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TOXICITY AND BIOCHEMICAL IMPACTS OF SEVERAL INSECTICIDES AND THIER MIXTURES ON THE 4TH INSTAR LARVAE OF COTTON LEAFWORM *Spodoptera Littoralis* (BIOSD).

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ABSTRACT

The objective of this research was to evaluate the toxicity of new type of insecticides mixtures (insecticide + insecticide + synergist) to 4th instar larvae of cotton leafworm *spodoptera littoralis* in addition to study the effect of this mixtures and their individual insecticides on some biochemical enzymes activites in hemolymph in 4th instar larvae. Toxicological Results revealed that cordon plus was the most effective insecticides mixture with LC_{50} (11.04 ppm) followed by lambada 5%, encore and pulmic. While chlorpyrifos was the most effective individual insecticide against 4th instar larvae of cotton leafworm *S. littoralis* with LC_{50} (46.17 ppm) followed by fenitrothion, diazinon and lambada 2.5%. Biochemical results revealed that all the tested insecticides increased the activity of aliphatic esterase except chlorpyrifos and there was appositive correlation between the concentration used and the activities. All the tested insecticides decreased (α-E), all the tested insecticides increased (ß -E) .Also all the tested insecticides and insecticides mixtures increased acid phosphatases and alkaline phosphates activities when larvae treated with $LC_{12.5}$ or LC_{25}, in comparison with control. All the tested compound decreased (GOT /AST) and (GPT /ALT) activites in hemolymph of 4th instar larvae of *S. littoralis*

INTRODUCTION

The cotton leaf worm *spodoptera litoralis* (Boisd) has long been recognized as the most serious insect pest of cotton and other crops in Egypt.

The occurrence of insect resistance to insecticides is mainly due to the action of enzymes which either insensitive to the insecticide or able to degrade it to non toxic metabolites (Al-Elimi, 1994) insecticide mixtures have an important role in reducing insect resistance. Recently many mixtures compounds appears in market in Egypt. This compounds consist of two insecticides belong to two different insecticides groups, one of them belong to pyrethriods while the other belong to the organophosphates insecticides in addition to the synergist piperonyl butoxide, this consider a new type of combination because it is not belong to insecticide – insecticide combination or insecticide synergist combination. So, it was very important to be determined against serious pest like larvae of cotton leaf worms *S. littoralis* by determined the median leathal concentration.

Joyce *et al.* (1988) studied the synergism of pyrethroids by piperonyl butoxide and MGK-264 against *Heliothis virescens*, *Spodoptera exigua, and Spodoptera frugiperda* (Lepidoptera: Noctuidae). Abdel-Fattah *et al.* (1986) determined the effect of the chitin biosynthesis inhibitors diflubenzuron and triflumuron at 3 conc (LC_{15}, LC_{30} and LC_{50}) on the activity of esterases

spectrophotometrically 0, 24, 28, 72 and 96 h after treatment in total homogenate of susceptible and profenofos-resistant strains of larvae of the noctuid *S. littoralis*. Saleh et al. (1988) studied the relationship between esterase activity and resistance to fenitrothion in 13 strains of the noctuid *S. littoralis* under laboratory conditions.The present investigation aimed to evaluate the toxicity of new type of insecticides mixtures (insecticide – insecticide- synergist) to 4th instar larvae of cotton leafworm *S. littoralis* in addition to assessment the effect of subleathal concentration $LC_{12.5}$ and LC_{25} of this mixtures and their individual insecticides on esterase activities aliphatic esterase (Ali-E) , alpha esterase (α – E) and beta esterase (β-E) , phosphatase activities both [acid phosphatase (AC-P) and alkaline phosphatase (ALP)] and transaminases enzymes activities both aspartate transaminase (AST/ GOT) and alinine transaminase (ALT/GPT) activity in haemolyph of 4th instar larvae of laboratory strain of *S. littorals* after treatment with LC_{25} and $LC_{12.5}$ of each compound.

MATERIAL AND METHODS

***I*. Strain of cotton leaf worm**

A susceptible colony of the Egyptian cotton leaf worm *S. littoralis* (Biosd.) needed for the present study was obtained as egg masses reared in the Plant Protection Research Institute Ministry of Agriculture, Dokki, Cairo, Egypt.

This strain was reared on castor oil been leaves according to the method described by El-Deffrawi et al., (1964).

***II* - Tested insecticides**

A -Synthetic pyrethroids :

1) DOLF 2.5% E.C

Lambada cyhalothrin: α-cyano–3 phenoxybenzyl 1.3 (2-chloro-3, 3, 3-trifluoroprop-1-enyl)–2,2-dimethylcyclo-propanecarboxylate as 1:1 mixture of the (z)-(1R,3R),s-ester and (z)-(1s,3s),R-ester.

B- Organophosphorus compounds

1) Diazinon (Durasen 30%) EC

Diazinon : o.o – diethyl o-(2-iso propyl –6-methyl pyrimidin-4-yl) phosphorothioate.

2) Fenitrithion (Sumithion Kz) 50% EC

Fenitrithion : o,o di methyl o-(3methyl 1-4- **nitrophenyl**)phosphorothioate.

3) Chlorpyrophos (Dursban) 48% EC

Chlorpyrifos: o,o - methyl o-(3,5,6-trichloro –pyridinyl) phosphorothioate.

C - Insecticides mixture:

1- PULMIC E.C

Diazinon	300 g/L
Lambada cyhalothrin	25 g / L
Piperonyl Butoxide	60 g/L synergist

2- ENCORE E.C

Fenitrithion	250 g/L
Lambada cyhalothrin	25 g / L
Piperonyl Butoxide	60 g/L synergist

3- CORDON plus E.C

Chlorpyrophos	240 g/L
Lambada cyhalothrin	25 g / L
Piperonyl Butoxide	60 g/L synergist

4- Lambada 5% E.C

Lambada cyhalothrin	500g/L.
Piperonyl Butoxide	60g/L.

***III* - Laboratory evaluation for median lethal concentration.**

For determining the LC_{50} value of various insecticides and insecticides mixtures water solution were prepared for each insecticide several concentration were prepared and each concentration was replicated 3 times .parts of castor oil leaves were dipped in each concentration for ten seconds ,left to dry for 1 hour. Mortality counts were made 24 hours after treatment .Mortality percentages were calculated and corrected by using Abbott's formula (1925) the corrected mortality percentages of each compound was statistically calculated according to Finney (1971).

***V*- Biochemical studies :**

A- treatments and preparing samples :

The 4th instar larvae of laboratory strain of *S. littoralis* were fed on castor oil leaves previously treated with subleathal concentration s $LC_{12.5}$ and LC_{25} of individual insecticides (lambada 2.5% , diazinon fenitrothion and chlorpyriphos) and insecticides mixtures (lambada5%, bulmac, Encor and cordon plus). Castor oil leaves were dipped for 10 seconds in an aqueous solution of each of the tested compounds then left to dry for 1 hour in laboratory temperature before being offered to the 4th instar. exposure and feeding on treated leaves was for 24 hour then transferred to fresh untreated leaves for one day . haemolymph was obtained by removing one of the prolegs by forceps and applying gentle . Pressure was on the larvae with the fingers. The haemolymph was collected in cold tubes. The sample was centrifuged at 2500 rpm for 10 minutes at low temperature 5 °C to remove the blood cells .After centrifugation, the haemolymph was divided into small portions (0.5 ml) and stored in a refrigerator until the enzyme activities were determined (AL-Elimi, 1994; Hanafy, 1999;Sooker et al.,1999 and Saleh, 2000 Abed El-Mageed 2005).

B-Determination of enzyme activities :

Aliphatic or carboxyl esterase (Ali-E)was measured according to the method described by Sympthon et al.(1964). Alpha esterase (α-E) and beta esterases (ß-E) were determined according to the method of Van Asperen (1962). Acid phosphatases (AC-P) and alkaline phosphatase (ALK-P) were determined according to the method described by Powell and Smith (1954). Glutamine pyruvic transaminase (GPT) and glutamic oxaloacetic transaminas (GOT) were determined colourimetrically according to the method of Reitman and Frakle (1957).

RESULTS AND DISCUSSION

Pesticidal activity of the tested compounds are summarized in Tables (1 & 2) the data in the tables. showed that as for the individual insecticides chlorpyriphos had the highest toxic action followed by fenitrothion and diazinon while Lambada 2.5% was the least in toxicity the obtained LC_{50} s were 46.17 ,767.38, 805.67 and 1279.2 ppm for the pervious compound , respectively .

Table (1):Susceptibility of 4th instar larvae of laboratory strain of cotton leafworm spodoptera littoralis to insecticides and insecticides mixtures

Label1 Treatments	LC_{50} ppm	Confidence limit For LC_{50}		LC_{90} ppm	Confidence limit For LC_{90}		Slop
		lower	upper		lower	upper	
Individual insecticides							
Lambada 2.5%	1297.2	1077.89	1492.74	3046.62	2419.77	4532.06	3.40 ± 0.54
Diazinon	805.67	709.60	885.88	1377.64	1208.01	1737.97	5.50 ± 0.93
Fenitrothion	767.38	661.07	870.15	1768.59	1396.06	2904.87	4.45 ± 0.88
Chlorpyriphos	46.17	37.61	54.84	124.96	96.26	199.59	2.96 ± 0.49
Insecticides mixtures							
Lambada5%	160.91	100.85	208.72	708.32	481.20	1738.89	1.99 ± 0.44
Pulmic	459.32	315.75	718.72	1732.97	1315.99	3089.29	2.57 ± 0.59
Encore	269.64	231.80	301.75	644.48	491.98	1309.42	4.35 ± 1.03
Cordon plus	11.04	6.51	15.78	91.54	51.72	312.57	1.39 ± 0.29

Table (2): Lethal and sublethal concentration used against 4th instar larvae of cotton leafworm *S. littorals*

Treatments	Used concentration		
	LC_{50} ppm	LC_{25} ppm	$LC_{12.5}$ ppm
Individual insecticides			
Lambada 2.5%	1297.2	810.19	586.88
Diazinon	805.67	607.49	497.71
Fenitrothion	767.38	544.90	427.90
Chlorpyriphos	46.17	27.34	18.88
Insecticides mixtures			
Lambada5%	160.91	73.76	42.53
Pulmic	549.32	300.07	195.80
Encore	269.64	188.63	146.58
Cordon plus	11.04	3.63	1.65

As for the activity of insecticides mixtures cordon plus which consist of (chlorpyriphos + lambadacyhalothrin + pipronyl butoxide) had the highest toxic action against 4th instar larvae of cotton leafworm *S. littoralis* followed by Lambada 5% (Lambadacyhalothrin +pipronyl butoxide) and Encore mixture which consist of (Fenitrothion + Lambadacyhalothrin +pipronyl butoxide) while pulmic mixture (Diazinon + Lambadacyhalothrin +pipronyl butoxide) was the least mixture in the toxicity the obtained LC_{50} s were 11.04 ,160.91, 269.64 and 549.32 ppm for the pervious compound , respectively.

Determination of enzyme activities:

Biochemical studies on *S. littoralis* showed the effect of insecticides (lambadacyhalothrin, diazinon, fenitrothion and chlorpyriphos) and their mixtures with the synergist pipronyl butoxide on esterase activities Aliphatic esterase (Ali-E), non specific esterases [alpha esterase (α – E) and Beta esterase (β-E)], Phosphatase activities both [acid phosphatase (AC-P) and alkaline phosphatase (ALP)] and transaminases enzymes activities both aspartate transaminase (AST/ GOT) and alinine transaminase (ALT/GPT) activity in haemolyph of 4th instar larvae of laboratory strain of *S. littorals* after treatment with LC_{25} and $LC_{12.5}$ of each compound .

The effect of sublethal concentrations of tested compound

The data in Table (3) are refer to the change in Aliphatic esterase (Ali-E) activities in haemolyph of 4th instar larvae of laboratory strain of S. littorals after treatment with sublethal concentrations $LC_{12.5}$ of each compound all the tested insecticides and insecticides mixtures increased Aliphatic esterase (Ali-E) activities than control except chlorpyrifos recorded reduction in enzyme activity reached – 1.89 % lower than control the maximum change accrrued by cordon plus with value 15.09% higher than control followed by fenitrothion , pulmic, encore, lambada2.5%, diazinon, and lambada5% .

Also, in Table (4), it was appeared that, LC_{25} increased Aliphatic esterase (Ali-E) activities than control the maximum increase occurred by encore reached 25.97 % followed by cordon plus , pulmic , lambada 2.5% , diazinon , lambada 5% ,fenitrothion and chlorpyriphos. With values 22.64,20.75, 5.03 ,3.77, 3.14, 2.52,1.26 % respectively. The present results coincide with those reported by several authors Anwar and Abd El- Mageed (2005) found that insect growth regulators (Diflubenzuron, Tebufenozide, flufenoxuron and chlorfluazuron) increased the activity of aliphatic esterase (Ali –E) than control the percentage of increase were3.75 ,7.5 ,18.75 and 16.25 % respectively in haemolymph of 4th instar larvae of laboratory strain of *S. Littorals* after treatment with $LC_{50}$of each compound similar effect was observed by Abd El-Mageed, and El-gohary (2006) who found that Ali-E on 4th instar larvae of the laboratory and the field strains of the cotton leafworm *S. littoralis.* increased after treatment with spinosad insecticide .

The data in Table (3) are refer to the change in alpha esterase (α – E) activities in haemolyph of 4th instar larvae of laboratory strain of S. littorals after treatment with sublethal concentrations $LC_{12.5}$ of each compound . On the other hand, at the same tables the results indicated that all the tested compound decreased (α – E) activities than control in general . lambada 2.5 % occurred the

maximum change with value – 21.52 % than control while the minimum reduction occurredby fentrothion with value -3.79 % lower than control .

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Also, data in Table (4) revealed that all the tested compound decreased (α – E) activities than control in general. lambada 2.5 %, chlorpyriphos ,pulmac ,encore , cordon plus , accrrued the maximum decrease in (α – E) activities with value- 24.05 % while the minimum change occurredby feitrothion with value -12.65% lower than control. In agreement with El-Ghar et al., (1995) reported that abamectin at 5 ppm caused a reduction in the activities of alpha –esterases in fifth-instar larvae of *S. littoralis* which allowed to feed for only 24 h on leaves treated with sublethal conc. by 28.30 %

On the other respect when larvae treated with $LC_{12.5}$ all the tested compound increased (β-E) activities than control in general. The maximum increased occurred by cordon plus reached 381.48 % higher than control followed by pulmic, encore, lambada 2.5%, fenitrothion, chlorpyriphos, diazinon and lambada5%.

Also all the tested compounds in LC_{25} increased (β-E) activities than control in general the maximum increased occurred by encore reached 566.67 % while the minimum increased occurred by lambada 5% with value 329.63 % higher than control. The obtained results are in agreement with Anwar and Abd El- Mageed (2005) how found that insect growth regulators (Diflubenzuron, Tebufenozide, flufenoxuron, chlorfluazuron, hexaflumuron and lufenuron) increased the activity of beta esterase than control in haemolymph of 4th instar larvae of laboratory strain of *S. Littorals* after treatment with LC_{50} .

The results indicated that when larvae treated with $LC_{12.5}$ all the tested compound increased Acid phosphates (AC-P) activities than control in general the highest increase occurred by encore with value 42.42%, followed by pulmic, cordon plus, chlorpyriphos, lambada5%, fenitrothion, diazinon and lambada2.5%.

Also, data in Table (4) showed that all the tested compound in LC_{25} increased Acid phosphates (AC-P) activities than control in general. The highest increase occurred by encore, followed by pulmic, cordon plus, diazinon, chlorpyriphos, lambada2.5% and fenitrothion.

The present results coincide with those reported by several authors Abd EL-Mageed *et al*., (2005) showed that Acid phosphates (AC-P) activities increased after treatment 4th instar larve field and laboratory strain of *S. littoralis* (Biosd) with chlorpyrifos, carbaryl and fenpropathrin.

Data showed that all the tested compounds in sublethal concentrations increased alkaline phosphatase (Alk-p) activities than control in general. The maximum change than control occurred by pulmic with value 83.23 %when larvae treated with $LC_{12.5}$ while it was 117.29 % when larvae treated with LC_{25}. The present results coincide with those reported by several authors El-Sheakh *et al* ., (1990) found that treatment 4th instar larvae of *S. littoralis* (Biosd) with ofunac and sumithion caused increasing in alkaline phosphatase (Alk-p) activity. Similar effect was observed by El-kordy *et al*. (1995) who determined the effects of pyriproxfen, flufenoxuron and teflubenzuron on the 4th and 6th instar larvae of *S. littoralis* (Biosd) and found that ALK- pase activity was increased after the treatment with the three compouneds.

The data in Table (3) are refer to the change in aspartate transaminase (GOT / AST) activity in haemolyph of 4th instar larvae of laboratory strain of S. littorals feeding on castor oil leaves previously treated with sublethal concentrations $LC_{12.5}$ of each compound . The results indicated that all the tested compound decreased (GOT/AST) activities than control in general. The maximum decreased occurred by cordon plus, encore and lambada5% with value -6.97% followed by pulmic, chlorpyriphos, lambada 2.5%, diazinon and fenitrothion.

Also, data in Table (4) indicated that all the tested compound in LC_{25} decreased (GOT/AST) activities than control in general. The maximum decreased occurred by cordon plus and encore with value -17.21% followed by pulmac, lambada 5%, chlorpyriphos, lambada2.5%, fenitrothion and diazinon. In agreement with Abdel-Hafez et al., (1993) who studied the efficacy of two insecticides (cyanophos and methomyl), two IGRs (diflubenzuron and flufenoxuron) and their combined mixture (dioradin, dannate and sumulin) against laboratory strain of *S. littoralis* (Biosd). The biochemical studies indicated that the treatment larvae with the LC_{50} of the tested compound caused variable reduction in GOT, under field condition, the IGRs / insecticides mixtures or their residues gave variable decrease in the activity of GOT.

The data in Table (3) are refer to the change in alanine transaminase (GPT / ALT) activity in haemolyph of 4th instar larvae of laboratory strain of S. littorals feeding on castor oil leaves previously treated with sublethal concentrations $LC_{12.5}$ of each compound . The results indicated that all the tested compound decreased (GPT / ALT) activities than control in general. The maximum decreased occurred by chlorpyriphos with value -17.70 % lower than control while the minimum decreased occurred by diazinon it was -4.30% lower than control.

Also, data in Table (4) indicated that all the tested compound in LC_{25} decreased (GPT / ALT) activities than control in general. The maximum decreased occurred by cordon plus with value -23.98% lower than control while the minimum decreased occurred by diazinon it was -7.17% lower than control. The present results coincide with those reported by several authors El-Kordy et al. (1995) determined the effects of pyriproxfen, flufenoxuron and teflubenzuron on the 4th and 6th instar larvae of *Spodoptera littoralis* (Biosd) there was a significant reduction in the level of GPT after the treatment with the tested compounds In the same trend Abd EL – Mageed et al ., (2005) studied the effect of two organophosphorus (profenofos and chlorpyrifos) two carbamates (carbaryl and thiodicarb) and two synthetic pyrethriod insecticides (fenpropathrin and Beta-cyfluthrin) on the activity GPT [alanine aminotransferase] on the field strain of Spodoptera littoralis (Biosd) compared with the laboratory strain. They found that all tested compounds gave variable reduction in (ALT) on the field and laboratory strain.

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دراسات تكسيكولوجيه و بيوكيميائيه على بعض المبيدات ومخاليطها ضد دوده ورق القطن

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أجريت الدراسة بهدف تقييم بعض مخاليط المبيدات التى ظهرت حديثا فى السوق المصريه تتكون هذه المخاليط من مبيد المباداسيهالوثرين والمنشط بيرونيل بيوتوكسيد بصفه اساسيه بالاضافه الى احد المبيدات الفسفوريه الاتيه (كلوربيرفوس أو فنتروثيون أو ديازينون) . اظهرت النتائج أن مخلوط كوردن بلاس المكون من (لمبادا سيهالوثرين + كلوربيرفوس+ البيرونيل بيوتوكسيد) كان اكثر المخاليط المختبره كفاءه ضد العمر الرابع لدوده ورق القطن حيث بلغت قيمه التركيز النصفى القاتل له ١١,٠٤ جزء/ المليون تلاه مبيد لمبادا ٥% ، انكور ، بولماك بينما كان اكثر المبيدات المفرده كفاءه مبيد الكلوربيرفوس حيث بلغت قيمه التركيز النصفى القاتل له ٤٦,١٧ جزء/ المليون تلاه فنتروثيون ، ديازينون، لمبادا ٢,٥%. بينما أظهرت نتائج الدراسات البيوكيميائيه للتركيزات غير القاتله سواء التركيز القاتل ل١٢,٥% & ٢٥% على بعض انزيمات دوده ورق القطن ما يلى ان كل المبيدات المختبره ادت الى ارتفاع معنوى فى نشاط (Ali –E) مقارنا بالكنترول فيما عدا مبيد الكلوربيرفوس عند المعامله بالتركيز القاتل ١٢,٥ % وكان اكثر المبيدات تأثيرا مبيد كوردن بلاس حيث بلغت نسبه الارتفاع ١٥,٠٩% بينما عند المعامله بالتركيز القاتل ل ٢٥% كان اكثر المبيدات تأثيرا مبيد انكور بلغت نسبه الارتفاع ٢٥,٩٧% كما اشارت النتائج الى حدوث انخفاض معنوى فى نشاط انزيم alpha esterase (α – E) عند معامله اليرقات بالتركيزات المختبره لكل المركبات وحدث اعلى انخفاض عند المعامله بمبيد انكور أما بالنسبه لنشاط انزيم Beta esterase (β-E) فقد لوحظ حدوث زياده معنويه عند معامله اليرقات بكل المبيدات المختبره بكلا التركيزين وكان اكثر المبيدات تأثيرا مبيد كوردن بلاس حيث بلغت نسبه الارتفاع ٣٨١,٤٨% بينما عند المعامله بالتركيز القاتل ل ٢٥% كان اكثر المبيدات تأثيرا مبيد انكور بلغت نسبه الارتفاع ٥٦٦,٦٧% واشارت النتائج الى حدوث زياده معنويه فى نشاط Acid phosphates (AC-P) فى اليرقات المعامله بكل المبيدات المختبره وكان اكثر المبيدات تأثيرا مبيد انكور اما بالنسبه لنشاط alkaline phosphatase (Alk-p) اشارت النتائج الى حدوث زياده معنويه فى نشاطه عند المعامله بكل المبيدات المختبره وادت المعامله بمبيد بولماك الى اعلى زياده وبلغت الزياده ٨٣,٢٣% مقارنا بالكنترول .اشارت النتائج الى حدوث انخفاض معنوى فى نشاط انزيم aspartate transaminase (GOT / AST) عند المعامله بكل المبيدات المختبره وكان اكثر المبيدات تأثيرا مبيد كوردن بلاس عند المعامله بالتركيز القاتل ل١٢,٥% او ل٢٥% اما بالنسبه لنشاط انزيم alanine transaminase (GPT / ALT) فقد حدث انخفاض معنوى فيه نتيجه المعامله بكل المبيدات المختبره وكان اكثر المبيدات تأثيرا عند المعامله بالتركيز القاتل ل١٢,٥% مبيد الكلوربيرفوس وبلغت نسبه الانخفاض ١٧,٧٠% مقارنا بالكنترول بينما عند المعامله بالتركيز القاتل ل٢٥% كان اكثر المبيدات تأثيرا مبيد كوردن بلاس وبلغت نسبه الانخفاض ٢٣,٩٨%

Table (3):Esterases ,phosphatses and Transaminase activity in haemolymph of 4th instar larvae of laboratory strain of *S. littoralis (Boisd)* after treatment (Boisd) after treatment with $LC_{12.5}$ of each insecticides.

Tested compounds	Aliphatic Esterase (Ali-E)		non specific esterases				phosphatases				transaminase			
			alpha Esterase (α – E)		Beta esterase (β-E)		Acid phosphates		Alkaline phosphatase		Alanine transaminase (GPT / ALT)		Aspartate transaminase (GOT / AST)	
	activity	%of control	activity	%of control	activity	%of control	activity	%of control	activity	%of control	activity	%of control	activity	%of control
Lambada 2.5%	3.28	3.14	3.10	-21.52	1.12	314.81	3.8	15.15	4.30	33.54	3.94	-5.74	8.22	-4.41
Diazinon	3.20	.63	3.6	-8.86	1.0	270.37	4.0	21.21	4.22	31.06	4.0	-4.30	8.30	-3.48
Fenitrothion	3.60	13.21	3.80	-3.79	1.10	307.41	4.10	24.24	4.18	29.81	3.98	-4.78	8.40	-2.32
Chlorpyrifos	3.12	-1.89	3.12	-21.01	1.10	307.41	4.12	24.85	4.12	27.95	3.44	-17.70	8.12	-5.58
Lambada 5%	3.20	.63	3.30	-21.01	1.0	270.37	4.10	24.24	4.10	27.33	3.94	-5.74	8.00	-6.97
pulmic	3.48	9.43	3.10	-21.52	1.22	351.85	4.5	36.36	5.90	83.23	3.95	-5.50	8.1	-5.81
Encor	3.38	6.29	3.20	-18.98	1.14	322.22	4.7	42.42	4.90	52.17	3.88	-7.17	8.00	-6.97
cordon plus	3.66	15.09	3.12	-21.01	1.3	381.48	4.20	27.27	5.70	77.02	3.90	-6.69	8.00	-6.97
Control	3.18	--	3.95	--	0.27	--	3.30	--	3.22		4.18	--	8.60	---

$$\% \text{ Change than Control} = \frac{\text{Test - Control}}{\text{Control}} \text{ x } 100$$

Table (4):Esterases ,phosphatses and Transaminase activity in haemolymph of 4th instar larvae of laboratory strain of *S. littoralis (Boisd)* after tretment (Boisd) after treatment with LC_{25} of each insecticides.

Tested compounds	Aliphatic Esterase Ali-E)		non specific esterases				phosphatases				transaminase			
			alpha esterase (α – E)		Beta esterase (β-E)		Acid phosphates		Alkaline phosphatase		Alanine transaminase (GPT / ALT)		Aspartate transaminase (GOT / AST)	
	activity	%of control	activity	%of control	activity	%of control	activity	%of control	activity	%of control	activity	%of control	activity	%of control
Lambada 2.5%	3.34	5.03	3.00	-24.05	1.40	418.52	4.60	39.39	5.10	58.39	3.50	-16.26	7.48	-13.02
Diazinon	3.30	3.77	3.40	-13.92	1.20	344.44	4.90	48.48	5.12	59.01	3.88	-7.17	7.9	-8.14
Fenitrothion	3.26	2.52	3.45	-12.65	1.30	381.48	4.40	33.33	5.12	59.01	3.60	-13.87	7.60	-11.63
Chlorpyrifos	3.22	1.26	3.00	-24.05	1.20	344.44	4.60	39.39	5.92	83.85	3.28	-21.53	7.30	-15.12
Lambada 5%	3.28	3.14	3.10	-21.52	1.16	329.63	4.5	36.36	5.80	80.12	3.55	-15.07	7.30	-15.12
pulmic	3.84	20.75	3.00	-24.05	1.70	529.63	5.33	61.51	7.00	117.39	3.42	-18.18	7.20	-16.28
Encor	4.0	25.79	3.00	-24.05	1.80	566.67	5.90	78.78	6.90	114.29	3.20	-23.44	7.12	-17.21
cordon plus	3.90	22.64	3.00	-24.05	1.6	492.59	5.20	57.57	6.90	114.29	3.18	-23.98	7.12	-17.21
Control	3.18	--	3.95	--	0.27	--	3.30	--	3.22	--	4.18	--	8.60	---

$$\% \text{ Change than Control} = \frac{\text{Test - Control}}{\text{Control}} \text{ x } 100$$