EFFICACY AND BIOCHEMICAL EFFECTS OF SOME INSECTICIDES AGAINST COTTON LEAFWORM, *Spodoptera littoralis* (BOISD.)

Rasha A.A. Sleem¹*, El-Zemaity² M.E., Hussein² M.I. and Sherifa A.N. El-Sherif ¹

1- Bioassay Dept., Central Agric. Pesticides Lab. Agric. Res. Center, Dokki, Giza, Egypt  
2- Plant Protection Dept., Fac. of Agric., Ain Shams Univ., P.O. Box 68, Hadayek Shubra 11241, Cairo, Egypt

*Corresponding author: rashasleem@yahoo.com

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**ABSTRACT**

The efficiency and biochemical effects of certain insecticides belonging to different groups namely: flubendiamide (diamide), pyridalyl (phenoxypyridaloxide), fipronil (phenylpyrazole) and pirimiphos-methyl (Ops) were tested against 2nd larval instar of *Spodoptera littoralis* laboratory strain using dipping technique. The efficacy of the tested insecticides are arranged as follows to LC₅₀ values. The results showed that flubendiamide was the superior toxicant insecticide (LC₅₀ 1.03 ppm) followed by pyridalyl (2.13 ppm), clothianidin (26.87 ppm), pirimiphos-methyl (76.31 ppm) and spirotetramat (431.91 ppm). Biochemical effects of the tested insecticides on acetylcholine esterase (AChE), glutathione-S-transferases (GST), adenosinetriphosphatase (ATPase), phenoloxidase, total calcium, and total protein were determined in the treated larvae. Data showed highest significant increase at AChE activity in treatment of fipronil by change% (70.59), while treatment with pirimiphos-methyl recorded highest significant decrease by change% (-56.41). Whereas, all treatments recorded increase in GST activity except pirimiphos-methyl recorded non significant decrease. All insecticides treatments were showed a decrease in phenoloxidase activity the highest decrease recorded by pirimiphos-methyl treatment by change% (-53.06). Regarding change percentage of ATPase, activity data recorded significant increase with pirimiphos-methyl treatment by (72.91%). However, total protein in all treatments showed a significant decrease. On the other hand, treatment with pirimiphos-methyl recorded a significant decrease in total calcium and the corresponding change % was (- 6.0%). Previous data confirmed the mode of action of the novel tested insecticides.

**Keywords:** *Spodoptera littoralis*, Toxicology, Novel insecticides, Pirimiphos-methyl, Biochemical aspects.

1. **INTRODUCTION**

The Egyptian cotton leafworm, *Spodoptera littoralis* is a highly polyphagous defoliator of many cultivated crops. This pest one of the most important lepidopteron pests which attack numerous economically important crops around the year causing economic losses in infected crops in both open fields and greenhouses. At present strategy of agricultural pest control of *S. littoralis* using chemical control by conventional insecticides only became undesirable because insects often developing resistance for this insecticides after much successive application and this effect can cause a defect in the implementation of effective pest control programs in agriculture (*Knight and Norton, 1989*). During the last five decades conventional insecticides, all neuroactive chemicals have played a major role in insect pests management in many crops. Unfortunately, their indiscriminate uses led to several problems like resistance, toxicity to non-target organisms and environmental long persistence. The current trend in insect pests controls is reduce the use of conventional insecticides and search for...
development of new control agents having novel biochemical targets to solve pest problem, management resistance and safety use to human and the environment. In recent years, several new insecticide groups having new chemistries like neonicotinoids, diamide, phenyl-pyridalox, tetramic acid, oxidazine, keto-enol, and phenylpyrazole were commercially formulated and traded in many countries including Egypt. (Kodandaram et al 2010).

The present study aimed to evaluate the efficacy of six insecticides; flubendiamide, pyridalyl, clothianidin, fipronil, spirotetramat and pirimiphos-methyl representative to different modes of action and estimate their biochemical effects on acetylcholinesterase, glutathione-s-transferases, phenoloxidase adenosinetriphosphatase, total calcium, and total soluble protein in 2nd larval instar of S. littoralis.

2. MATERIALS AND METHODS

2.1. Tested insect

The laboratory strain of cotton leafworm, Spodoptera littoralis was maintained under tightly conditions in the insect rearing room at 25±2°C and 60±5 relative humidity avoiding any intentional chemical pressure in Central Agriculture Pesticides Laboratory (CAPL), Dokki, Giza was used. A standard rearing method described by (El-Defrawi et al 1964) was followed.

2.2. Tested insecticides

Table 1. The tread name, common name, chemical group of tested insecticides in addition to their mode of action

<table>
<thead>
<tr>
<th>Trade name</th>
<th>Common name</th>
<th>Chemical group</th>
<th>IRAC MoA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Takumi® 20% WG</td>
<td>Flubendiamide</td>
<td>Diamide</td>
<td>Ryanodine receptor modulators</td>
</tr>
<tr>
<td>Pleo® 50%EC</td>
<td>Pyridalyl</td>
<td>Phenoxo-pyridalox</td>
<td>GABA-gated chloride channel antagonists</td>
</tr>
<tr>
<td>Coach® 20%SC</td>
<td>Clothianidin</td>
<td>Phenylpyrazole</td>
<td>Nicotinic acetylcholine receptor (nAChR)competitive modulators</td>
</tr>
<tr>
<td>Super Tox® 20%SC</td>
<td>Pirimiphos-methyl</td>
<td>Neonicotinoids</td>
<td>Acetylcholinesterase inhibitors</td>
</tr>
<tr>
<td>Actellic 50%EC</td>
<td>Spirotetramat</td>
<td>Organophosphate</td>
<td>Inhibitor of acetyl COA carboxylase</td>
</tr>
<tr>
<td>Movento® 10% SC</td>
<td></td>
<td>Tetramic acid</td>
<td></td>
</tr>
</tbody>
</table>

2.3. Leaf dipping technique

Leaf-dipping technique (Shepared, 1958) was used to estimate the susceptibility of 2nd larval instars of S. littoralis to the tested insecticides. Fresh and clean dried leaves of castor (Ricinus communis) were dipped for 30 seconds in serial concentrations (6-8) of an aqueous solution to each insecticide. Three replicates were used each of which has 10 healthy larvae of S. littoralis. The present mortality was recorded in the second day and corrected by Abbott’s formula (1925).

Data analyzed by applying the Ldp line software (Bakr, 2007).The values of LC50 and slope in addition to toxicity index ,which calculated to (Sun, 1950) were illustrated in Table (2).

2.4. Biochemical analysis

The survivor second larval instars after exposure to median lethal concentration of each insecticides and the untreated larvae were cooled at – 40°C before homogenizing.

The activity of the total soluble protein, adenosinetriphosphatase (ATPase), glutathione-S-transferases (GST), phenoloxidase, acetylcholine esterase (AChE) and total calcium was determined spectrophotometrically in whole body tissue homogenate.
2.4.1. Preparation of insect samples for biochemical analysis

The frozen larvae were homogenized in a glass tissue grinder under an ice jacket in (1:7 w/v) with homogenization buffer (pH 7.8) which prepared by dissolving 15 ml of glycerol into 75 ml distilled water and adding 606 mg Tris, 292 mg EDTA and 5mg phenylthiourea, the pH adjusted to 7.8 then the final volume was completed to 100 ml distilled water (Salama, 1985). Homogenates were centrifuged at 12000 rpm for 20 minutes at 4°C and the resultant supernatants were held in clean Eppendorf for biochemical analysis.

2.4.2. Estimation methods of enzymatic activity

Acetylcholinesterase (AChE) activity was determined according to the method described by Ellman et al (1961). Glutathione S-transferases (GST) activity was measured by the method of Habig et al (1974). Adenosinetriphosphatase (ATPase) estimated by the method of Shiosaka et al (1971). Phenoloxidase activity was determined using the method of Ishayaa and Casida (1974). Total protein was measured according to the method described by Bradford, (1976). Total calcium was determined using kit according to the method described by Gindler, (1972).

Statistical analysis

Data statistically analyzed by using SPSS program V.16.0 and differences were considered significant at < 0.05 level.

3. RESULTS AND DISCUSSION

3.1. Toxicity of tested insecticides

The potency of the six tested commercial insecticides, pirimiphos-methyl, pyridalyl, flubendiamide, clothianidin, fipronil, and spirotetramat were evaluated against the new molted 2nd larval instar of S. littoralis as shown in Table (2). Data indicated that the efficiency of tested insecticides varied according to the value of median lethal concentration (LC50).

The main aim of this study was to evaluate six compounds representing different chemical groups against S. littoralis larvae in order to find alternative and supplements compounds to conventional chemical insecticides. The results in Table (2) show the efficiency of the tested insecticides; flubendiamide, pyridalyl, fipronil, clothianidin, pirimiphos-methyl and spirotetramat against second larval instar of cotton leaf worms. The candidate insecticides were arranged according to LC50 values in the following descending order: flubendiamide (1.03 ppm), pyridalyl (2.13 ppm), fipronil (7.42 ppm), clothianidin (26.87 ppm), pirimiphos-methyl (76.31 ppm) and then spirotetramat (431.91 ppm). Data indicate that flubendiamide was more effective than the other tested insecticides against S. littoralis larvae. On the contrary, spirotetramat had poor efficacy. The results confirmed that flubendiamide, pyridalyl and fipronil were highly toxic against S. littoralis larvae than the insecticides; clothianidin, pirimiphos-methyl and spirotetramat. The insecticides clothianidin and pirimiphos-methyl showed moderate activity toward S. littoralis larvae with LC50 26.87 and 76.31 ppm, respectively.

The slope values of toxicity lines for flubendiamide, pyridalyl, fipronil, clothianidin, pirimiphos-methyl and spirotetramat were 2.166, 2.607, 1.723, 1.738, 1.346 and 3.781. Concerning the slope values, data in Table (2) indicate that spirotetramat showed the steepest toxicity line (slope = 3.781) followed by pyridalyl (2.607) and flubendiamide (2.166). The slope values of the other toxicity lines had approximately equal slope values and ranged between 0.24 and 3.83%.

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Toxicity of the tested insecticides against different insects including S.littoralis was evaluated by many researchers such as Argentine et al (2002), Rastegari and Subrahmanyam (2003), Saito et al (2004) and Andric et al (2014). Regarding the cotton leafworm, S.littoralis. Abd-Allah (1998) evaluated the efficacy of pirimiphos-methyl against S.littoralis in laboratory and field. The ob-
tained data found that the LC$_{50}$ value was recorded 1485.7 ppm after 24 h of treatment in laboratory using leaf dipping technique while pirimiphos-methyl led to reduction in S. littoralis field strain population by 80.11 % & 47.15% after 1 and 3 days of insecticides spraying. Abdel-Rahim et al (2009) reported that LC$_{50}$ of pyridalyl was 1.8 ppm to 2$^{nd}$ larval instar larvae of S. littoralis laboratory strain. Also, Abdel-Rahim (2011) estimated pyridalyl bio-residual activity against 2$^{nd}$ larval instar of sensitive strain S. littoralis after feeding for 48 hrs on treated cotton leaves with the recommended rate of application. The mortality percentage reached to 100, 90, 62, 40% after 0, 3, 7, 12 day post application. Dahi et al (2011) noticed that LC$_{50}$ of pyridalyl on S. littoralis 2$^{nd}$ larval instar was 6.77 ppm after 24 hrs. Abdel-Rahim and Zidan (2012) evaluated the efficiency of flubendiamide against S. littoralis 2$^{nd}$ larval instar and found that the LC$_{50}$ was 0.06 ppm. Abdel-Hafez and Osman (2013) reported that pyridalyl as a semi-synthetic insecticide was toxic against 2$^{nd}$ instar larvae of S. littoralis based on their LC$_{50}$ values which were 2.56, 1.75, 0.58 and 0.63 ppm after 2, 3, 5 and 7 days. Bhatti et al (2013) evaluated flubendiamide efficiency using leaf dip bioassay against S. littoralis 2$^{nd}$ instar after 24, 48, 72 hrs. The values of LC$_{50}$ were 2.81, 0.37 and 0.31 µl/ml, respectively. Also, Abd-El-Aziz (2014) reported that the LC$_{50}$ value of pyridalyl after 48 hrs from treatment of 4$^{th}$ larval instar S. littoralis was 3.94 ppm. Andric et al (2014) study the residual activity of pirimiphos-methyl against Plodia interpunctella (Hubner) larvae after 2, 7 and 14 days of insect exposure to treated concrete. The results that the pirimiphos-methyl achieved maximum efficacy (100%) in all treatment after 2-14 days of exposure. Abou-Taleb et al (2015) found that fipronil was toxic for the field strain of S. littoralis and recommended it can be a good alternative in controlling of cotton leafworm. Saleh et al (2015) recorded that LC$_{50}$ value of pyridalyl was 18.679 ppm against the same instar after 24 hrs from treatment. El-Dewy (2017) found that the LC$_{50}$ values of pyridalyl to 4$^{th}$ larval instar of S. littoralis laboratory strain were 37.88, 13.01 and 10.16 ppm after 24, 48 and 72 hrs, respectively. Hatem et al (2017) evaluated the efficiency of clothianidin LC$_{50}$ against S. littoralis 4$^{th}$ larval instar the LC$_{50}$ value was 70.24 ppm after 24 hrs of treatment using leaf dipping techniques.

The present study considering and the previous investigations it could be concluded that flubendiamide, pyridalyl, clothianidin and fipronil can be use in IPM programs of S. littoralis.

**Table 2.** Susceptibility of 2$^{nd}$ larval instar of cotton leafworm, S. littoralis lab. strain to tested insecticides

<table>
<thead>
<tr>
<th>Insecticides</th>
<th>LC$_{50}$ (ppm)</th>
<th>95% Fiducial Limits</th>
<th>Slope ± S.E.</th>
<th>Toxicity Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- Flubendiamide</td>
<td>1.03 (0.794-1.332)</td>
<td>2.166±0.31</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>2- Pyridalyl</td>
<td>2.13 (1.689-2.751)</td>
<td>2.607±0.43</td>
<td>48.36</td>
<td></td>
</tr>
<tr>
<td>3- Fipronil</td>
<td>7.42 (5.565-9.938)</td>
<td>1.723±0.24</td>
<td>13.88</td>
<td></td>
</tr>
<tr>
<td>4- Clothianidin</td>
<td>26.87 (19.598-42.541)</td>
<td>1.738±0.30</td>
<td>3.83</td>
<td></td>
</tr>
<tr>
<td>5- Pirimiphos-methyl</td>
<td>76.31 (53.088-109.252)</td>
<td>1.346±0.19</td>
<td>1.35</td>
<td></td>
</tr>
<tr>
<td>6- Spirotetramat</td>
<td>431.91 (379.546-490.681)</td>
<td>3.781±0.58</td>
<td>0.24</td>
<td></td>
</tr>
</tbody>
</table>

**3.2. Effects of tested insecticides on biochemical components of exposed insects**

Effect of the tested insecticides at level of LC$_{50}$ on some vital components of exposed insects namely: (AChE, ATPase, GST, phenoloxidase, total calcium, and total proteins) in the 2$^{nd}$ larval instar of S. littoralis was recorded in Tables (3-4).

**3.2.1. AChE**

The data in Table (3) clearly showed the activity of AChE it was clear significant increase in treatment with fipronil by 0.178 (µmol/min/mg protein) and change% (70.59%) while, treatments with pirimiphos-methyl and pyridalyl recorded significant decrease by 0.045 and 0.067(µmol/min/mg protein) and change % (-56.41 and -34.96 %, respec-
Efficacy and Biochemical Effects of Some Insecticides Against Cotton Leafworm, *Spodoptera littoralis* (Boisd.)

3.2.2. GST

In case of GST activity, data in Table (3) indicate that treatments with flubendiamide, pyridalyl, clothianidin and spirotetramat caused various significant increase in enzyme activity only fipronil caused non-significant increase in enzyme activity. The difference in enzyme activity and change % were 3030.49 (149.53%), 3843(190.29%), 4702.46 (255.20%), 4262.12 (221.94%) and 1715.96 (29.61%) (mmol/min/mg protein) of flubendiamide, pyridalyl, clothianidin, spirotetramat and fipronil, respectively. On the other hand, treatment with pirimiphos-methyl recorded non-significant decrease in enzymatic activity by 994.91 (mmol/min/mg protein) and change % (2.33) all treatments compared to untreated control which recorded enzymatic activity by 0.104 (µmol/min/mg protein).

3.2.3. Phenoloxidase

The obtained data tabulated in Table (3) indicated that the phenoloxidase activity achieved decrease in all insecticides treatments. Both pirimiphos-methyl, spirotetramat and fipronil recorded significant decrease in enzyme activity by 0.18, 0.31 and 0.33 (ΔOD/Min/mg protein) while insecticides treatment with clothianidin, flubendiamide and pyridalyl recorded non-significant decrease in enzyme activity as shown 0.36, 0.38 and 0.38 (ΔOD/Min/mg protein) all treatments compared to control 0.39 (ΔOD/Min/mg protein). Changes % recorded (-53.06, -21.04, -16.20, -8.90, -4.31 and -2.60% for pirimiphos-methyl, spirotetramat, fipronil, clothianidin, flubendiamide and pyridalyl, respectively).

3.2.4. ATPase

The activity of ATPase matrix in Table (4), treatments with insecticide pirimiphos-methyl recorded the highest significant increase level of enzyme activity by 31.62 (mmol/min/mg protein) with change % (72.91%). Both flubendiamide and clothianidin recorded non-significant increase in enzyme activity by 18.71 and 18.61 (mmol/min/mg protein) with change % (2.33 and 1.78 %, respectively). On the other hand treatments of fipronil, pyridalyl and spirotetramat also showed non-significant decrease in ATPase activity by 17.36, 17.42 and 17.67 (mmol/min/mg protein) with change % (-5.04, -4.76 and -3.36%, respectively) in addition to enzyme activity in control by 18.29 (mmol/min/mg protein).

3.2.5. Total proteins

Data given in Table (4) indicated that all tested insecticides led to decrease in the total proteins content in all different treatments. The total protein content reached to 4.34, 4.78, 5.23, 4.91, 5.80 and 5.65 mg/ml homogenate for flubendiamide, pyridalyl, fipronil, clothianidin, pirimiphos-methyl and spirotetramat, respectively, in relevant to total protein content in control (7.02 mg/ml homogenate). The decreases in protein content expressed by change percentage. The highest decrease in activity observed in treatment with flubendiamide by change % (-38.14 %), while the other treatments recorded change % value as follows (-31.82, -29.97, -25.46, -19.43 and -17.32%) for treatments with pyridalyl, clothianidin, fipronil, spirotetramat and pirimiphos-methyl, respectively.

3.2.6. Total calcium

Data in Table (4) recorded non-significant increase or decrease of calcium activity in all insecticides treatments expect treatment with pirimiphos-methyl recorded a significant decrease of calcium activity by 11.14 (mmol/L) with change % (-6.0). The enzymatic activity and change % of different treatments were 11.71 (-1.16), 11.62 (-1.91%), 11.85 (0.0033%), 11.58 (-2.24%) and 11.92 (0.58%) (mmol/L) of flubendiamide, pyridalyl, fipronil, clothianidin and spirotetramat, respectively in comparison with activity in control 11.85 (mmol/L).

Organophosphates compounds are an inhibitor of acetylcholinesterase enzyme primarily by phosphorylation of the acetylcholinesterase enzyme (AChE) at nerve endings. Thus blocking the transmission of nervous impulse through the neuronal synapses thus, Ops plays a pivoted role in acetylcholinesterase inhibition (Ishaya and Degheel, 1998, Thomson, 2001) the obtained data confirmed this action same where pirimiphos-methyl inhibited the AChE by (-) 56.41% of the exposed insect.

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Neonicotinoids are an agonist of nicotinic acetylcholine esterases (nAChR) which mediate fast cholinergic synaptic transmission. Nicotine does not act as an acetylcholinesterase inhibitor (Gour and Sridevi, 2012). This results in agreement with obtained results which showed an increase in the AChE activity of insect treated with clothianidin by (+) 26.53.

Fipronil is potent nerve poison that blocks the $\gamma$-aminobutyric acid (GABA) regulated chloride channel in neurons caused an excessive release of acetylcholine at presynaptic (Gour and Sridevi, 2012), it similar with our results which found an increase in AChE in treatment with fipronil.

Gour and Sridevi, 2012 reported that diamides, caused their toxicity effects by binding and stimulate muscular calcium channels, causing un-controlled calcium release and resultant muscle contractions. On the other hand (Bers, 2002; Fill & Copello, 2002; Fessenden et al 2004 and Ogawa, 2008) evidence the flubendiamide mode of action when caused low concentration or inhibition of free calcium for ryanodine receptor (RyR) contains two types of Ca$^{2+}$ binding site which stimulatory high-affinity sites and inhibitory low-affinity sites. This result compatibility with the obtained result which recorded a decrease in flubendiamide treatment.

Pyridalyl is toxic for insect cells by causing inhibition of cell growth (Saito et al 2004 & 2006). The insecticide activity and selectivity of pyridalyl may be the results of selection inhibition of cellular protein synthesis (Moriya et al 2008). Conspicuous depletion in total protein content in 4th and 6th S.littoralis larval instar treated with pyridalyl recorded by (Dahi et al 2011, Abdel-Aziz and El-Gohary, 2013). The previous data confirm the insecticides mode of action which in agreement with the obtained data of total protein of the exposed insect which decreased by (+) 31.82 % than control. Nath et al (1997) mentioned that, protein depletion in tissues may constitute a physiological mechanism and might play a role in compensatory mechanism under insecticidal stress to provide intermediates to the Krebs cycle by retaining free amino acid content in insect hemolymph.

These results similar to the results obtained by(Gamil et al 2013; Abdel-Aziz and El-Gohary, 2013) reported a decrease in acetylcholine esterase (AChE) and increased in glutathione -S-transferases (GST) in 2nd larval instar of S.littoralis which treated with pyridalyl LC$_{50}$. Hatem et al (2017) reported decrease in total protein content, increase in GST and slight increase in AChE activity in S.littoralis larvae which treated by clothianidin than untreated control.

**Table 3.** Enzymes activity in whole body homogenate of survivor second larval instars of S.littoralis after application with LC$_{50}$ of each tested insecticides

<table>
<thead>
<tr>
<th>Insecticides treatments</th>
<th>AChE activity (µmol/min/mg protein)</th>
<th>Glutathione S-transferases (mmol/min/mg protein)</th>
<th>Phenoloxidase (ΔOD/Min/mg protein)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean±SE</td>
<td>Change%</td>
<td>Mean±SE</td>
</tr>
<tr>
<td>Flubendiamide</td>
<td>0.082±0.016</td>
<td>(-) 21.36</td>
<td>3303.49±398.34 *</td>
</tr>
<tr>
<td>Pyridalyl</td>
<td>0.067±0.0113 *</td>
<td>(-) 34.96</td>
<td>3843.12±26.90 *</td>
</tr>
<tr>
<td>Fipronil</td>
<td>0.178±0.011 *</td>
<td>(+) 70.59</td>
<td>1715.96±10.34</td>
</tr>
<tr>
<td>Clothianidin</td>
<td>0.132±0.010</td>
<td>(+) 26.53</td>
<td>4702.46±80.22 *</td>
</tr>
<tr>
<td>Pirimiphos-methyl</td>
<td>0.045±0.0048 *</td>
<td>(-) 56.41</td>
<td>994.91±19.30</td>
</tr>
<tr>
<td>Spirotetramat</td>
<td>0.083±0.009</td>
<td>(-) 19.82</td>
<td>4262.12±18.95 *</td>
</tr>
<tr>
<td>Control</td>
<td>0.104±0.0053</td>
<td>----</td>
<td>1323.89±13.70</td>
</tr>
</tbody>
</table>

Change % = mean activity of treated – mean activity of control / mean activity of control X 100 (according Paul, 2008).

* Significant at $p < 0.05$
Table 4. Protein concentrations and enzymes activity in whole body homogenate of survivor second larval instar of *S. littoralis* after application with LC$_{50}$ of each tested insecticide

<table>
<thead>
<tr>
<th>Insecticides treatments</th>
<th>ATPase activity (mmol/min/mg protein)</th>
<th>Total soluble protein (mg/ml homogenate)</th>
<th>Ca++ activity (mmol/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean±SE</td>
<td>Change%</td>
<td>Mean±SE</td>
</tr>
<tr>
<td>Flubendiamide</td>
<td>18.71±0.09 (+) 2.33</td>
<td>4.34±0.10∗ (-) 38.14</td>
<td>11.71±0.054 (-) 1.16</td>
</tr>
<tr>
<td>Pyridalyl</td>
<td>17.42±0.38 (-) 4.76</td>
<td>4.78±0.05∗ (-) 31.82</td>
<td>11.62±0.014 (-) 1.91</td>
</tr>
<tr>
<td>Fipronil</td>
<td>17.36±0.14 (-) 5.04</td>
<td>5.23±0.12∗ (-) 25.46</td>
<td>11.85±0.19 (+) 0.0033</td>
</tr>
<tr>
<td>Clothianidin</td>
<td>18.61±0.11 (+) 1.78</td>
<td>4.91±0.04∗ (-) 29.97</td>
<td>11.58±0.024 (-) 2.24</td>
</tr>
<tr>
<td>Pirimiphos-methyl</td>
<td>31.62±1.64∗ (+) 72.91</td>
<td>5.80±0.02∗ (-) 17.32</td>
<td>11.14±0.22∗ (-) 6.0</td>
</tr>
<tr>
<td>Spirotetramat</td>
<td>17.67±0.62 (-) 3.36</td>
<td>5.65±0.07∗ (-) 19.43</td>
<td>11.92±0.32 (+) 0.58</td>
</tr>
<tr>
<td>Control</td>
<td>18.29±0.328 ----</td>
<td>7.02±0.26 ----</td>
<td>11.85±0.039 ----</td>
</tr>
</tbody>
</table>

Change % = mean activity of treated – mean activity of control / mean activity of control X 100 (according Paul, 2008).

* Significant at p < 0.05

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الفعالية والتأثيرات البيوكيميائية لبعض المبيدات تجاه دودة ورق القطن

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رشا أحمد أحمد سليم*1 - محمد السيد الزميتني2 - محمد إبراهيم حسين2
شريفة عبد الحميد نصر الشريف1

1- قسم الاختبارات والبحوث الحيوية - العمل المركز للفيروسات- مركز البحوث الزراعية دقي- جيزة- مصر
2- قسم وقاية النبات- كلية الزراعة- جامعة عين شمس- ص:68- حديث شبرا 12112- القاهرة- مصر

*Corresponding author: rashasleem@yahoo.com

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الموجز

أجريت الدراسة الحالية لتقييم فعالية بعض المبيدات الكيميائية الحديثة من مجموعات مختلفة وهي: (فلوبيديميميد (مجموعة الديميدين)، بريداليل (مجموعة فينيكس)، بايراليلكس، (مجموعة أستيل فينيكس- يفزولز)، فينزولز (مجموعة فورمليد)) وسبوتريماتات (مجموعة تيرامبلس إيد) ومقارنة فعاليتها بالمبيد الفسفوري بيريميفوس- ميثيل (مجموعة الفوسفات المحمية). تجاو العين البروتي الثاني لسلاسة المعملية لدودة ورق القطن. أظهر النتائج المحصلة عليها بعد 48 ساعة من العناية بطرقية غير الأرار أن أكثر المبيدات سمية هو فلويديميميد حيث سجل الترتيب النصفي الميميت له 0.73. سجل بيريميفوس- ميثيل على النضج المعياري معه قيمة (2.93). سجلت المعالمة ببيريميفوس ميثيل أعلى نضج معنوي في الأزم الادينوزين تراى فوسفات بقيمة (72.91%).

أظهرت الدراسة على طريقة فعال المبيدات الحديثة المختبرة.

الكلمات الدالة: دودة ورق القطن، مبيدات كيميائية حديثة، دراسات توكسيولوجية، بيوكيميائية

التحكيم: د. هاني محمود عاشور
د. سيد عبد الطلح دحروف