Insecticides and Their Mixtures for Controlling *Tuta Absoluta* Infesting Tomato under Egyptian Field Conditions

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ABSTRACT

Field trials were carried at El-Ashartalaf feddan region, Behaira government, Egypt during two successive seasons of 2016 and 20117 to evaluate four insecticides and three of their mixtures against the tomato leafminer *Tuta absoluta* under field conditions. The seven evaluated insecticidal treatments were applied in three consequent sprays within an interval of 10 days between each in addition to the treatment of untreated check. The lonely or individually evaluated insecticides included chlorantraniliprole, thiamethoxam, lufenuron and chlorpyriphos which have been sprayed according to the recommendations of the Egyptian Ministry of Agriculture. Meanwhile, their evaluated mixtures: chlorantraniliprole + thiamethoxam, chlorantraniliprole+ lufenuron and thiamethoxam + lufenuronwere were applied at the rate of half recommended dose of each insecticide within the tested mixture. The obtained results showed a more or less toxic efficiency of the individually and/or admixed insecticides against the insect throughout both the seasons of 2016 and 2017. In the first season of 2016, the mixture of chlorantraniliprole + lufenuron was comparatively high effective during the elapsed period after the 1st and 2nd spray; furthermore it was proved to be the utmost superior efficient post the 3rd spray achieving complete infestation reduction (100%) of larvae. During the second season of 2017, chlorpyriphos was the most effective tested individual insecticide. The mixture of chlorantraniliprole + lufenuron was proved again to be superior achieving reduction level of 100% after the 3rd spray. Therefore, this mixture would be recommended for achieving efficient control of *T. absoluta* in the growing tomato plants under field conditions. It is also better to use chlorpyriphos alone in IPM program to reduce the costs and slow down the development of resistance of this insect-pest to other involved compounds in the mixtures.

***Keywords*: Tomato plants, the tomato leafminer *Tuta absoluta*, insecticidal treatments, mixture of insecticides and infestation reduction percentage.**

INTRODUCTION

The tomato leafminer, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) originating from South America, was considered as a significant tomato insect-pest (Leite *et al.*, 2001 and Lobos *et al.*, 2013), not only due to its intensity of attack but also to its occurrence during all crop cycle (Oliveira *et al.*, 2008). Frequently, the tomato leaf miner *T. absoluta* attacks tomato plants in sufficient numbers to cause damage for leaves and fruits of plants. It is an invasive insect- pest causing severe loss of tomato production in many countries either in open field or green houses (Khidr *et al.*, 2013). If there were no control measures taken, this insect- pest can cause up to 80-100% loss of yield by attacking leaves, flowers, stems and especially fruits. (Apablaza, 1992; Desneux *et al.*, 2010; ?ztemiz, 2012).

It was first observed damaging tomato plants in Turkey (Klc,2010 and Unlu, 2012), in Montenegro (Italy) (Hrncic and Radonjic, 2012), in Iran (Baniameri and Cheraghian, 2012), in Russia (Izhevsky *et al.*, 2011), Greece (Roditakes *et al*., 2010), Egypt (Mohammed, 2010) and in Khartoum State, Sudan (Mohamed *et al*., 2012).This insect- pest has spread rapidly throughout the Mediterranean area, and has also reached the countries of northern Europe. In 2009, *Tuta absoluta* has been found in the UK and the Netherlands travelling on Spanish tomato imports (Miniermotte, 2010).

Because of its characteristic biology and behavior, *T. absoluta* is a challenging insect-pest to be controlled. *T. absoluta* has been controlled with synthetic insecticides. Organophosphates and pyrethroids were used during the 1970's and 1980's. Control failures had been noted with organophosphates and pyrethroids in South America (Salazar and Araya, 2001) due to the resistance status of *T. absoluta* (Lietti *et al.,* 2005 and Siqueira *et al.,* 2000 a&b). However, newer classes of insecticides provided good control of this pest (IRAC, 2009). Indoxacarb, spinosad, imidacloprid, deltamethrin, and *Bacillus thuringiensis* var. *kurstaki* were applied for the control of larval infestations in Spain (FERA, 2009 and Russell, 2009). Chlorpyrifos and pyrethrins were also used in Italy (Garzia *et al.*, 2009).

In Egypt, *T. absoluta* is newly reported and until now there are few registered and recommended insecticides (*B.t*., IGIs , emamectin benzoate, spinotram, thiomethoxam and chloranitraniliprol) for controlling this insect (EMALR, 2015). However, in Egypt there are going on research work for the evaluation of some insecticides under registration and there were few studies describing the efficiency of some insecticides for the control of *T. absoluta* (Derbalah *el al.,* 2012; Shalaby *et al.,* 2012; Hanafy and El-Sayed, 2013; Soliman *et al.,* 2014; Ramadan, 2014; Saad *et al*.,2014). Insecticides and their mixtures achieved a

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considerable reduction of *T. absoluta* (Soliman *et al.*, 2014; Shiberu and Getu, 2017).

There is an urgent need for efficient and sustainable management methods for controlling this harmful insect-pest. Nevertheless, one of the main means of controlling this pest is through the use of chemical insecticides. Therefore, the aim of the present study was focused on evaluating certain chemical insecticides alone or in mixtures against the common injurious gelechiid insect, *Tuta absoluta* to tomato plants during two successive seasons of 2016 and 2017 under Egyptian field conditions.

MATERIALS AND METHODS

Field experiments

Field trials were carried out in the region of El-Ashartalaf feddan, Behaira governorate, Egypt during two successive seasons of 2016 and 2017 (June-September). A selected area of approximately 4 carats (700 m^2) was divided into longitudinal blocks (Randomized Compelete Block Design [RCBD]) separated by buffer paths of 1 m^2 wide made between every plot to prevent insecticides drift. Transplanted tomato seedlings (Variety 006) were grown alternatively at random all over the different blocks. The recommended agricultural practices were followed during both seasons according to the recommendations of the Egyptian Ministry of Agriculture. The presence of *T. absoluta* was confirmed by inspecting the occurring symptoms of morphological changes in the examined plants of the collected specimens from the adopted treatments in field.

Insecticidal treatments

In both seasons of 2016 and 2017, each block of planted tomato represented a treatment and implied three replicates. The plants of untreated check (control) were chosen to be a little far away from those treated plants to avoid any contamination or interference of spray drift.

Seven different insecticidal treatments were evaluated; each treatment was applied in three consequent sprays (1^{st}, 2^{nd} and 3^{rd}) with an interval of 10 days in between beside the treatment of untreated check (control). The adopted individual treatments included chlorantraniliprole, thiamethoxam, lufenuron and chlorpyriphos which had been sprayed at the recommended rates by the Egyptian Ministry of Agriculture. Meanwhile, certain evaluated mixtures of chlorantraniliprole+thiamethoxam, chlorantraniliprole+ lufenuron and thiamethoxam + lufenuron were applied and sprayed at half dose of each insecticide. (Table 1). All sprayed plants in the performed treatments were compared with the untreated check plants.

In the second season of 2017, the aforementioned seven insecticidal treatments (plus the control one) were identically carried out as the same as that done in the first season of 2016. The insecticidal applications were started when the plants reached the age of 8 weeks using a Knapsack sprayer (20 liters), at the rate of 200 liters/fed with a 10 days interval between each spray.

Sampling technique and inspection of *Tuta absoluta*

The infestation rate was recorded after 3, 6 and 9 days post each spray taking into account the mean number of larvae/5 sampled plants/ replicate in each treatment compared with the control. The percentages of infestation reduction were calculated using the equation of Henderson and Tilton (1955) as follows:

$$\text{Reduction \%} = 1 - \left[\frac{A}{B} \times \frac{C}{D} \right] \times 100 \quad \text{where,}$$

A: number of larvae in treatment after insecticide spray
B: number of larvae in treatment before insecticide spray
C: number of larvae in the check (control) before insecticide spray
D: number of larvae in the check (control) after insecticide spray

Table 1. Tested insecticides, their mixtures and their rates of applications during the successive experimental seasons of 2016 and 2017

	Common name	Trade name	Formulation	Rate/Fed. (ml/200 liters)
Individual insecticides	Chlorantraniliprole	Coragen®	20% SC*	60
	Thiamethoxam	Actara®	25% WP**	80g
	Lufenuron	Match®	5% EC***	160
	Chlorpyriphos	Dursban®	48% EC	500
Insecticides mixture	Chlorantraniliprole + Thiamethoxam	Coragen®+ Actara®	20% SC + 25% WP	30 + 40g
	Chlorantraniliprole+ Lufenuron	Coragen® + Match®	20% SC+ 5% EC	30 + 80
	Thiamethoxam+ Lufenuron	Actara® + Match®	25% WP + 5% EC	40g + 80

*Sc = Suspension Concentrate, **WP= Wettable Powder and ***EC= Emulsifiable Concentrate

Statistical analysis

Data of the present study were subjected to the analysis of variance ANOVA using ″F″ Test following the randomized complete block design (RCBD). The least significant differences (L.S.D) at 0.05 probability level were determined by using a computer program (COSTAT software, 1988) to compare the mean numbers of the different treatments and control. The reduction percentages were subjected to transformation as described by Wadley (1967) where each value (x) was transformed to $\sqrt{x + 0.5}$ and then these transformed values were statistically analyzed because there were values of 0.00%.

RESULTS AND DISCUSSION

The first season of 2016

During the first season of 2016, seven treatments were evaluated against the tomato leafminer, *Tuta absoluta* compared with the untreated check after each of three applied consequent insecticidal sprays for each treatment. All the tested compounds and their mixture showed significant infestation reduction of *T. absoluta* as compared with control treatment. The residual effect of each of these treatments on the mean number of detected larvae on tomato plants and the calculated reduction percentages are presented in Table (2). It could be seen that the mean numbers of larvae are going to be decreased till the 9th day post-treatment, versus the increased number in the treatment of untreated check. Meanwhile, the calculated percentage of reduction of each treatment was found to have, merely, the same trend.

Considering the extracted general mean of reduction (%) after the application of the different performed insecticides treatment, it is noticed that the treatment of chlorantraniliprole + lufenuron was the most effective one in reducing the number of inspectedlarvae and increased their reduction percentages up to 58.40%, followed by the treatment of thiamethoxam+ lufenuron that gave a reduction percentage of 53.76% after 9 days post 1st spray, while the mixture of chlorantraniliprole + thiamethoxam gave a reduction percentage of 46.64%. On the other hand, the application of chlorantraniliprole, chlorpyriphos, lufenuron and thiamethoxam alone gave the least reduction percentages of 48.90, 47.85, 47.48 and 43.38%, in respect (Table 2).

Before the application of the evaluated treatments of the second spray, it was noticed that the number of the detected larvae increased. Nevertheless, both the tested treatments of chlorpyriphos and chlorantraniliprole were so effective in reducing the number of the inspected larvae and increasing the calculated reduction percentages. The treatment of chlorpyriphos was somewhat more potent and recorded high general mean of reduction of 52.40% over 9 days of inspection, followed by the treatments of chlorantraniliprole (50.51%) and lufenuron (48.38%). The mixtures of chlorantraniliprole+ thiamethoxam, chlorantraniliprole+ lufenuron and thiamethoxam+ lufenuron gave a more or a less similar toxic effect on the tomato leafminer *T. absoluta* resembled by general means of reduction percentages comprised 45.99, 45.77 and 45.52, successively, while the application of thiamethoxam alone gave the least reduction percentage of 44.61 (Table 2).

The detected effect of applied treatments in the 3rd spray against the insect-pest confirmed or revealed again that the mixture of chlorantraniliprole+lufenuron was proved to be the superior treatment achieving complete reduction (100%) all over the inspection periods post-spraying followed by 90.83, 85.33 and 81.65% reductions for chlorpyriphos, thiamethoxam + lufenuron and chlorantraniliprole, successively. Meanwhile, the treatments of the individual insecticides: thiamethoxam and lufenuron gave lower reduction values of 69.44, 64.55; the mixture of chlorantraniliprole + thiamethoxam showed the least reduction one-53.55% (Table 2).

Generally, in the first season of 2016, the performed treatments of chlorantraniliprole+ lufenuron, chlorpyriphos and chlorantraniliprole were found to be effective for controlling the leafminer, *T. absoluta*, which would be recommended to be included within the Integrated Pest Management (IPM) programs. The above presented results are in conformity with Shiberu and Getu (2017) who found that chlorantraniliprole (Coragen® 200 SC) and a mixture of emamectin benzoate and prosuler oxymatrin (Prove® 1.9 E.C and Levo® 2.4 SL, in respect) were efficient for controlling *T. absoluta* larvae and could be recommended to be applied within a program of integrated pest management.

The second season of 2017

As previously mentioned for the 1st season of 2016, the second season of 2017 involved the same seven evaluated insecticidal treatments against the tomato leafminer *T. absoluta* and compared with the untreated check (Table 3). The obtained results ascertained again that the mixture of chlorantraniliprole+ lufenuron and treatment of chlorpyriphos alone were the more effective treatments against the tomato leafminer, *T. absoluta* after the 1st spray and gave higher general reduction means of 59.17% and 59.01%, successively.

The treatment of chlorantraniliprole+ thiamethoxam came in

Table 2. Effect of the evaluated insecticidal treatments against the tomato leafminer, *Tuta absoluta* infesting tomato plants in 2016 season (1st, 2nd and 3rd spray)

Treatment	1st season (2016)							General mean of Reduction percentages (%)
	Pre-spray	Mean No. of alive *T. absoluta* larvae/5 plants after different intervals (days) post-spraying						
		3		6		9		
	1st spray							
	A**	A	R%	A	R%	A	R%	
Chlorantraniliprole	19.00	15.00	31.35^{d*}	13.00	49.32d	10.00	66.04^{c}	48.90^{a}
Thiamethoxam	21.00	17.00	29.61^{f}	16.00	43.56^{e}	14.00	56.99^{g}	43.38^{a}
Lufenuron	20.00	16.00	30.43^{e}	13.33	50.74^{c}	12.00	61.29^{d}	47.48^{a}
Chlorpyriphos	18.00	14.00	32.37^{c}	12.00	50.62^{c}	11.00	60.57^{e}	47.85^{a}
Chlorantraniliprole + Thiamethoxam	19.00	15.00	31.35^{d}	13.00	49.32^{d}	12.00	59.25^{f}	46.64^{a}
Chlorantraniliprole + Lufenuron	21.00	14.00	42.03^{a}	12.00	57.67^{a}	8.00	75.42^{a}	58.40^{a}
Thiamethoxam+ Lufenuron	20.00	15.00	34.78^{b}	12.00	55.55^{b}	9.00	70.97^{b}	53.76^{a}
Untreated check	20.00	23.00	0.00^{g}	27.00	0.00^{f}	31.00	0.00^{h}	0.00^{b}
	2nd spray#							
Chlorantraniliprole	10.00	7.00	32.19^{c}	5.00	56.94^{a}	4.00	62.42^{b}	50.51^{a}
Thiamethoxam	14.00	11.00	23.88^{e}	7.00	56.94^{a}	7.00	53.03^{b}	44.61^{a}
Lufenuron	12.00	9.00	27.36^{d}	6.00	56.94^{a}	5.00	60.86^{c}	48.38^{a}
Chlorpyriphos	11.00	7.00	38.35^{b}	6.00	53.03^{b}	4.00	65.84^{a}	52.40^{a}
Chlorantraniliprole + Thiamethoxam	12.00	9.00	27.34^{d}	7.00	49.77^{c}	5.00	60.86^{c}	45.99^{a}
Chlorantraniliprole + Lufenuron	8.00	6.00	27.34^{d}	4.00	56.94^{a}	4.00	53.03^{d}	45.77^{a}
Thiamethoxam+ Lufenuron	9.00	5.00	46.18^{a}	6.00	42.59^{d}	5.00	47.81^{e}	45.52^{a}
Untreated check	31.00	32.00	0.00^{f}	36.00	0.00^{e}	33.00	0.00^{f}	0.00^{b}
	3rd spray#							
Chlorantraniliprole	4.00	0.66	45.00^{d}	0.00	100.00^{a}	0.00	100.00^{a}	81.65^{a}
Thiamethoxam	7.00	1.33	31.90^{e}	0.33	76.43^{b}	0.00	100.00^{a}	69.44^{a}
Lufenuron	5.00	1.00	26.67^{f}	0.33	67.00^{c}	0.00	100.00^{a}	64.55^{a}
Chlorpyriphos	4.00	0.33	72.50^{b}	0.00	100.00^{a}	0.00	100.00^{a}	90.83^{a}
Chlorantraniliprole + Thiamethoxam	5.00	1.00	26.67^{f}	0.66	34.00^{d}	0.00	100.00^{a}	53.55^{a}
Chlorantraniliprole + Lufenuron	4.00	0.00	100.^{0a0}	0.00	100.00^{a}	0.00	100.00^{a}	100.00^{a}
Thiamethoxam+ Lufenuron	5.00	0.66	56.00^{c}	0.00	100.00^{a}	0.00	100.00^{a}	85.33^{a}
Untreated check	33.00	9.00	0.00^{g}	6.00	0.00^{e}	5.33	0.00^{b}	0.00^{b}

***** Means followed with the same letter(s) within the same column are not significantly different at 0.05 probability level. **** A**= Mean number of larvae and **R%** = Infestation reduction percentage.

The second (2nd) spray was applied after 10 days and the 3rd spray after 20 days post the first spray.

the second rank giving a general mean of reduction amounted to 56.27%, followed by the treatment of lufenuron which gave a reduction percentage of 55.25%, then the mixture of thiamethoxam+lufenuron which gave the lowest reduction percentage of 34.31 (Table 3).

Table 3. Effect of the evaluated insecticidal treatments against the tomato leafminer, *Tuta absoluta* infesting tomato plants in 2017 season (1st, 2nd and 3rd spray)

Treatment	2nd season (2017)							
	Pre-spray	Mean No. of alive *T. absoluta* larvae/5 plants after different intervals (days) post-spraying						General mean of Reduction percentages (%)
		3		6		9		
	A**	A	R%	A	R%	A	R%	
1st spray								
Chlorantraniliprole	13.00	12.00	35.42^{f*}	10.00	52.72^{f}	7.33	69.72^{d}	52.62^{a}
Thiamethoxam	12.66	11.00	39.28^{e}	9.33	54.70^{e}	7.00	70.31^{c}	54.76^{a}
Lufenuron	14.33	12.33	39.87^{c}	10.00	57.11^{d}	8.33	68.78^{e}	55.25^{a}
Chlorpyriphos	13.66	11.33	42.04^{b}	8.33	62.52^{a}	7.00	72.48^{b}	59.01^{a}
Chlorantraniliprole+ Thiamethoxam	16.66	13.66	42.70^{a}	11.00	59.41^{c}	10.33	66.70^{f}	56.27^{a}
Chlorantraniliprole+ Lufenuron	14.66	12.66	39.65^{d}	9.00	62.26^{b}	6.66	75.60^{a}	59.17^{a}
Thiamethoxam+ Lufenuron	10.66	13.66	10.46^{g}	11.66	32.77^{g}	8.00	59.70^{g}	34.31^{b}
Untreated check	17.00	24.33	0.00^{h}	27.66	0.00^{h}	31.66	0.00^{h}	0.00^{c}
2nd spray#								
Chlorantraniliprole	7.30	4.66	33.36^{a}	3.33	55.78^{d}	1.00	86.85^{d}	58.66^{a}
Thiamethoxam	7.00	5.33	20.51^{c}	3.66	49.31^{f}	1.66	77.24^{f}	49.02^{a}
Lufenuron	8.33	6.33	20.67^{c}	3.33	61.24^{b}	.66	92.39^{c}	58.10^{a}
Chlorpyriphos	7.00	5.33	20.55^{c}	3.00	58.45^{c}	.33	95.47^{b}	58.15^{a}
Chlorantraniliprole+ Thiamethoxam	10.33	8.33	15.82^{d}	5.66	46.88^{g}	2.66	75.29^{g}	45.99^{a}
Chlorantraniliprole+ Lufenuron	6.66	4.66	26.96^{b}	1.66	75.83^{a}	0.00	100.00^{a}	67.59^{a}
Thiamethoxam+ Lufenuron	8.00	6.66	13.09^{e}	3.66	55.65^{e}	1.33	84.05^{e}	50.93^{a}
Untreated check	31.66	30.33	0.00^{f}	32.66	0.00^{h}	33.00	0.00^{h}	0.00^{b}
3rd spray#								
Chlorantraniliprole	1.00	0.00	100.00^{a}	0.00	100.00^{a}	0.00	100.00^{a}	100.00^{a}
Thiamethoxam	1.66	0.00	100.00^{a}	0.00	100.00^{a}	0.00	100.00^{a}	100.00^{a}
Lufenuron	0.66	.33	38.10^{c}	0.00	100.00^{a}	0.00	100.00^{a}	79.36^{a}
Chlorpyriphos	0.33	0.00	100.00^{a}	0.00	100.00^{a}	0.00	100.00^{a}	100.00^{a}
Chlorantraniliprole+ Thiamethoxam	2.66	0.33	84.64^{b}	0.00	100.00^{a}	0.00	100.00^{a}	94.88^{a}
Chlorantraniliprole+ Lufenuron	0.00	0.00	100.00^{a}	0.00	100.00^{a}	0.00	100.00^{a}	100.00^{a}
Thiamethoxam+ Lufenuron	1.33	0.00	100.00a	0.00	100.00^{a}	0.00	100.00^{a}	100.00^{a}
Untreated check	33.00	26.66	0.00^{d}	22.00	0.00^{b}	10.33	0.00^{b}	0.00^{b}

***** Means followed with the same letter(s) within the same column are not significantly different at 0.05 probability level. **** A**= Mean number of larvae and **R%** = Infestation reduction percentage.

The second (2nd) spray was applied after 10 days and the 3rd spray after 20 days post the first spray.

Moreover, the deduced mean numbers of inspected insect larvae and calculated reduction percentages post the application of different evaluated insecticides and their mixtures along 3, 6 and 9 days post- the 2nd spray are exhibited in Table 3. In this concern, the calculated general mean of reduction is being used for evaluating and determining the residual effect of formerly applied treatments in 1st spray and the cumulative efficacy of each of reapplied treatments in 2nd spray. The results revealed that the applied mixture of chlorantraniliprole+ lufenuron was the most potent treatment that reduced the number of *Tuta absoluta* larvae and gave a higher general mean of reduction percentage of 67.59, followed by chlorantraniliprole (58.66%), chlorpyriphos (58.15%) and lufenuron (58.10%). The treatment of (thiamethoxam+ lufenuron) gave comparative lower general mean of reduction amounted to 50.93%, followed by the treatment of thiamethoxam alone (49.02%); then The mixture of chlorantraniliprole+ thiamethoxam which gave the lowest reduction percentage of 45.99. Herein, it could be seen that the addition of an insecticide to another give a high effect and reduce the incidence of *Tuta absoluta* larvae. It is also better to use chlorpyriphos alone in IPM program to reduce the costs and slow down the possible occurrence and development of resistance to other compounds involved in the tested mixtures against the insect.

The deduced delayed effects of the applied treatments after the 3rd spray against the insect in the second season of 2017 is shown and tabulated in Table (3). It could be seen again that each of the treatments of chlorantraniliprole+lufenuron, thiamethoxam+lufenuron, chlorantraniliprole, thiamethoxam and chlorpyriphos were proved to be the superior ones achieving complete reduction (100%) all over the adopted inspection periods post-spraying.

Meanwhile, the treatments of chlorantraniliprole+ thiamethoxam and lufenuron gave as less high reduction as 94.88 and 79.36%, in respect (Table 3).

Generally, in the second season of 2017, treatments of chlorantraniliprole+lufenuron, chlorpyriphos and chlorantraniliprole were the utmostly effective treatments for controlling the leafminer, *Tuta absoluta*; and such treatments would be included within IPM programs. These results are in agreements with those reported by Bassi *et al.* (2012) who reported that chlorantraniliprole (Rynaxypyr®, chlorantraniliprole and Altacor®) is a novel diamide insecticide with outstanding performance against *T. absoluta* and has an extremely low mammalian toxicity profile and could be considered as a new standard of *T. absoluta* control, even on insecticide-resistant populations. Braham et al. (2012) found that Ampligo® 150ZS (a mixture of chlorantraniliprole + lambda□cyhalothrin) in laboratory bioassays demonstrated good performance against *T. absoluta.* Ayalew (2015) in Ethiopia stated that the mean fruit infestation in the untreated control plot ranged between 54 and 76 %, while in the plots treated with diamide insecticide (chlorantraniliprole) fruit infestation was significantly lower with 2–6 % fruit damage. Moreover, Passos *et al.* (2017) reported that chlorantraniliprole and teflubenzuron (an IGI as lufenuron) should be preferred insecticides for use in tomato leaf miner IPM programmes that aim to conserve the biological agent *M. basicornis* populations.

It could be also seen from the above cited results that the effect of chlorpyriphos and/or chlorantraniliprole alone was merely and efficiently equal to the tested mixture of chlorantraniliprole+ lufenuron. Therefore, the application of each alone (in rotation) within IPM programs would be useful and cheap than the use of the mixture of chlorantraniliprole+ lufenuron.

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الملخص العربي

المبيدات الحشرية وخلائطها لمكافحة التوتا أبسليوتا التي تصيب نباتات الطماطم تحت الظروف الحقلية المصرية

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أجريت التجارب الحقلية فى موسمين متتالين (٢٠١٦و٢٠١٧) بمنطقة الألف فدان، محافظة البحيرة، مصر لتقييم بعض المبيدات الحشرية الكيماوية وخلائطها ضد حشرة حافرة الطماطم التي تصيب نباتات الطماطم تحت الظروف الحقلية حيث تم تطبيق كل معاملة بمعدل ٣ رشات (بين كل رشة وأخرى ١٠ أيام). وقد تضمنت المعاملات المستخدمة أربعة مبيدات هي: كلورانترانيليبرول (كوراجين)، ثياميزوكسام (أكتارا)، ليفينيورون (ماتش)، كلوربيريفوس (دورسبان) وثُلاثة خلائط هي: (كلورانترانيليبرول+ ثياميزوكسام)،(كلورانترانيليبرول+ ليفينيورون) و(ثياميزوكسام+ ليفينيورون)، وتم تطبيق المبيدات الحشرية المنفردة بالجرعة الموصى بها من قبل وزارة الزراعة المصرية بينما تم تطبيق المخاليط بإستخدام نصف الجرعة من كل مبيد حشرى ضمن الخليط.

أوضحت النتائج خلال الموسم الأول ٢٠١٦ أن المعاملة بالمخلوط المكون من (كلورانترانيليبرول + ليفينيورون) أظهرت كفاءة عالية في خفض الإصابة والتي وصلت إلي ٥٨,٤٠% بالمقارنة بالمعاملات الأخري في الرشة الأولي. كما أظهرت النتائج أن المعاملة بمبيد كلوربيريفوس منفرداً كانت أكفأ المعاملات المختبرة وسجلت أعلي متوسط عام لخفض الإصابة الذي تم حسابه خلال تسعة أيام من الفحص حيث بلغ هذا المتوسط ٥٢,٤٠% يلية كلورانترانيليبرول منفرداً (٥٠,٥١%) وليفينيورون منفرداً (٤٨,٣٨%) بعد الرشة الثانية. أما بعد الرشة الثالثة والتي أُستعمل فيها خليط (كلورانترانيليبرول + ليفينيورون) أظهر هذا الخليط أيضاً كفاءة عالية محققاً الخفض الكامل لأعداد الحشرة في النباتات المعاملة وذلك بعد الرشة الثالثة.

وخلال الموسم الثاني ٢٠١٧ أظهر المخلوط المكون من (كلورانترانيليبرول + ليفينيورون) مرة أخري كفاءة عالية في خفض نسبة الإصابة التي قُدرت بـــ ٥٩,١٧ ، ٦٧,٥٩% و ١٠٠% فى الرشة الأولى والثانية والثالثة على الترتيب. ولهذا يمكن التوصية بإستخدام المخلوط المكون من (كلورانترانيليبرول + ليفينيورون) لمكافحة التوتا أبسيليوتا فى نباتات الطماطم النامية تحت الظروف الحقلية. كما ويمكن إستخدام مركب كلوربيريفوس (دروسبان) بمفرده في برنامج المكافحة المتكاملة لهذه الآفة الحشرية لتقليل تكاليف المكافحة وأيضاً لتأخير وإبطاء ظهور صفة مقاومة الحشرة ضد المركبات الأخري المستعملة في الخلائط.