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RESEARCH ARTICLE

Effectiveness of pesticides against vegetable Leafminer *Liriomyza sativae* (Blanchard) and the whitefly *Bemisia Tabaci* (Gennadius) infesting cucumber crops

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Abstract

This study was conducted to evaluate nine insecticidal combinations against the whitefly *Bemisia tabaci* (Gennadius) and the Leafminer *Liriomyza sativae* (Blanchard) attacking cucumber crops in the open field during 2022 and 2023 seasons. These treatments were abamectin, abamectin with bifenthrin, chlorfenapyr, fenpropathrin with etoxazole, jojoba oil, imidacloprid, imidacloprid with abamectin, thiamethoxam and thiamethoxam with abamectin. All treatments resulted in significant reduction on both insects. Chlorfenapyr was the most effective compound against whitefly at initial effect, 5, 7, 10 days after treatments and overall average by 95.3±0.32, 94.95±0.00, 92.50± 0.23, 89.99±0.66 and 93.19%, In the first season and 94.18±0.90 ,95.83±0.00, 93.41±0.29, 87.49±0.26, and 92.73 % in the second season. Fenpropathrin with etoxazole was the most effective compound against Leafminer by 97.91±1.06, 93.06±0.24 ,84.97±0.06, 94.34±0.75 and 92.57% in the first season and 95.51±0.70, 93.11±0.20, 91.48±0.26 ,92.33±0.75 and overall average 93.11%in the second season. All compounds significantly increased chlorophyll content at initial, five and seven days. However, chlorophyll content was almost normal except with using imidacloprid that reduced chlorophyll. Almost all treatments reduced significantly the antioxidant enzymes and non-enzymatic components in cucumber plants.

Keywords: Cucumber; Pesticides; Leafminer; Whitefly.

1. Introduction

Cucumber, *Cucumis sativus* L. is one of the most important crops produced in Egypt in more one plantation every year (Abdallah *et al.*, 2019). the plants are attacked by several piercing sucking insects as the whitefly, *Bemisia tabaci* (Genn.) (Hem.: Aleyrodidae) which causes economic damage (Xu *et al*., 2012; Saleh *et al*.2020), and transmits pathogenic fungal and viral diseases (Cruz *et al*., 2013; Saleh *et al*.,2020). *B. tabaci* adults and nymphs sap plant juices causing losses of production and quality (Lasheen *et al*., 2020). The vegetable leafminer *Liriomyza sativae* (Blanchard) is one of the polyphagous insects that attacks a large number of plant families (Andersen *et al.*, 2008; Haghani *et al*., 2014), Larvae are feeding upon upper and lower leaf epidermis (Liu *et al.*,2015). Both insects are characterized by its high resistance to insecticides (Golmohammadi *et al.*, 2014; Wei *et al*., 2015; Elrazik, 2018). All insecticides were used in the open fields to control whitefly and leafminer as abamectin which showed a moderate effect against whitefly (Banshiwal Richa *et al.*, 2018; Majumder *et al*., 2024) and leafminer (Aly *et al.*, 2023; Hamza *et al.*, 2023). Fenpropathrin mixed with etoxazole was highly effective on whitefly and Leafminer (Al-Kazafi *et al*.,2015; Majurnder *et al*., 2024). Chlorfenapyr is one of the acaricides with high effective against whitefly and leafminer (Thamilarasi *et al*., 2016 and Udhayakumar *et al.*, 2020), but its toxicity to human health should be considered (Joko *et al.*, 2017). Jojoba oil is one of

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the organic extracts safe to humans with a good efficiency against several insect pests (Abbassy *et al.* 2007; Nassar *et al.*, 2019). Thiamethoxam and imidacloprid recorded 75.0% -80% reductions in whitefly and leafminer populations (Hanumappa *et al*., 2013). Fenpropathrin was the most effective against whitefly (Wang *et al*., 2008). According to the different effects of insecticides, in this study, we tested the efficiency of some compounds against both insects as initial effects, and after 5 ,7 and 10 days after treatments.

2. Materials and methods

2.1. Experimental field

This experiment was conducted at the experimental farm of the Sakha Agricultural Research Station during 2022 and 2023 seasons. The “Prince” cucumber variety was planted in the 2nd week of March in both seasons in a total area of 4000 m2, divided into ten equal parts. All agricultural operations were applied according to the recommendations of Egyptian Ministry of Agriculture. The Knapsack sprayer(20L) was used to apply the tested compounds.

2.2. Tested compounds

Number of insects were counted before insecticide applications (Table1). The insecticides were applied at the recommended concentrations, then the numbers were counted after the second, fifth, seventh and tenth days after treatments. All pesticides were applied based on the Egyptian Ministry of Agriculture recommendations for each insecticide. Population reductions in both insect populations were calculated according to the equation of Henderson and Tilton (1955).

$$Reduction\% = 100\{1 - (\frac{Ta\ X\ Cb}{Tb\ X\ Ca})\}$$

Where:

Ta = Post treatment insect counts

Cb = Untreated insect count before treatment

Tb = Pretreatment counts

Ca = Untreated insect count after treatment

2.3. Assessment of chlorophyll content in cucumber plants

From one to ten days, after insecticide application against whitefly and leafmainer treatments samples of cucumber leaves were collected from each replicate. Individuals of *B. tabaci* and *L. sativa* were excluded before chemical analysis by using spectrophotometric methods according to Lichtenthaler and Buschmann (2001) to chlorophyll analysis.

2.4. Antioxidant enzymes, protein content and total carbohydrates

One gram of fresh cucumber leaves was homogenized in liquid N2 with 0.05 M. EDTA and 1 PVP at 4 °C. After homogenization, the extracts were centrifuged at 4 °C 5000 xg according to Lowry *et al.* (1951). Results of antioxidant enzymes (catalase, peroxidase and superoxidase) and nonenzymatic components (total carbohydrates and protein content) were measured according to Aebi (1984). Peroxidase activity was determined by method of Polle *et al*. (1994). Superoxidase activity was determined according to Yu Zhou *et al.* (2007), protein content was measured according to A.O.A.C. (1990). Total carbohydrates were determined by phenol-sulphuric acid method described by Dubois *et al*. (1956) and was calculated as percentage. Chlorophyll, enzymatic and non-enzymatic content were analyzed in the laboratory of Pesticides Chemistry and Toxicology Department, Faculty of Agriculture, Damanhur University.

Analysis of variance (ANOVA) was calculated, and significant differences between the means of these treatments were compared by Duncan’s Multiple Rangs Test (Duncan, 1955) using the SPSS statistical software package 16.0 SPSS Inc., Chicago, IL, USA, (2016).

Table 1. Insecticide products applied in the experimental field

Common name	Trade name	Manufacturer	Application rate/100ml
Abamectin	Espinosa 1.8% EC	Jiangsu Fengyuan Bioengineering Co., Ltd China	40 ml
Abamectin 1.3% + bifenthrin 8.8%	Quick 10.1% EC	Starchem Industrial Chemicals Egypt	75 ml
Chlorfenapyr	Challenger24%	Debbie Johnlong Agrochemical Co., Ltd China	60 ml
Fenpropathrin 10% + etoxazole 10%	Turbo 20% SE	Starchem Industrial Chemicals Egypt	25 ml
Jojoba oil	Top healthy 60% EC	Top Chemical Factory for the manufacture of pesticides and specialized Chemicals	400 ml
Imidacloprid	Keribs 35% SC	National Agricultural Chemicals Co.	75 ml
Imidacloprid 12% + abamectin 2%	Congest-Extra 14% SC	Starchem Industrial Chemicals Egpyt	50 ml
Thiamethoxam	Coragector 25% WG	Bionoblestar Agrochemical Co, Ltd China	40 g
Thiamethoxam 15.24% + abamectin 3.32%	Regular-zol 18.56% SC	Mirs Agricultural Development Co.	60 l

3. Results and discussion

3.1. *Insect population reductions due to insecticide treatments*

Data in Table (2) show the efficiency of tested compounds against B. tabaci on cucumber during 2022 season. The insect reductions due to chlorfenapyr at initial effect, 5, 7, 10 day after treatment and overall average were 95.30±0.32, 94.95±0.00, 92.50± 0.23, 90.00±0.50 and 93.19 %, respectively. Meanwhile, the lowest reductions were recorded with thiamethoxam with abamectin by 80.60±0.13, 91.46±0.32 91.50±0.23, 89.54±0.23 and 88.28 %, respectively.

In a column, means followed by the same letter are not significantly different at the 5%

Data in Table (3) show the efficiency of tested compounds against *B. tabaci* on cucumber during 2023 season. The highest insect reductions were due to chlorfenapyr at initial effect, 5, 7, 10 day after treatment and overall average were 94.18±0.90 ,95.83±0.00, 93.41±0.29, 87.49±0.26, and 92.73 %, respectively. Meanwhile, the lowest insect reductions were due to imidacloprid with abamectin were 85.82±0.09 ,62.74±0.13 ,91.41±0.26, 88.13±0.39, and 82.03 % respectively. As a conclusion, chlorfenapyr was the most effective compound against *B. tabaci* reduction which agrees with Satpathy *et al. (*2005) and Abdel-Wali *et al.* (2012), but disagrees with Udhayakumal *et al*. (2020) who obtained a moderated effect. Fenpropathrin with etoxazole recorded high reduction which agrees with Al-Kazafi *et al.* (2015). Bifenthrin with abamectin induced high level of reduction which agrees with Kodandaram *et al. (*2016) and Banshiwal Richa *et al.* (2018). Imidacloprid recorded a moderate level of reduction which agrees with Golmohammadi *et al.* (2017). Thiamethoxam recorded a moderate reduction which agrees with Hirekurubar *et al*. (2018). Jojoba oil recorded a level of reduction ranged from 85 to 90 % which agrees with Tantawy *et al*. (2018) and Khalifa *et al*. (2023)

Table 2. Efficacy of tested compounds in reducing *Bemisia tabaci* infestation on cucumber plants at Sakha Agricultural Research Station, Kafr El-Sheikh Governorate during 2022 season

Compound	pre-treat. /10 leaves	Mean reduction± S. E				
		Initial effect	5Day	7Day	10Day	Overall average
Abamectin	90	90.30±0.33^{d}	87.99±0.15^{e}	94.70±0.12^{b}	87.44±0.28^{b}	90.11
Abamectin+ bifenthrin	76	89.60±0.12^{d}	95.79±0.36^{a}	93.80±0.14^{c}	84.87±0.07^{e}	91.02
Chlorfenapyr	100	95.30±0.32^{a}	94.95±0.00^{b}	92.50±0.23^{d}	90.00±0.50^{a}	93.19
Fenpropathrin+ etoxazole	48	93.60±0.11^{b}	95.90±0.15^{a}	95.80±0.09^{a}	85.46±0.27^{d}	92.44
Imidacloprid	62.5	88.80±0.00^{d}	91.58±0.34^{d}	93.80±0.05^{c}	80.83±0.74^{f}	90.87
Imidacloprid+ abamectin	68.7	87.60±0.62^{e}	96.15±0.18^{a}	93.30±0.33^{c}	89.77±0.11^{b}	88.75
Jojoba oil	102	91.40±0.22^{c}	92.09±0.35^{d}	93.60±0.20^{c}	86.37±0.31^{d}	91.71
Thiamecthioxam	62.2	88.80±0.00^{d}	93.59±0.35^{c}	92.50±0.24^{d}	87.43±0.28^{b}	90.58
Thiamecthioxam + abamectin	66.5	80.60±0.13^{f}	91.46±0.32^{d}	91.50±0.23^{e}	89.54±0.23^{c}	88.28
Control	102					

Table 3. Efficacy of tested compounds in reducing *Bemisia tabaci* infestation on cucumber plants at Sakha Agricultural Research Station, Kafr El-Sheikh Governorate during 2023 season

compound	pre- treat. /10 leaves	Mean reduction± S. E				
		Initial effect	5Day	7Day	10Day	Overall average
Abamectin	141	89.66±0.17^{bc}	86.67±0.15^{f}	92.81±0.10^{a}	86.87±0.06^{de}	89.00
Abamectin+bifenthrin	91	86.98±0.00^{d}	93.71±0.36^{b}	91.47±0.26^{b}	82.91±0.05^{g}	88.77
Chlorfenapyr	70.5	94.18±0.90^{a}	95.83±0.00^{b}	93.41±0.29^{a}	87.49±0.26^{bc}	92.73
Fenpropathrin+etoxazole	166	93.33±0.8^{a}	93.50±0.25^{a}	88.93±0.28^{a}	83.82±0.09^{f}	89.90
Imidacloprid	61	87.7±0.88^{cd}	90.60±0.20^{d}	90.75±0.12^{c}	79.89±0.55^{h}	87.24
Imidacloprid+ abamectin	137	85.82±0.09^{d}	62.74±0.13^{g}	91.41±0.26^{b}	88.13±0.39^{b}	82.03
Jojoba oil	98	91.11±0.48^{b}	89.70±0.35^{e}	90.78±0.11^{c}	85.95±0.03^{e}	89.39
Thiamecthioxam	88.25	86.48±1.25^{d}	91.47±0.24^{c}	89.73±0.09^{d}	86.60±0.20^{cd}	88.57
Thiamecthioxam + abamectin	59.5	79.38±.30^{e}	90.44±0.28^{d}	90.60±0.20^{c}	89.11±0.20^{a}	87.38
Control	60					

In a column, means followed by the same letter are not significantly different at the 5%.

Data in Table (4) show the efficiency of tested compounds against *L. sativae* on cucumber during 2022 season. The highest insect reductions due to fenpropathrin with etoxazole at initial effect, 5, 7, 10 day after treatment and overall average were 97.91±1.06, 93.06±0.24, 84.97±0.06, 94.34±0.75 and 92.57%, respectively. Meanwhile, the lowest insect reductions due to thiamethoxam were 96.47±0.70,70.56±0.69 ,68.74±0.46, 78.76±0.44and 78.63%, respectively.

In a column, means followed by the same letter are not significantly different at the 5%

Data in Table (5) show the efficiency of tested compounds against *L. sativae* on cucumber during 2023 season. The highest insect reductions due to fenpropathrin with etoxazole at initial effect, 5, 7 and 10 day after treatment were 95.51±0.7, 93.11±0.20 ,91.48±0.26 ,92.33±0.75 and overall average 93.11%, respectively. Meanwhile, the lowest insect reductions due to thiamethoxam were 92.62±0.00 ,72.94±0.22 ,66.91 ±0.27, 76.85±0.35 overall average77.33%, respectively. Thus, fenpropathrin with etoxazole recorded the highest reduction which agrees with

Kumari *et al*. (2022) and Majurnder *et al. (*2024). Bifenthrin with abamectin recorded a moderate level which agrees with Hamza *et al. (*2023). Imidacloprid, thiamethoxam and abamectin recorded the lowest level of insect reductions which agrees with Hirekurubar *et al. (*2018) and Kale *et al*. (2022).

Table 4. Potency of tested compounds in reducing *Liriomyza sativae* infestation on cucumber plants at Sakha Agricultural Research Station, Kafr El-Sheikh Governorate during 2022 season

Compound	pre-treat. /10 leaves	Mean reduction± S. E				
		Initial effect	5Day	7Day	10Day	Overall average
Abamectin	40	92.13±1.01^{c}	87.08±0.27^{e}	94.64±0.55^{b}	83.5±0.65^{f}	89.34
Abamectin+bifenthrin	34.2	88.39±0.73^{d}	90.40±0.58^{b}	91.24±0.04^{c}	80.62±0.57^{g}	87.66
Chlorfenapyr	23.5	91.46±0.70^{c}	89.30±0.16^{c}	74.90±0.29^{h}	85.82±0.38^{e}	85.37
Fenpropathrin+etoxazole	56	97.91±1.06^{a}	93.06±0.24^{a}	84.97±0.06^{f}	94.34±0.75^{a}	92.57
Imidacloprid	39	97.80±1.14^{a}	73.40±0.58^{g}	81.04±0.18^{g}	91.60±0.58^{c}	85.96
Imidacloprid+ abamectin	37	91.60±0.72^{c}	86.06±0.22^{f}	88.01±0.100^{e}	90.96±0.18^{d}	89.16
Jojoba oil	37	93.80±0.44^{b}	93.02±0.15^{a}	96.00±0.07^{a}	91.08±0.43^{d}	93.48
Thiamecthioxam	28.2	96.47±0.70^{a}	70.56±0.69^{h}	68.74±0.46^{i}	78.76±0.44^{h}	78.63
Thiamecthioxam + abamectin	46	96.66±0.75^{a}	88.54±0.68^{d}	90.24±0.46^{d}	92.81±0.40^{b}	92.06
Control	13					

Table 5. Potency of tested compounds in reducing *Liriomyza sativae* infestation on cucumber plants at Sakha Agricultural Research Station, Kafr El-Sheikh Governorate during 2023 season

Compound	pre-treat. /10 leaves	Mean reduction± S. E				
		Initial effect	5Day	7Day	10Day	Overall average
Abamectin	35	89.84±0.51^{d}	85.53±0.70^{e}	90.88±0.31^{b}	81.93±0.24^{e}	87.05
Abamectin+bifenthrin	41	85.16±1.01^{f}	89.58±0.72^{b}	88.82±0.39^{d}	79.76±0.45^{f}	85.83
Chlorfenapyr	27.5	88.56±0.61^{e}	87.52±0.67^{c}	71.99±0.07^{h}	84.53±0.63^{d}	83.15
Fenpropathrin+etoxazole	54	95.51±0.70^{a}	93.11±0.20^{a}	91.48±0.26^{f}	92.33±0.75^{a}	93.11
Imidacloprid	39	95.20±0.41a	72.00±0.07^{h}	80.16±0.37^{g}	81.70±0.50^{e}	82.27
Imidacloprid+ abamectin	41	88.88±0.31^{e}	84.64±0.00^{f}	86.14±0.35^{e}	88.37±0.73^{c}	87.01
Jojoba oil	31	91.04±1.00^{c}	91.13±0.33^{a}	93.86±0.34^{a}	88.90±0.28^{c}	91.23
Thiamethoxam	31	92.62±0.00^{b}	72.94±0.22^{g}	66.91±0.27^{i}	76.85±0.35^{g}	77.33
Thiamethoxam + abamectin	52	94.78±0.32^{a}	86.18±0.39^{d}	89.09±0.28^{c}	90.35±0.74^{b}	90.10
Control	31					

In a column, means followed by the same letter are not significantly different at the 5%.

3.2. Effect of tested compounds on chlorophyll content

Data in Table (6) clarify the effect of tested compounds on chlorophyll content. One day after treatments, the highest chlorophyll content in cucumber leaves found with chlorfenapyr with 57.53±1.49 one day after treatment, while the lowest content was recorded with imidacloprid with abamectin by48.40±1.39. On day five, all tested compounds increased the chlorophyll content. Also, on day seven, all compounds increased the chlorophyll content, the highest was recorded with imidacloprid 59.35±0.20. On day ten, the chlorophyll content increased with thiamethoxam by 55.93±0.13 and decreased with imidacloprid by45.54±0.2. Thus, compounds affected chlorophyll content on one, five, seven days after treatment by increasing it which agrees with Baozhen *et al*. (2013) and Bughdady *et al. (*2020). Meanwhile, on day ten, the content returned to be close to normal, except with using imidacloprid which reduced chlorophyll content which agrees with Mishra *et al.* (20089) who investigate the effect of the high concentrations of imidacloprid on chlorophyll content.

Table 6. Effect of tested compounds on chlorophyll content in cucumber leaves at Sakha Agricultural Research Station, Kafr El-Sheikh Governorate

Compound	Used* conc.	Means ±SE of chlorophyll content			
	[mg a.i.l-1]	Initial effect	5Day	7Day	10 Day
Abamectin	7	55.46±1.35b	56.29±0.31[c]	45.93±0.24[h]	52.73±0.24[c]
Abamectin+bifenthrin	76	51.73±0.45[d]	52.37±0.68[d]	53.88±0.13[d]	50.03±0.13[e]
Chlorfenapyr	144	57.53±1.49[a]	51.43±0.24[f]	57.23±0.24[b]	49.34±0.24[f]
Fenpropathrin+etoxazole	50	48.73±0.48[f]	51.37±0.55[f]	47.71±0.27[h]	46.73±0.27[i]
Imidacloprid	262	52.44±0.71[c]	51.21±0.27[f]	59.35±0.20[a]	45.54±0.20[j]
Imidacloprid+ abamectin	70	48.40±1.39[f]	57.57±0.34[a]	53.77±0.34[e]	47.95±0.34[g]
Jojoba oil	2395	47.60±1.02[g]	52.49±0.19[d]	50.28±0.13[g]	47.65±0.20[h]
Thiamethoxam	100	50.80±1.26[e]	56.82±0.44[b]	50.88±0.13[f]	55.93±0.13[a]
Thiamethoxam + abamectin	111	57.53±1.75[a]	51.87±0.34[e]	50.23±0.24[g]	50.19±0.24[d]
Control	-	49.80±1.20[f]	50.35±0.20[g]	56.25±0.20[c]	53.12±0.20[b]

In a column, means followed by the same letter are not significantly different at the 5%.

3.3. Effect of tested compounds on non-enzymatic activity

Data in Table (7) present the effect of tested compounds on the nonenzymatic concentrations in cucumber. All compounds significantly reduce carbohydrates content. Thiamethoxam with abamectin recorded the lowest content with 37.66±0.16, meanwhile abamectin with or without bifenthrin had no effect**.** Also, protein decreased significantly as thiamethoxam reduced protein component to 4.27±0.03, while abamectin with or without bifenthrin had no effects on protein. As, for fats, all components reduced fats compared to control with significant differences among each other. Imidacloprid with abamectin reduced fats with 0.70±0.0, respectively. Total lipids (Tble7) decreased also compare to control with significant differences among each other. Thiamethoxam with abamectin recorded the lowest average with 0.35±0.09. All compounds also affected total phenols with significant differences, thiamethoxam with abamectin reduced total phenols with average of 1.66±0.092. As a conclusion, all compounds affected on non-enzymatic components such as carbohydrates, protein, fat, lipids and phenolic by decreasing it with a signification difference among others which were agreed with Shakir *et al*. (2018) and Li l *et al* (2024).

3.4. Effect of tested compounds on activity of antioxidant enzymes

Data in Table (8) show the effect of tested compounds on the activity of antioxidant enzymes in cucumber leaves up to 10 days post-treatments. All compounds reduced catalase with signification differences among the treatments Imidacloprid with abamectin recorded the lowest average with 3.83±0.03. Also, all compounds affected on peroxidase by decreasing with signification between them, thiamethoxam recorded the lowest average with 6.13±0. 05. Also, all compounds affected on superoxidase with signification differences among each other, thiamethoxam recorded the lowest average with 7.64±0.0. As a conclusion, all compounds significantly affected the cucumber antioxidant enzymes which agrees with Hajji-Hedfi *et al. (*2022) and Macar oksal (2022), the content of catalase and superoxidase also decreased which agrees with Bajguz and Hayat (2009) and Shakir *et al*. (2018).

Table 7. Effect of compounds on non-enzymatic components activity in cucumber leaves after treatment on *Liriomyza sativae and* Bemisia *tabaci* for 10 days at Sakha Agricultural Research Station, Kafr El-Sheikh Governorate

Compound	Non-enzymatic components				
	Carbohydrates	Protein%	Fats%	Total lipid%	Total phenols%
Abamectin	49.14±0.18^{c}	5.82±0.09^{b}	0.83±0.01^{e}	0.61±0.07^{b}	1.68±0.072^{f}
Abamectin+bifenthrin	52.57±0.46^{a}	5.04±0.01^{d}	1.06±0.01^{a}	0.47±1.00^{e}	2.10±0.002^{a}
Chlorfenapyr	47.58±0.15^{d}	5.73±0.08^{b}	0.94±0.003^{b}	0.53±0.07^{cd}	1.86±0.072^{d}
Fenpropathrin+etoxazole	44.51±0.39^{e}	5.82±0.09^{b}	0.97±0.01^{b}	0.42±0.07^{f}	1.93±0.072^{c}
Imidacloprid	38.02±0.23^{g}	5.28±0.03^{c}	0.76±0.003^{f}	0.55±0.02^{cd}	1.49±0.022^{g}
Imidacloprid+ abamectin	41.74±0.12^{f}	4.93±0.09^{e}	0.70±0.003^{g}	0.51±0.09^{de}	1.43±0.092^{g}
Jojoba oil	44.50±0.04^{e}	6.24±0.03^{a}	0.89±0.00^{d}	0.65±0.02^{a}	1.75±0.02^{e}
Thiamethoxam	44.52±0.23^{e}	4.27±0.03^{f}	0.91±0.01^{cd}	0.38±0.02^{g}	1.77±0.022^{e}
Thiamethoxam + abamectin	37.66±0.16^{g}	4.93±0.09^{e}	0.83±0.01^{e}	0.35±0.09^{g}	1.66±0.092^{f}
Control	51.44±0.22^{b}	6.2±0.05^{a}	1.04±0.03^{a}	0.56±1.01^{de}	2.03±0.012^{b}

In a column, means followed by the same letter are not significantly different at the 5%

Table 8. Effect of compounds on antioxidant enzymes activity in cucumber leaves after treatment against *Liriomyza sativae and Bemisia tabaci* for 10 days at Sakha Agricultural Research Station, Kafr El-Sheikh Governorate

Compound	Antioxidant enzymes		
	Catalase (Nmol H2O2 mg protein^{-1}(min-^{1}) (CAT)	Peroxidase (Nmol ascorbate oxidized mg protein^{-1} min^{-1})	Superoxidase (Nmol NO2 mg protein^{-1} min^{-1})
Abamectin	4.48±0.01^{g}	8.44±0.09^{e}	10.17±0.06^{c}
Abamectin+bifenthrin	5.51±0.003^{c}	7.18±0.01^{g}	8.98±0.00^{e}
Fenpropathrin+etoxazole	5.22±0.04^{e}	9.84±0.09^{a}	10.64±0.12^{b}
Chlorfenapyr	5.34±0.03^{d}	8.78±0.03^{d}	10.21±0.03^{c}
Jojoba oil	6.08±0.006^{a}	9.67±0.02^{b}	10.64±0.33^{b}
Imidacloprid	5.21±0.43^{e}	8.24±0.08^{f}	9.2±0.05^{d}
Imidacloprid+ abamectin	3.83±0.03^{h}	7.18±0.03^{g}	8.68±0.03^{f}
Thiamethoxam	4.72±0.04^{f}	6.13±0.05^{h}	7.64±0.00^{g}
Thiamethoxam + abamectin	4.43±0.033^{g}	8.38±0.02^{e}	9.10±0.05^{d}
Control	5.76±0.02^{b}	9.51±0.03^{c}	10.90±0.00^{a}

In a column, means followed by the same letter are not significantly different at the 5%

4. Conclusion

All tested compound recorded a high reduction against *B. tabaci* and *L. sativa* on initial effects. Chlorfenapyr was the most effective on overall average against *B. tabaci* and fenpropathrin with etoxazole recorded the highest reduction against *L. sativa*. Tested compounds increased the chlorophyll content except with using imidacloprid which reduced chlorophyll. On non-enzymatic components of cucumber such as carbohydrates, protein, fat, lipids and phenolic were decreasing it with a signification difference. A significant effected of antioxidant enzymes were found with all compounds.

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All authors are contributed in this research

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