleared that,the highest SA was recorded in larvae treated with Protecto (699.33±4.25 u * 10^3 g.bwt) recorded increase of 14.46% in compared with untreated larvae, while the lowest AS was recorded for Betavant (219.67±7.83 u *10^3 g.bwt) recorded reduction of -64.05% in compared with (611±13.29 u*10^3 g.bwt)SA for untreated larvae.

In regarding to the effect of LC_{25} concentration of tested compound on GPT activity in treated and untreated 4th instar larvae sampled after 7 days as SA andRA% in treated larvae in relation to untreated ones. The highest AS was recorded in larvae treated with Komatch (502.33±7.23 u *10^3 g.bwt) recorded increasein RA% by 9.84% in compared with untreated larvae, while the lowest effect was recorded for larvae treated with Dursban (238.67± 8.18 u *10^3 g.bwt) recorded reduction of-47.81% in compared with (457.23±23.98 u *10^3 g.bwt) for untreated larvae.

In the same trend the results of LC_{50} concentration after 7 days cleared that, the highest SA recorded in larvae treated with Protecto (537±18.79 u *10^3 g.bwt) recorded increase of 17.42% in compared with untreated larvae, while the lowest effect was recorded in larvae treated with Kz oil (221.67±11.48 u *10^3 g.bwt) recorded reduction of -51.53% in compared with (457.33±23.98 u *10^3 g.bwt) for untreated larvae.These results relatively in affinity with those of EL-Kordy, *et al*. (1995);Kandil (2005);Abou-Taleb,*et al*.(2015); and Hamadah, *et al*.(2016).The mineral oil effected GPT activity in *S. littoralis*.

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التـــأثيرات الســـامة والبيوكيميائيـــة لـــبعض المركبـــات البديلـــة والموصـــى بهـــا علـــى دودة ورق القطن(Noctuide:Lepidoptera) *Spodoptera littoralis* (Boisd.) فى حقول القطن.

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أجريت التجارب الحقلية والمعملية لتقييم إثنين من منظمات النمو الحشرية (ليفينرون والتفلوبنزيرون) ومركب مانع للتغذية (اندوكساكارب) والزيت المعدنى (كزدأول) والمركب البكتيرى (باسيلس ثيوروجينزيز) والمركب الفوسفورى العضوى (كلوربيريفوس) وذلك ضد يرقات دودة ورق القطن .

وأجريت التجارب الحقلية خلال موسمى ٢٠١٣ – ٢٠١٤ فى منطقة كفر صقر – بمحافظة الشرقية – مصر، وأوضحت النتائج أن مركب الكلوربيريفوس أعطى أعلى خفض فورى (٨٩.٣٨ ، ٨٨.٣٩%) وكذلك متوسط أثر متبقى (٨٨.٥٢ ، ٨٧.٧٢%) ومتوسط عام (٨٧.٧٤، ٨٧.٣٧%) على دودة ورق القطن خلال موسمى الدراسة على الترتيب.

وبالنظر إلى نتائج المعاملات المعملية والمتمثلة فى النشاط البيوكيمائى لليرقات المعاملة، فإن جميع المركبات المختبرة سببت اضطرابات فى الأنشطة البيوكيميائية. سجل أعلى تأثير على تركيز البروتينات الكلية (٤٠.٥٧ ملى جرام / جرام وزن الجسم ليرقات العمر الرابع المعاملة بالتركيز LC_{50}من مركب الكلوربيريفوس وذلك بعد ٣ أيام من المعاملة بينما سجلت أعلى نسبة خفض فى تركيز البروتينات الكلية (- ٥٤.٠١٥%)لليرقات المعاملة بمركبة الإندوكسكارب بعد ٣ أيام أيضاً مقارنة باليرقات الغير معاملة.

كما أدت المعاملة بالتركيزات المختبرة (LC_{25}) و (LC_{50}) لجميع المركبات اضطرابات فى نشاط الإنزيمات الناقلة لمجموعة الأمين فى اليرقات المعاملة حيث سجل أعلى تأثير على GOT (٢٥٧٤.٣٣ وحدة دولية فى $١٠^{٣}$ من وزن الجسم) لليرقات المعاملة بتركيز LC_{25} للزيت المعدنى وذلك بعد ثلاث ايام من المعاملة بينما سجلت أعلى خفض فى النشاط النسبى (- ٤٣.٣٦%) لليرقات المعاملة بنفس التركيز لمركب الكلوريريفوس وذلك بعد ٧ أيام من المعاملة.

سجل أعلى تأثير على نشاط GPT (٥.٢ ± ٧١١.٣٣ وحدة دولية $١٠^{٣}$ جرام وزن جسم) لليرقات المعاملة بمركب الليفينيرون وبالتركيز LC_{25} وذلك بعد ثلاث أيام من المعاملة ، بينما سجلت أعلى نسبة خفض للنشاط النسبى (- ٦٤.٠٥%) لليرقات المعاملة بتركيز LC_{50} من مركب الإندوكسكارب وذلك بعد ثلاث أيام من المعاملة أيضاً. مقارنة باليرقات الغير معاملة.

وبخصوص تأثير المركبات المختبرة على الإنزيمات المحللة للكربوهيدرات كانت ٩.٠٣ ± ٤٠٥.٦٧٩ ، ٧.٢٦ ± ٢٢٢.٣٣ ، ٣.٣١± ١٢٣.٠٠ سجلت لليرقات المعاملة بالزيت المعدنى (تركيز LC_{50} والاندوكساكارب (تركيز LC_{25}) وذلك بعد ثلاث أيام من المعاملة ، على الترتيب. وإختلف النشاط النسبى عن ذلك حيث سجل أعلى خفض للنشاط النسبى – ٠.٥٣ ، - ٠.٤٤ ، -٠.٦١% لليرقات المعاملة بتركيز LC_{50} لمركب التيفلوبنزورون وذلك بعد ثلاث أيام والتركيز LC_{25} لنفس المركب بعد ثلاث أيام من المعاملة أيضاً وكانت الأخيرة لليرقات المعاملة بالزيت المعدنى بتركيز LC_{50} بعد سبعة أيام وذلك للثلاث أنزيمات على الترتيب. وذلك للمقارنة لليرقات الغير معاملة.