Impact of certain insecticides on enzymes activity of whitefly Bemisia tabaci (Genn.) and aphids Aphis gossypii (Glover) on cucumber plants

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Abstract

A field trial was conducted at the experimental station of Sindyon, Qalyubia, Egypt during the nili season of 2008. The effect of azadirachtin, cloves oil, damaseia extract, Orizor (acetampride + abamectin), Botany Gard (Beauveria bassiana), imidacloprid and profenofos (at a half of the recommended rate) on activity of some enzymes in Bemisia tabaci (Genn.) and Aphis gossypii (Glover) was studied, on cucumber (Cucumis sativus) variety (Hageen eshrak). After five days of the tested compounds application, the results revealed that these compounds had various effects on the activity of acid and alkaline phosphatases, α and β esterases, transaminases (GOT and GPT) and carbohydrates hydrolyzing enzymes (trehalase, invertase and amylase). The enzyme activity reduced or increased significantly for some compounds in both insect species. Activity of acid and alkaline phosphatases, α and β esterases and GPT was more higher in A. gossypii than in B. tabaci, while the activity of GOT, trehalase, invertase and amylase was more higher in B. tabaci than in A. gossypii.

Key words azadirachtin, cloves, damaseia, Orizor, imidacloprid, profenofos Bemisia tabaci, Aphis gossypii, Cucumis sativus, enzymes

Introduction

Cucumber, Cucumis sativus (Cucurbitaceae) is one of the most important economic cucurbitaceous vegetables cultivated in Egypt, its cultivated area was increased during the last years especially in new reclaimed land for local consumption and exportation to the foreign markets. Cucumber plants are liable to infestation by many phytophagous pests such as the aphids, Aphis gossypii (Glover.) and the whitefly, Bemisia tabaci (Genn.), which considered the most common and important insect pests of cucumber plants. In case of heavy infestation, these pests are causing serious damage to plants, leading to great reduction in the yield (Hanafy, 2004).

To combat the pests, growers use synthetic organic insecticides, and some biorational insecticides. With the implementation of the Food Quality Protection Act likely to limit the applications of some organic chemical insecticides, scientists and growers are seeking alternative materials that are effective against the pests and safe to humans and the environment (Liu, 1999 and Liu et al., 1999). The bio-insecticides which provide control agents equal or better than synthetic insecticides are considered nowadays as mainly of IPM programs (Sannino, 2001 and Raslan, 2002).

The change in response to some biocides in insects could be associated with the decrease in alkaline phosphatases activity and various effect in acid phosphatases activity (El-Mageed et al., 2008).

Esterase enzymes play an important role in conferring or contributing to insecticide resistance in insects (Field and Devonshire, 1998, Guillemaud et al., 1997, Campbell et al., 1998, Claudianos et al., 1999; Taskin and Kence, 2004). The reduction in enzyme synthesis is due to the direct effect of toxicants on the synthesis (Kurappasamy et al., 2001). The low esterase activity may be used as a marker for resistant individuals in populations of B. tabaci (Wool and Greenberg, 1990).

The activities of transaminase enzymes (GOT & GPT) and carbohydrate hydrolyzing enzymes (trehalase, invertase and amylase) affected by some bio-insecticides (Mead, 2000). The invertase enzyme is believed to be important for digestion and utilization of sucrose by insects (Naveed et al., 2009).

In insects’ bodies carbohydrates are of vital importance since they can be utilized by the insect body for production of energy or conversion to lipids or proteins. Metabolism of carbohydrates is controlled mainly by trehalase, amylase and invertase enzymes that play a principle role in the digestion and utilization of carbohydrate by insects (Wigglesworth, 1972).

In the present investigation the effect of azadirachtin, imidacloprid, Orizor (acetampride + abamectin), cloves oil, damaseia plant extract, Botany Gard (Beauveria bassiana) and profenofos on the enzymes activity of trehalase, invertase, amylase, transaminases (GOT& GPT), alpha- and beta- esterases (α-E & β-E), acid and alkaline phosphatases (AcP & AlKP) of whitefly and aphids on cucumber plants has been studied.
Materials and Methods

Location, experimental design and planting
The field tests were carried out at the experimental station of Sindyun, Qalyubia Governorate during the nili season. An area of 1/3 feddan was sown with cucumber seeds (Cucumis sativus.) variety (Hageen eshrak) on 5th September. The experiments were designed in the following ways: seeds were sown in rows at the rate of 8 rows/2 poles; the distance between the hills was about 30 cm apart on one side of the ridge. Treatment plots (each plot about 60 m²) were arranged in a randomized complete block design with three replications. Irrigation and fertilization were done according to the crop schedule.

Insecticides
- Azadirachtin [Achook 0.15% EC] produced by Bahar Agrochem and Foods Pvt. Ltd., India.
- Cloves-oil, Syzygium aromaticus, (Fam. Myrtaceae) was bought from the local market.
- Damaseia, plant extract of Ambrosia maritima (Fam. Compositae) was obtained from Horticulture Research Institute (HRI) Egypt.
- Acetampride + Abamectin [Orizin 11% EC] produced by Egey kem company.
- Botany Gard, Beauveria bassiana (ES2 x10⁶ conidia/mg) produced by the world Company for Chemicals and pesticides, Egypt.
- Imidacloprid, 1-[(6-chloro-3-pyridinyl) methyl]-N-nitro-2-imidazolidinimine: [Nopride 35% SC] produced by Cairo Company for Chemicals-
- Profenofos, O O-4-bromo-2-chlorophenylO-ethylS-propyl phosphorothioate: [Selecron 72% EC] produced by Novartis Company, Switzerland.

Insecticide Application
The insecticides were applied on 6th October 2008 using a knapsack sprayer (20 litres). The formulated insecticides were applied at (half of the recommendation concentration for feddan) 93.7, 125, 150, 25, 125, 15 and 93.7 ml/100L water for azadirachtin, cloves-oil, damaseia extract, Orizin, Botany Gard, imidacloprid and profenofos, respectively. Water was used as controls (or untreated plants).

Sampling
Samples of Bemisia tabaci and Aphis gossypii insects were taken randomly from each replicate 5 days after spray. Samples were frozen for subsequent enzymes activity analysis.

Determination of enzymes activities
Phosphatases enzymes (AcP & AIKP)
Acid phosphatase (AcP) and alkaline phosphatase (AIKP) were determined according to the method described by Powell and Smith (1954).

Non-specific esterases activities
Alpha- and Beta- esterases (α-E, β-E) were determined according to the method of Van Asperen (1962).

Transminase enzymes
Glutamic oxaloacetic Transminase (GOT) and glutamic pyruvic Transminase (GPT) activities were determined colorimetrically according to the method of Reitman and Frankle (1957).

Carbohydrate hydrolyzing enzymes
The methods to determine the digestion of trehalose, starch and sucrose by trehalase, amylase and invertase enzymes respectively were similar to those described by Ishaaya and Swiriski (1976).

Data Analysis
Data were subjected to analysis of variance (ANOVA) followed by least significant difference (CoStat Statistical Software, 1990).

Results and Discussion
The overall results indicated that the activity of tested enzymes varies with different insecticide treatments and insect species.

1- Effect of the tested compounds on alkaline and acid phosphatases activities
Data in Table (1) indicated that, five days after treatment of the tested compounds, the activities of alkaline and acid enzymes in the supernatant of the homogenated insects increased or decreased as affected by the tested compounds compared with control. In damaseia extract treatment, alkaline and acid enzymes activities increased significantly in both tested insects. The percentage of increase of alkaline enzymes activity was 51.6 and 14.0 % in B. tabaci and A. gossypii, respectively. These were 19.9 and 37.4 % in acid enzymes activity in B. tabaci and A. gossypii, respectively. Also, in cloves oil, Orizin, Botany Gard and profenofos treatments, alkaline enzymes activity increased significantly in B. tabaci, the percentages of enzyme increase were 45.4, 31.7, 45.7 and 29.7%, respectively. Activity of acid enzymes increased significantly in both tested insects after Orizin and Botany Gard application. In Orizin and Botany Gard treatments, percentages of increase were 14.4 and 21.6 % in B. tabaci, they were 17.3 and 22.3 % in A. gossypii, respectively. As well, azadirchitin application caused an increase in the activity percentage of acid enzymes by 10.6 % in A. gossypii compared with control.

On other hand, in imidacloprid treatment, the activities of alkaline enzymes decreased significantly in both the insects tested, the percentages of reduction were -9.8 and -5.2 % in B. tabaci and A. gossypii, respectively. Also, azadirchitin caused a

reduction in the activity percentage of alkaline enzymes by -5.5 % in A. gossypii compared with control. Activity percentage of acid enzymes decreased significantly in B. tabaci after imidacloprid application and in A. gossypii after cloves oil treatment, these percentages were -6.3 and -7.6 %, respectively.

Profenofos was the only tested compound that had no significant effect on the activity of acid enzymes in both tested insects in this field trial.

Phosphatases are defined as enzymes hydrolyzing any phosphorus ester or anhydride bond (O’Brien, 1967). Van Asperen (1960) found that resistant strains of houseflies could degrade organophosphorus compounds by increasing phosphatase activity.

The inhibition in the activity of both acid and alkaline phosphatases was obtained by Abdel Hafez et al., (1993) who stated that treatment with LC$_{50}$ of diflu benzuron and flufenoxuron reduced acid and alkaline phosphatases of 4$^{	ext{th}}$ instar larvae of S. littoralis. Also, Eid (2002) found great reduction in the activities of both enzymes for all tested strains of S. littoralis using chlorpyrifos. In continuity, El-Mageed et al., (2008) cited that the change in response to biocides (Vertimec, Dipel 2X and Agerin) in S. littoralis larvae could be associated with the decrease in alkaline phosphatases activity and multifarious effect in acid phosphatases activity.

2- Effect of the tested compounds on alpha- and beta- esterases activities:

Table (2) shows the changes in the activity of alpha- and beta- esterases, Orizon and cloves oil revealed significant decrease in the both enzyme activity and in both tested insects, this effect was higher in A. gossypii than B. tabaci. In Orizon treatment, percentages of alpha-esterases reduction were -19.5 and -29.7 % in B. tabaci and A. gossypii, respectively. While the reduction percentages of beta- esterases activity were -35.3 and -51.1 % in B. tabaci and A. gossypii, respectively. In cloves oil treatment, percentages of alpha-esterases reduction were -14 and -20.5 % in B. tabaci and A. gossypii, respectively. The reduction percentages of beta- esterase were -18 and -42.6 % in B. tabaci and A. gossypii, respectively.

Although, in azadirchitin treatment, alpha-esterases activity decreased significantly, beta-esterases increased significantly in B. tabaci and A. gossypii, the percentages of enzyme decrease were -14.6 and -11.8 %, respectively, and the increase percentages were 22.2 and 16.1 %, respectively. The activity of beta- esterases decreased significantly (by -1.8 %) only in B. tabaci after Botany Gard treatment, while alpha- esterases activity increased significantly in both tested insects, the percentage of enzyme increase reached 54.5 % in B. tabaci and 24.7 % in A. gossypii. On other hand, in imidacloprid and profenofos treatments, beta- esterases increased significantly in both tested insects, while alpha- esterases activity increased significantly only in B. tabaci. This effect was more higher in case of profenofos than imidacloprid, in profenofos treatment, the percentages of activity increase of beta- esterases were 36.1 and 18.8 % in B. tabaci and A. gossypii, respectively, in imidacloprid treatment, these percentages were 13.8 and 10.1 % in B. tabaci and A. gossypii, respectively. In B. tabaci, the percentages of activity increase of alpha- esterases were 25.4 and 22.7 % in profenofos and imidacloprid treatments, respectively. In damaseia extract treatment, only alpha- esterases activities were increased significantly, the percentages of enzyme increase were 26.7 and 18.0 % in B. tabaci and A. gossypii, respectively. In addition to, damaseia extract was the only tested compound that had no significant effect on the activity of acid enzymes in both tested insects in this field experiment. Esterases activity may be used as a marker for resistance of B. tabaci (Wool and Greenberg, 1990). The direct effect of the insecticides is on the enzyme synthesis (Kurappasamy et al., 2001).

3- Effect of the tested compounds on GOT and GPT activities:

The results in Table (3) revealed that, five days after application of azadirchitin, cloves oil, damaseia extract, Botany Gard and profenofos, the activity of glutamic oxaloacetic transaminase (GOT) increased significantly in B. tabaci by 67.6, 73.8, 51.30.7 and 65.1 %, respectively. While GOT activity increased significantly in A. gossypii by 21.3, 33.1, 54.0 and 35.8 % when azadirchitin, damaseia extract, Botany Gard and profenofos were applied. Also glutamic pyruvic transaminase (GPT) activity increased significantly in B. tabaci by 136, 55.1, 22.7 and 119.8 % after treatment of azadirchitin, cloves oil, damaseia extract and imidacloprid, respectively. In case of A. gossypii, azadirchitin, cloves oil and imidacloprid treatments caused significant increase in GPT activity, the percentages of increase were 39.4, 24.5 and 92.7 %, respectively.

It was clear that, except for Botany Gard, GOT and GPT activities were more sensitive to increase in B. tabaci than A. gossypii after treated with the other effective tested compounds. The activity of GOT and GPT reduced significantly only after Orizon treatments, the reduction percentages of GPT activity were -60.1 and -45.1 % in A. gossypii and B. tabaci, respectively, the significant decrease of GOT activity was only in B. tabaci by -17.2 %. As well as GPT activity decrease significantly only in A. gossypii after treated with imidacloprid by -15.0 %. Profenofos was the only tested compound that had no significant effect on the activity of GPT in both tested insects in this field experiment. An increase in
the activities of transaminase enzymes (GOT & GPT) in adults of *A. craccivora* after treatment with the aqueous extracts of garlic bulbs (Mead, 2000). There was irregular effect of fenvalerate on GOT and GPT activity of the 4th instars larvae of *S. littoralis* at the different time intervals where it fluctuated between increase and decrease throughout the 72 hrs period of the experiment (Mohamady, 2000).

Heba (2005) investigated the efficacy of *Bacillus thuringiensis* on GOT activity of *S. littoralis* did not affected through the first three days then activities decreased to -44.44 % after 8 days. While, GPT activity increased through the 2nd day to 30 %, then decreased to -20 % after 9 days.

4. Effect of the tested compounds on carbohydrates hydrolyzing enzymes activities:

The changes in the activity of carbohydrate hydrolyzing enzymes (trehalase, invertase and amylase) of *B. tabaci* than *A. gossypii* after treated with tested insecticides (Table 4).

Trehalase activity reduced significantly after application of cloves oil. Botany Gard and imidacloprid in both tested insects, the percentages of enzyme reduction were -17.6, 25 and -20.6 % in *B. tabaci*, respectively, and they were -11.1, -29.0 and -16.4 % in *A. gossypii*, respectively. In damaseia extract and Orizon treatments, trehalase activity increased significantly only in *A. gossypii*, the percentages of enzyme increase were 6.3 and 7.3 %, respectively. Azadirichin and profenofos were the only tested compounds that had no significant effect on the activity of trehalase in both tested insects in this field experiment.

Invertase activity had a different affect (a significant decrease or increase) according to the insect species in azadirichin, cloves oil and profenofos treatments. In these the invertase activity decreased significantly in *A. gossypii* by -7.1, -22.6 and -13.9 %, respectively, and it increased significantly in *B. tabaci* by 12.2, 46.3 and 46.3 %, respectively. Azadirichin and profenofos were the only tested compounds that had no significant effect on the activity of trehalase in both tested insects in this field experiment.

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Invertase activity had a different affect (a significant decrease or increase) according to the insect species in azadirichin, cloves oil and profenofos treatments. In these the invertase activity decreased significantly in *A. gossypii* by -7.1, -22.6 and -13.9 %, respectively, and it increased significantly in *B. tabaci* by 12.2, 46.3 and 46.3 %, respectively. Azadirichin and profenofos were the only tested compounds that had no significant effect on the activity of trehalase in both tested insects in this field experiment.

Invertase activity had a different affect (a significant decrease or increase) according to the insect species in azadirichin, cloves oil and profenofos treatments. In these the invertase activity decreased significantly in *A. gossypii* by -7.1, -22.6 and -13.9 %, respectively, and it increased significantly in *B. tabaci* by 12.2, 46.3 and 46.3 %, respectively. Azadirichin and profenofos were the only tested compounds that had no significant effect on the activity of trehalase in both tested insects in this field experiment.

Amylease activity was reduced significantly in both tested insects after the application of cloves oil, Orizon, Botany Gard, imidacloprid and profenofos, the percentages of enzyme reduction were -30.6, -6.9, -42.7, -45.7 and -18.6 9 % in *B. tabaci*, respectively, and they were -33.9, -26.3, -42.6, -37.5 and -13.1 in *A. gossypii*, respectively. In azadirichin treatment, amylase activity increased significantly only in *B. tabaci*, the percentage of activity increase was 7.1 %. Damaseia extract was the only tested compound that had no significant effect on the activity of amylase in both tested insects in this field application.

The results indicated also, that amylase appeared as the most affected enzyme activity with high level of significant reduction more than both trehalase and invertase enzymes. Carbohydrates are of vital importance since they can be utilized by the insect body for production of energy or conversion to lipids or proteins. Metabolism of carbohydrates is controlled mainly by trehalase, amylase and invertase enzymes that play a principle role in the digestion and utilization of carbohydrate by insects (Wigglesworth, 1972). Trehalase has the important function for liberating glucose for energy and activated during molting to generate glucose for chitin build up. Invertase and amylase are two important digestive enzymes, however, few data is known about their physiological and biochemical contribution to insecticide toxicity. The general disturbance in carbohydrate metabolism as expressed by reduction of trehalase, invertase and amylase activities could be result from a chain effect originating primarily from inhibition of chitin synthesis (Meisner et al., 1978).

These results are in harmony with El-Ghar et al., (1995) who observed pronounced decrease in the carbohydrate hydrolyzing enzymes especially amylase and invertase after treated 5th instar larvae with sub lethal concentrations of thuringeinsin (beta-exotoxins of *B. thuringiensis*). Also, Eid, (2002) found Consult and Mimic decreased the invertase activity after 5 days of treatment, whereas Consult, Atabron and Cascade exhibited reduction in trehalase and invertase activities.

The activities of trehalase, invertase and amylase enzymes in larvae treated with spinosad and triflumuron were generally decreased than untreated larvae during different tested times (Mead et al., 2008). On the other hand, Khedr et al., (2005) reported that, when 4th instar larvae were treated with Consult, Atabron, Match, Mimic and Cascade noticed increase in the carbohydrate hydrolyzing enzymes was recorded. Furthermore, the irregular effects of IGRs which ranged between decrease or increase during the tested time intervals was observed by Mohamady, (2000). This contradiction in results may be due to difference in treatments, larval instar, concentrations used and tested times. The activities of trehalase and amylase were increased at the initial time intervals (after 24 hr.) than the last one (after 72 hr.). The reverse was true in the case of invertase enzyme. Abdel-Fattah et al., (1986) showed that the activities of the three enzymes were much higher at the initial time interval (Zero-time) than at the last one (96 hr.) at the three

of beta- esterases, GOT and GPT and high inhibition in trehalase, invertase and amylase activities were recorded. After treatment of A. gossypii with profenofos, the results revealed high increase in activity of beta- esterases and GOT and high decrease in invertase and amylase activities.

References


Table 1. Alkaline and Acid phosphatases activities (ug phenol released /g.b.wt./minute) in the supernatant of the homogenated aphids *A. gossypii* and whitefly *B. tabaci* after five days of the tested compounds application.

<table>
<thead>
<tr>
<th>Compounds</th>
<th>Application Rate (ml/100 L Water)</th>
<th>Alkaline phosphatase Activity (mean ± S.E.)</th>
<th>Increase or decrease (%)</th>
<th>Acid phosphatase Activity (mean ± S.E.)</th>
<th>Increase or decrease (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Azadirachtin</td>
<td>93.7</td>
<td>1413±40&lt;sup&gt;d&lt;/sup&gt;</td>
<td>679±4&lt;sup&gt;d&lt;/sup&gt;</td>
<td>-5.5</td>
<td>-2.16</td>
</tr>
<tr>
<td>Cloves oil</td>
<td>125</td>
<td>1526±16&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>1009±20&lt;sup&gt;a&lt;/sup&gt;</td>
<td>+2.0</td>
<td>+45.4</td>
</tr>
<tr>
<td>Damaseia extract</td>
<td>150</td>
<td>1706±20&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1052±29&lt;sup&gt;c&lt;/sup&gt;</td>
<td>+14.0</td>
<td>+51.6</td>
</tr>
<tr>
<td>Orizon (Acetampride + Abamectin)</td>
<td>25</td>
<td>1476±21&lt;sup&gt;c&lt;/sup&gt;</td>
<td>914±6&lt;sup&gt;c&lt;/sup&gt;</td>
<td>-1.3</td>
<td>+31.7</td>
</tr>
<tr>
<td>Botany Gard</td>
<td>125</td>
<td>1573±25&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1011±10&lt;sup&gt;b&lt;/sup&gt;</td>
<td>+5.1</td>
<td>+45.7</td>
</tr>
<tr>
<td>Imidacloprid</td>
<td>15</td>
<td>1418±25&lt;sup&gt;d&lt;/sup&gt;</td>
<td>626±5&lt;sup&gt;c&lt;/sup&gt;</td>
<td>-5.2</td>
<td>-9.8</td>
</tr>
<tr>
<td>Profenofos</td>
<td>93.7</td>
<td>1536±23&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>900±8&lt;sup&gt;c&lt;/sup&gt;</td>
<td>+2.7</td>
<td>+29.7</td>
</tr>
<tr>
<td>Control</td>
<td>-</td>
<td>1496±25&lt;sup&gt;c&lt;/sup&gt;</td>
<td>694±4&lt;sup&gt;d&lt;/sup&gt;</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Values within the same column having the same letters are not statistically different, p>0.05.

A= aphids (*A. gossypii*)  B= whitefly (*B. tabaci*)

Table 2. Alpha- and Beta- esterases activities (ug naphthol released /g. b. wt./minute) in the supernatant of the homogenated aphids *A. gossypii* and whitefly *B. tabaci* after five days of the tested compounds application.

<table>
<thead>
<tr>
<th>Compounds</th>
<th>Application Rate (ml/100 L Water)</th>
<th>Activity (mean ± S.E.)</th>
<th>Increase or decrease (%)</th>
<th>Activity (mean ± S.E.)</th>
<th>Increase or decrease (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Azadirachtin</td>
<td>93.7</td>
<td>54.6±1.16&lt;sup&gt;c&lt;/sup&gt;</td>
<td>15.6±0.6&lt;sup&gt;d&lt;/sup&gt;</td>
<td>-11.8</td>
<td>-14.6</td>
</tr>
<tr>
<td>Cloves oil</td>
<td>125</td>
<td>49.26±1.28&lt;sup&gt;f&lt;/sup&gt;</td>
<td>15.7±0.64&lt;sup&gt;d&lt;/sup&gt;</td>
<td>-20.5</td>
<td>-14</td>
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<tr>
<td>Damaseia extract</td>
<td>150</td>
<td>73.17±2.26&lt;sup&gt;b&lt;/sup&gt;</td>
<td>29.7±0.83&lt;sup&gt;c&lt;/sup&gt;</td>
<td>+18.0</td>
<td>+26.7</td>
</tr>
<tr>
<td>Orizon (Acetampride + Abamectin)</td>
<td>25</td>
<td>43.6±2.3&lt;sup&gt;f&lt;/sup&gt;</td>
<td>14.7±0.64&lt;sup&gt;a&lt;/sup&gt;</td>
<td>+29.7</td>
<td>-19.5</td>
</tr>
<tr>
<td>Botany Gard</td>
<td>125</td>
<td>77.3±1.53&lt;sup&gt;a&lt;/sup&gt;</td>
<td>28.21±1.33&lt;sup&gt;a&lt;/sup&gt;</td>
<td>+24.7</td>
<td>+54.5</td>
</tr>
<tr>
<td>Imidacloprid</td>
<td>15</td>
<td>64.07±0.89&lt;sup&gt;c&lt;/sup&gt;</td>
<td>22.4±0.5&lt;sup&gt;b&lt;/sup&gt;</td>
<td>+3.3</td>
<td>+22.7</td>
</tr>
<tr>
<td>Profenofos</td>
<td>93.7</td>
<td>58.6±1.22&lt;sup&gt;d&lt;/sup&gt;</td>
<td>22.9±0.9&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-5.5</td>
<td>+25.4</td>
</tr>
<tr>
<td>Control</td>
<td>-</td>
<td>62±1&lt;sup&gt;ed&lt;/sup&gt;</td>
<td>18.26±0.29&lt;sup&gt;f&lt;/sup&gt;</td>
<td>-</td>
<td>-</td>
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</tbody>
</table>

Values within the same column having the same letters are not statistically different, p>0.05.

A= aphids (*A. gossypii*)  B= whitefly (*B. tabaci*)
Table 3. GOT and GPT activities (μM pyruvate released /g. b. wt./minute) in the supernatant of the homogenated aphids *A. gossypii* and whitefly *B. tabaci* after five days of the tested compounds application.

<table>
<thead>
<tr>
<th>Compounds</th>
<th>Application Rate (ml/100 L Water)</th>
<th>Glutamic Oxaloacetic Transaminase (GOT)</th>
<th>Glutamic Pyruvic Transaminase (GPT)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Activity (mean ± S.E.)</td>
<td>Increase or decrease (%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Azadirichin</td>
<td>93.7</td>
<td>12±0.40^c</td>
<td>32.2±1.2^a</td>
</tr>
<tr>
<td>Cloves oil</td>
<td>125</td>
<td>10.45±0.25^d</td>
<td>33.39±1.6^a</td>
</tr>
<tr>
<td>Damasea extract</td>
<td>150</td>
<td>13.16±0.62^b</td>
<td>29±0.15^b</td>
</tr>
<tr>
<td>Orizon (Acetamipride + Abamectin)</td>
<td>25</td>
<td>9.16±0.39^c</td>
<td>15.9±0.46^c</td>
</tr>
<tr>
<td>Botany Gard</td>
<td>125</td>
<td>15.23±0.68^a</td>
<td>25.1±0.5^c</td>
</tr>
<tr>
<td>Imidacloprid</td>
<td>15</td>
<td>11.37±0.32^cd</td>
<td>19.13±0.11^d</td>
</tr>
<tr>
<td>Profenofos</td>
<td>93.7</td>
<td>13.43±0.25^b</td>
<td>31.71±2^a</td>
</tr>
<tr>
<td>Control</td>
<td>-</td>
<td>8.99±0.38^c</td>
<td>19.21±0.2^d</td>
</tr>
</tbody>
</table>

Values within the same column having the same letters are not statistically different, p<0.05.

A= aphids (*A. gossypii*)  B= whitefly (*B. tabaci*)

Table 4. Carbohydrates hydrolyzing enzymes activities (ug. glucose released /g. b. wt./g. b. wt./minute) in the supernatant of the homogenated aphids *A. gossypii* and whitefly *B. tabaci* after five days of the tested compounds application.

<table>
<thead>
<tr>
<th>Compounds</th>
<th>Application Rate (ml/100 L Water)</th>
<th>Trehalase</th>
<th>Invertase</th>
<th>Amylase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Activity (mean ± S.E.)</td>
<td>Increase or decrease (%)</td>
<td>Activity (mean ± S.E.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>Azadirichin</td>
<td>93.7</td>
<td>83.57±2.23^b</td>
<td>131±3.6^b</td>
<td>-1.4</td>
</tr>
<tr>
<td>Cloves oil</td>
<td>125</td>
<td>75.33±1.15^c</td>
<td>112±2.5^a</td>
<td>-11.1</td>
</tr>
<tr>
<td>Damasea extract</td>
<td>150</td>
<td>90.17±2.75^a</td>
<td>138±2^a</td>
<td>+6.3</td>
</tr>
<tr>
<td>Orizon (Acetamipride + Abamectin)</td>
<td>25</td>
<td>91.00±2.1^a</td>
<td>139±2.1^a</td>
<td>+7.3</td>
</tr>
<tr>
<td>Botany Gard</td>
<td>125</td>
<td>60.17±0.76^d</td>
<td>102±5.3^d</td>
<td>-29.0</td>
</tr>
<tr>
<td>Imidacloprid</td>
<td>15</td>
<td>70.83±1.26^c</td>
<td>108±1.5^d</td>
<td>-16.4</td>
</tr>
<tr>
<td>Profenofos</td>
<td>93.7</td>
<td>86.93±2.53^ab</td>
<td>135±2^a</td>
<td>+2.5</td>
</tr>
<tr>
<td>Control</td>
<td>-</td>
<td>84.77±1.37^b</td>
<td>135±1.5^ab</td>
<td>-</td>
</tr>
</tbody>
</table>

Values within the same column having the same letters are not statistically different, p<0.05.

A= aphids (*A. gossypii*)  B= whitefly (*B. tabaci*)


تأثير بعض المبيدات على نشاط إنزيمات حشرتي الذبابة البيضاء ومن القطن على نباتات الخيار

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أجرت تجربة حقلية بمحطة سنديون البحثية بمحافظة القيروانية - مصر خلال الموسم النبئي سنة 2008 لدراسة تأثير كل من الأدراختين والإيميدوكوريد والأوزون وزيت القرنفل والبوتاتي جارد والبروفينفوكوس وذلك بنصف التكرار الحقل الموصى به على نشاط بعض الإنزيمات في حشرتي الذبابة البيضاء ومن القطن على نباتات الخيار من صنف هجين إشراق.

وقد أظهرت النتائج أنه بعد خمس أيام من تطبيق هذه المركبات كان لهذه المركبات تأثيرات معنوية مثبتة على نشاط إنزيمات الفسفاتاز الحامضي والفاعلي والأنف وبيتا إستيراز وترانس أمينز (جوت وجيت) بالإضافة إلى التيربيناز والأفزاز والأمليز حيث كان التأثير

بالمقص أو الزيادة في نشاط هذه الإنزيمات مع بعض المركبات في كل من الحشرتين تحت الدراسة.

كما بنت النتائج أيضاً أن نشاط إنزيمات الفسفاتاز الحامضي والفاعلي وبيتا إستيراز وترانس أمينز (جيت) كان أعلى في من القطن عن الذبابة البيضاء بينما كان نشاط إنزيمات الترانس أمينز (جوت) والتيربيناز والأفزاز وأمليز كان أعلى على الذبابة البيضاء

عن من القطن.