Acaricidal Management of Abamectin Mixtures against All Stages 0f the Two-Spotted Spider Mite, *Tetranychus urticae* Koch, Infesting Cucumber Plants

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ABSTRACT

***Tetranychus urticae* is a worldwide common pest for many vegetable species in greenhouses and open fields. The study was conducted to evaluate the performance of two acaricide mixtures: Highpoint® 10% EC (abamectine + hexythiazox) and Ignar® 20% SC (abamectine + spirodiclofen), as well as a single active ingredient, Envidor® 24% SC (spirodiclofen), against the two-spotted spider mite in greenhouse and lab experiments.**

In the greenhouse experiment, both Ignar® and Highpoint® outperformed Envidor® acaricide against the adult and immature stages through the first 3 days in both experimental seasons. After 24 hours, Ignar® and Highpoint® achieved the highest efficacy with percent of reduction 95.00 and 94.86 in the 1st season and 97.84 and 95.76% in the 2nd season, respectively. Meanwhile, Envidor® gave lower reduction percentages of 84.93 and 83.88%, respectively. Regarding the immature stage, Ignar®, Highpoint®, and Envidor® achieved reductions of 95.63%, 94.26%, and 83.31% after 24 hours for the first season and 94.09, 95.79, and 80.57% in the second season, respectively. The residual efficacy gradually decreased to reach 62.22 and 59.72% for Ignar® and 58.31 and 59.31% for Highpoint® in both seasons.

On the other hand, the initial kill for all acaricides against the egg stage was low after 24 hours. However, after 3 days, Ignar® and Highpoint® showed a sharp increase in efficacy, with a reduction percent (81.24 and 51.60% in the 1st season) and (73.83 and 81.86% in the 2nd season), respectively. Envidor® showed high efficacy only at the 7th day, with varying efficacy during the inspection periods.

Laboratory bioassay tests revealed that Ignar® was the most toxic acaricide against *T. urticae* adults and immatures, with a 100% toxicity index. Highpoint® had a moderate toxicity index against adult and immature stages, while Envidor® was less effective. Ignar® and Highpoint® were the most toxic compounds against eggs.

Abamectin mixtures are the most toxic compounds. Highpoint® and Ignar®, were considered to have the best efficacy on all developmental stages of the two-spotted spider mite. Due to the extensive use of abamectin to eliminate mites and numerous sucking insects, it is better to avoid its repeated use alone or in the same mixtures to control mites for more than one or two applications in the season.

The data may suggest that the appropriate acaricide for integrated pest management (IPM) for all stages of *T. urticae* could be Ignar® and Highpoint®.

Keywords: *T. urticae*, acaricides, abamectin, mixtures, cucumber, Ignar®, Highpoint®, Envidor®

INTRODUCTION

Tetranychus urticae Koch, is known as a major crop pest that feeds on over 1000 plant species and has been found on every continent except Antarctica (Migeon *et al.*, 2018). This mite often causes economic damage to more than 150 species of host plants around the world (Ramasubramanian *et al.*, 2005 and Premalatha *et al.*, 2018).

In tropical and subtropical regions of the world, cucumber is a valuable vegetable crop, and it is ranked fourth among the most important vegetables after tomato, cabbage, and onion. According to the FAO report, 13,142,000 tons of cucumbers are produced worldwide annually (FAO, 2006 and Shams *et al.*, 2013). Egypt's production is coming from 12 places as 519,858 tons per year in global terms. Whereas Iraq's yearly production rate was 91,487 tons, ranking it 39th (Wikipedia, 2022). In recent years, at the local level, Egyptian production of cucumber was 409561 tons (Central Agency for Public Mobilization and Statistics, 2021). Comparable with Iraqi production for cucumbers was 242.6 tons in 2020 (Central Statistical Organization of Iraq, 2022).

Treatment with synthetic acaricides is essential for controlling *T. urticae*, which has swiftly developed resistance to the bulk of the acaricides that are now available for controlling it on the market (Rabea, 2009).

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Hence, resistant pests decrease agricultural production's yield, increasing the cost of controlling them, resulting in significant financial losses and threatening food security (Al Khoury *et al*., 2021 and Herron *et al.*, 2021).

Therefore, this study sheds light on the efficacy and toxicity of two different mixtures of abamectin to avoid and/or delay the development of resistance by mites toward abamectin.

MATERIALS AND METHODS

A. Tested acaricides

Two mixtures of acaricides and/or single active ingredients were tested to determine their performance in the lab and to evaluate their residual efficacy in the greenhouse against different stages of *T. urticae* on cucumber plants:

- In the laboratory: nine concentrations were made in the following ranges: Highpoint® and Envidor® from 0.25 ppm to 64 ppm and Ignar® from 0.05 ppm to 12.8 ppm to determine their LC_{50} values.
- Greenhouse: used three acaricides at the recommended dosage.

- Highpoint® 10% EC (abamectine 1% +hexythiazox 9%) from Shoura Chemicals Co., Egypt, rate of application 25 cc/100 Liter water.
- Ignar® 20% SC (abamectine 2% + spirodiclofen 18%) from Shoura Chemicals Co., Egypt, too, rate of application 20 cc/100 Liter water.
- Envidor® 24% SC (spirodiclofen) from Bayer Crop Science, rate of application 40 cc/100 Liter water.

Figure 1 Showed the chemical structure of acaricides active ingredient

B. Mite source and rearing:

The *T. urticae* adult females were collected from infested cucumber plants in Alexandria, Egypt. The culture of spider mites was placed in the greenhouse and was used in this study after they were left to lay eggs. They were reared on the leaves of *Phaseoulus vulgaris* L. plants growing in the greenhouse at the Faculty of Agriculture, Saba Basha, Alexandria University, for more than 18 months to obtain a sensitive strain to bioassay the toxicity of the three tested acaricides and to estimate their LC_{50} values.

C. Experimental Greenhouse:

The greenhouse experiment was conducted to determine the residual efficacy of the tested acaricides 15 days post-treatment. The experiment was performed at the Experimental Farm of Fac. of Agric. Saba Basha Alex Univ., Egypt, during two sequential seasons of 2021–2022 and 2022–2023 under greenhouse conditions. Cucumber Victor hybrid seeds were sown in the first week of October in the nursery, and then seedlings were planted in the greenhouse after the third week of October. Each acaricide was applied as a single treatment versus untreated control check.

Each treatment was replicated three times (four or five plants in a 2 m^2 plot). Normal agricultural practices were followed except for keeping the whole area free from other pesticides. After the plants reached an appropriate size (1.5 meters in height), 20 individuals were infested with each plant. Sampling started after about two weeks of mite infestation and continued after 24 hours, 72 hours, 5 days, 7 days, and 15 days. Samples of 27 leaves were randomly selected for each treatment from three different height levels of the plant (top, middle, and bottom).

D. Leaf-dip bioassay for determination of the acaricidal activity:

The toxicity of the tested acaricides was determined by the leaf-dip bioassay method against adult, immature, and egg stages of *T. urticae* at the laboratory of the Plant Protection Department of Fac. Agric. Saba Basha Alex Univ., Egypt. These tests were conducted using the approach summarized by Knight *et al*. (1990) and İnak *et al*. (2022).

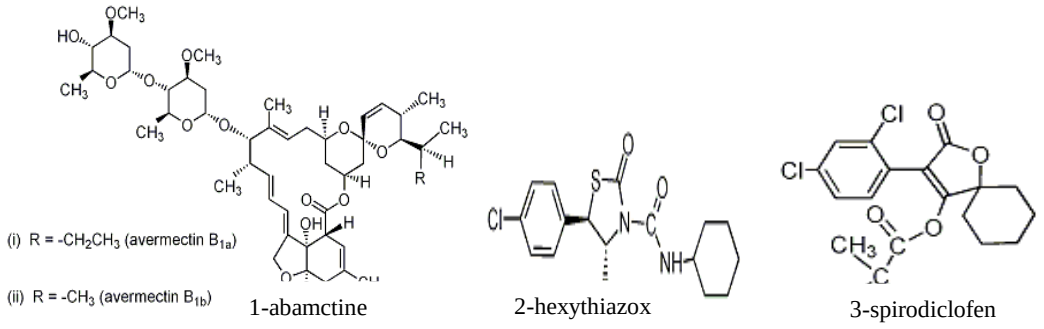

Figure 1. illustration of chemical structures of acaricides

1. *T. urticae* adults and immatures: -

The toxicity of the acaricides against the adults of *T. urticae* was evaluated using a leaf-dipping bioassay method. Cucumber leaf disc arenas (2 cm in diameter) were dipped in different prepared aqueous acaricide dilutions and transferred above a piece of moist cotton placed in Petri dishes after drying. Ten adults were transferred onto a leaf disc, bottom side up. Five replicates for each treatment, including the untreated check, were used. The number of surviving mites was recorded after 1, 2, and 3 days post-treatment.

2. *T. urticae* eggs: -

After being washed and dried and then sliced into 2-centimeter-diameter discs. The lower surfaces of cucumber leaf discs were facing upward and positioned above a piece of damp cotton placed in Petri dishes to maintain their freshness. Ten *T. urticae* eggs were placed on each of these discs. Various acaricide concentrations were sprayed with a manual sprayer at a rate of 1 ml per disc (for five duplicates of each concentration). The untreated check treatment was treated with distilled water alone. The number of hatched eggs was counted four days after the treatment.

Data analysis

The obtained data in each experiment were analyzed using analysis of variance (ANOVA) and the L.S.D test by CoStat Version 6.45, Statistics Software (Sawyer, 2009). Data in the form of percentages were transformed to arcsine values for the ANOVA. The LC_{50} values were estimated by the Ldp Line 1.0 software programme. The Toxicity Index was estimated for each bioassay period by the following equation:

Toxicity Index = LC_{50} of the most effective compound/LC_{50} of the other tested compound × 100.

RESULTS

Residual efficacy of the acaricides against *T. urticae* stages under greenhouse conditions:

The obtained results for the greenhouse experiment showed a significant difference in the residual efficacy of the tested acaricides against the different stages of the two-spotted spider mite, *T. urticae* Koch.

The adult stage

The results in Table (1) show that Ignar® and Highpoint® acaricides, (abamectine with spirodiclofen or hexythiazox), were most effective in reducing adults than Envidor® (spirodiclofen) after 24 and 72 hours.

After 24 hours, Ignar® and Highpoint® achieved the highest efficacy on the adult stage with percent of reduction amounted to 95.00 and 94.86 in the 1st season and 97.84 and 95.76% in the 2nd season, respectively. Meanwhile, Envidor® gave lower reduction percent of 84.93 and 83.88% in the first and second seasons, respectively.

It was obvious that the residual efficacy of both Ignar® and Highpoint® decreased gradually until 15 days post-treatment, recording reductions of 53.79 and 56.25% in the 1st season and 53.93 and 53.62% in the 2nd season, respectively. However, Envidor® showed a little gradual decrease in the reduction percent of adults, ranging from 84.93% after 24 hours to 67.18% after 15 days in the first season and 83.88%, and 61.70% in the second season, respectively.

Table 1. Reduction percent for *T. urticae* adults during 15 days post-treatment in a greenhouse of cucumber plants.

Treatment	The 1st season 2021				
	24 h.	72 h.	5 d.	7 d.	15 d.
Ignar® (Abamectine 2% + Spirodiclofen 18%)	95.00 %	86.17 %	72.01 %	61.71 %	53.79 %
Highpoint® (Abamectine + Hexythiazox)	94.68 %	88.16 %	68.31 %	62.93 %	56.25 %
Envidor® (Spirodiclofen)	84.93 %	77.58 %	74.96 %	73.64 %	67.18 %
	The 2nd season 2022				
Ignar® (Abamectine 2% + Spirodiclofen 18%)	95.76 %	87.05 %	69.44 %	61.45 %	53.93 %
Highpoint® (Abamectine + Hexythiazox)	97.84 %	87.77 %	61.63 %	59.84 %	53.62 %
Envidor® (Spirodiclofen)	83.88 %	75.53%	71.00 %	70.21 %	61.70 %

Both Ignar® and Highpoint® outperformed Envidor® acaricide through the first 3 days, but their residual efficacy became close in the following 5, 7, and 15 days after treatment in both experimental seasons. The finding agrees with Nadimi *et al*. (2008), who used 25%, 50%, and 100% of the advised dosage of abamectin in the field to control *T. urticae* and discovered that all these levels were successful. However, all other treatments had a convergent impact from the first day till the end of the test, according to the time of degradation (PHI).

Many studies showed that chloride channel activators affect the body's lipid biosynthesis inhibitor with a neuromuscular stimulant, and several researchers have examined the effect of acaricides (particularly abamectin, spirodiclofen, and hexythiazox) on *T. urticae* at various stages of its life cycle and throughout its reproductive process (Wael & Mohamed, 2019 and Schmidt-Jeffris *et al*., 2021). The results were consistent with the results of Sahoo *et al.* (2003), who found that abamectin was the most harmful to the adult *T. urticae* population infesting tea. This could be due to the presence of the fast-acting compounds abamectin and hexythiazox, a substance with a high PHI of up to 15 days, according to Deskeyser (2005).

A. The immature stage

In respect to the immature stage, the results did not differ significantly compared with their effect on adults. The results showed a reduction of 95.63%, 94.26%, and 83.31% after 24 hours for Ignar®, Highpoint®, and Envidor® in the first season, and 94.09, 95.79, and 80.57% in the second season, respectively. The residual efficacy gradually decreased to reach 62.22 and 59.72% for Ignar® and 58.31 and 59.31% for Highpoint® in both seasons, respectively. Meanwhile, the reduction percent for Envidor® was slightly higher at 69.81% and 70.17% after 15 days. In both seasons, respectively.

Both Ignar® and Highpoint® outperformed Envidor® acaricide through the first 3 days, and their residual efficacy decreased gradually until it became less at the following inspection periods 7, and 15 days after treatment in both experimental seasons (Table 2).

Mixtures of abamectin with spirodiclofen or with hexythiazox were more harmful to the *T. urticae* mite, according to the population growth rate, and spirodiclofen alone was the least active. The low performance of this compound is definitely related to its mode of action in the stages of *T. urticae* in the acaricides, as indicated by some recent studies (Dekeyser, 2005; Taha, 2017; Herron *et al*., 2021 and Koo *et al*., 2021).

B. The egg stage

Results in Table (3) show the residual effect of the experimented acaricides on the eggs of *T. urticae* throughout the five inspection periods after treatment. The initial kill of the three acaricides was very low after 24 hours. Ignar® was the least effective acaricide giving reduction of 12.15 and 1.79% versus 33.68 and 26.17 for Highpoint® and 29.67 and 23.42% for Envidor® in both seasons, respectively.

Table 2. Reduction percent for *T. urticae* immatures during 15 days post-treatment in a greenhouse of cucumber plants.

Treatment	The 1st season 2021				
	24 h.	72 h.	5 d.	7 d.	15 d.
Ignar® (Abamectine 2% + Spirodiclofen 18%)	95.63 %	88.34 %	72.16 %	66.07 %	62.22 %
Highpoint® (Abamectine + Hexythiazox)	94.26 %	85.94 %	68.36 %	62.29 %	58.31 %
Envidor® (Spirodiclofen)	83.31 %	75.21 %	70.27 %	69.67 %	69.81 %
	The 2nd season 2022				
Ignar® (Abamectine 2% + Spirodiclofen 18%)	94.09 %	87.18 %	70.62 %	68.87 %	59.72 %
Highpoint® (Abamectine + Hexythiazox)	95.79 %	88.54 %	73.08 %	66.15 %	59.31 %
Envidor® (Spirodiclofen)	80.57 %	76.94 %	72.27 %	70.08 %	70.17 %

Table 3. Reduction percent for *T. urticae* eggs during 15 days post-treatment in a greenhouse of cucumber plants.

Treatment	The 1st season 2021				
	24 h.	72 h.	5 d.	7 d.	15 d.
Ignar® (Abamectine 2% + Spirodiclofen 18%)	12.15 %	81.24 %	80.05 %	89.89 %	80.36 %
Highpoint® (Abamectine + Hexythiazox)	33.68 %	51.60 %	79.10 %	76.01 %	79.42 %
Envidor® (Spirodiclofen)	29.67 %	44.68 %	41.17 %	85.62 %	42.07 %
	The 2nd season 2022				
Ignar® (Abamectine 2% + Spirodiclofen 18%)	1.79 %	73.83 %	79.14 %	89.34 %	76.14 %
Highpoint® (Abamectine + Hexythiazox)	26.17 %	81.86 %	79.78 %	84.51 %	83.46 %
Envidor® (Spirodiclofen)	23.42 %	77.87 %	42.84 %	86.66 %	79.82 %

However, a sharp increase in the efficacy of both Ignar® and Highpoint® occurred after 3 days, showing reduction percentages of 81.24 and 51.60% in the 1st season, and 73.83 and 81.86% in the 2nd season, respectively. The residual efficacy of either Ignar® or Highpoint® continued high up to 15 days after the treatment, showing reductions of 80.36 or 79.42% and 76.14 or 83.46% in both successive seasons, respectively. On the other hand, a fluctuating efficacy of Envidor® was cleared through the inspection periods, indicating its high efficacy at the 7th day, giving 85.62 and 86.66% reduction in both seasons, respectively (Table 3).

Hexythiazox, which has a different mechanism of action from spirodiclofen, demonstrates substantial activity on eggs and has a progressive impact on spider mite immature stages over time, although its effect on adults is lower and there is a noticeable decrease in fecundity and fertility (Dekeyser, 2005; Bretschneider *et al*., 2007 and Wu *et al*., 2019). However, spirodclofene was effective against the adults and larvae but not effective against the egg stage of *T. urticae* (Ochiai *et al*., 2007). It is interesting to note that *T. urticae* becomes resistant to abamectin as a result of repeated treatment because of the acaricide's positive cross-resistance (Nicastro *et al*., 2010).

Toxicity index for the tested acaricides on *T. urticae* developmental stages:

A. The adult stage

In laboratory bioassay tests, Ignar® exhibited the most remarkable toxicity against the adult stage. Where the LC_{50} (mg/L) values were 1.99, 0.79, and 0.29, followed by Highpoint® with values of 2.27, 1.62, and 1.22, while Envidor® was less effective against adults of *T. urticae* with values of 17.21, 9.82, and 5.14 after 24 hours, 48 hours, and 72 hours, respectively (Table 4).

Estimating the toxicity index (Table 4) shows that Ignar® proved to be the most toxic, having the highest toxicity index of 100.00% over the three bioassay periods (24, 48, and 72 hrs.). Meanwhile, Highpoint® showed moderate toxicity indexes of 87.67, 48.77, and 23.77%, respectively. Envidor® was the least toxic acaricide along the bioassay periods, giving 11.56, 8.04, and 5.64% toxicity indexes, respectively. It is noticeable that the toxicity indices of Highpoint® and Envidor® decreased with increasing bioassay periods, compared to Ignar®, which was the most effective acaricide towards the adult stage. Similarly, many studies, such as Weidong (2002), investigated the toxicity of several pesticides and discovered that the LC_{50} values of abamectin on the eggs and adults of *T. urticae* ranged between 0.122 and 7.656 mg/L. Abamectin has been demonstrated to be more effective than other chemicals at reducing mite populations at all doses. This might be due to the GABA-agonist mode of action and the translaminar efficacy, which provide long-lasting benefits against feeding mites.

B. The immature stage

Data in Table (5) show that Ignar® was the most toxic acaricide against the immature stage, revealing LC_{50} values of 1.14, 0.57, and 0.22 with an estimated toxicity index of 100.00 through bioassay periods of 24, 48, and 72 hrs., respectively. On the other hand, Highpoint® gave high LC_{50} values of 4.21, 2.72, and 1.51 mg/L, indicating descending lower toxicity indexes of 27.08, 20.96, and 14.57% at 24, 48, and 72 hrs., respectively.

Table 4. The LC_{50} values and toxicity index for the tested compounds against the adults *Tetranychus urticae*.

Acaricide	Time	[a]LC50 (mg/L)	Confidence limits (95% CL)	Slope ± SE	H[b]	X^{2c}	G	[d]Toxicity index %
Ignar® (Abamectine 2% + Spirodiclofen 18%)	24 h.	1.99	1.61 - 2.50	1.04 ± 0.07	0.32	0.95	0.02	100.00
	48 h.	0.79	0.65- 0.97	1.04 ± 0.07	0.57	3.98	0.02	100.00
	72 h.	0.29	0.23 - 0.36	1.05 ± 0.07	1.29	9.03	0.02	100.00
Highpoint® (Abamectine + Hexythiazox)	24 h.	2.27	1.89 - 2.73	1.23 ± 0.08	0.64	3.87	0.02	87.67
	48 h.	1.62	1.32 - 1.97	1.18 ± 0.08	0.54	3.23	0.02	48.77
	72 h.	1.22	1.01 - 1.45	1.37 ± 0.10	0.62	3.10	0.02	23.77
Envidor® (Spirodiclofen)	24 h.	17.21	14.29 - 20.95	1.20 ± 0.07	0.21	1.46	0.01	11.56
	48 h.	9.82	8.01 - 12.08	1.04 ± 0.07	0.73	5.09	0.02	8.04
	72 h.	5.14	4.16 - 6.31	1.05 ± 0.07	0.60	4.19	0.02	5.64

[a] LC50 = Lethal concentration, 50%. The concentration value for acaricide that is required to kill 50% of the members of tested eggs after specified test duration.

[b]H= Heterogenctiy.

[c] $\mathbf{X^2}$= Chi-square goodness of fit test.

[d]Toxicity Index = LC_{50} for the most effective compound/LC_{50} and the other tested compound × 100, for each bioassay period.

Table 5. The LC_{50} values for the tested acaricides against the immature individuals of *Tetranychus urticae*.

Acaricide	Time	LC50 (mg/L)	Confidence limits (95% CL)	Slope ± SE	H	X^2	G	*Toxicity index %
Ignar® (Abamectine 2% + Spirodiclofen 18%)	24 h.	1.14	0.92 - 1.44	0.95 ± 0.06	0.21	1.45	0.02	100.00
	48 h.	0.57	0.46 - 0.70	1.03 ± 0.07	0.41	2.86	0.02	100.00
	72 h.	0.22	0.17 - 0.27	1.02 ± 0.07	0.55	3.88	0.02	100.00
Highpoint® (Abamectine + Hexythiazox)	24 h.	4.21	3.48 - 5.14	1.18 ± 0.08	1.40	8.37	0.02	27.08
	48 h.	2.72	1.75 - 4.23	1.09 ± 0.08	2.81	16.88	0.08	20.96
	72 h.	1.51	0.94 - 2.26	1.18 ± 0.08	3.11	18.68	0.08	14.57
Envidor® (Spirodiclofen)	24 h.	21.29	17.69 - 25.97	1.24 ± 0.08	0.37	2.59	0.01	5.53
	48 h.	13.18	10.81 - 16.22	1.08 ± 0.07	0.13	0.91	0.02	4.32
	72 h.	6.40	5.17 - 7.95	1.03 ± 0.08	0.63	3.79	0.02	3.44

*Toxicity Index = LC_{50} for the most effective compound/LC_{50} of the other tested compound × 100, for each bioassay period.

Envidor® was the least toxic. compound exhibiting highest LC_{50} values of 21.29, 13.18, and 6.40 mg/L, which represented the least toxicity index of 5.53, 4.32, and 3.44% compared with Ignar® at the same bioassay periods. These results are in line with Alzoubi and Çobanoğlu (2008) and Taha (2017).

C. The eggs stage:

The illustrated results in Table (6) showed the toxic efficacy of the tested acaricides against the egg stage. The results explained that abamectin mixtures in Ignar® and Highpoint® were the most toxic compounds after four days post-treatment. The values of LC_{50} (mg/L) were 1.99 for Ignar®, followed by 2.49 for Highpoint®, representing a toxicity index of 100.00 and 97.29%, respectively. While that LC_{50} was 22.80 for Envidor®, revealing the lowest toxicity index of 8.73%. It is worth mentioning that Ignar® 20% SC (mixture of abamectin 2% + spirodiclofen 18%) and Highpoint® 10% EC (mixture of abamectine 1% + hexythiazox 9%) may be more toxic owing to the compatible effect of their active ingredients and/or their formulation types (Table 6).

In this context, Kumari *et al*. (2017) observed that by applying the spray technique at the suggested concentration, there was a significant difference between hexythiazox and other acaricides against eggs of *T. urticae*.

Table 6. The LC_{50} values for various acaricides against *Tetranychus urticae* eggs.

Time	96 Hours						
Acaricide	**LC_{50} (mg/L)**	**Confidence limits (95% CL)**	**Slope ± SE**	**X^2**	**H**	**P***	****Toxicity index%**
(Ignar)® (Abamectine 2% + Spirodiclofen 18%)	1.99	1.60 – 2.51	1.01 ± 0.07	1.71	0.24	0.97	100.00
(Highpoint)® (Abamectine1% + Hexythiazox9%)	2.49	1.63 – 3.93	1.27 ± 0.09	14.43	2.89	0.01	97.29
(Envidor)® (Spirodiclofen)	22.80	18.70 – 28.29	1.15 ± 0.08	0.78	0.13	0.10	8.73

* P = Probability.

**Toxicity Index = LC_{50} for the most effective compound/LC_{50} of the other tested compound ×100, after a bioassay period of 96 hrs.

Additionally, there are contradictory reports about the ovicidal activity of abamectin. Whereas, Salman (2007) and Taha (2017) reported that abamectin was very harmful to eggs of all ages but had no effect on mite fertility, (Kumar and Singh, 2004) indicated that it did not damage *T. urticae* eggs in a broad spectrum of doses.

CONCLUSION

According to the results, these admixed compounds can be included in an integrated control program for *T. urticae* on cucumber crops in greenhouses and/or used interchangeably with acaricides that have a longer PHI period to avoid resistance to abamectin compounds, which are widely and frequently used during this period in most fields.

Therefore, we can say that amongst the suitable acaricides for integrated pest management (IPM) for *T. urticae* are Ignar® and Highpoint®.

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الملخص العربي

إدارة التأثير الإبادي لخلائط الأبامكتين ضد جميع أطوار العنكبوت الأحمر ذي البقعتين *Tetranychus urticae* ، الذي يصيب الخيار

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أجريت الدراسة لتقييم أداء خليطين من المبيدات الأكاروسية: هاي بوينت 10% EC (أبامكتين ١%+ هكسيثيازوكس ٩%) وأجنر 20٪ SC (أبامكتين ٢%+ سبيروديكلوفين ١٨%)، بالإضافة إلى انفيدور 24 SC ٪ (سبيروديكلوفين)، ضد العنكبوت الأحمر ذي البقعتين *Tetranychus urticae* تحت ظروف الزراعة في الصوبة الزراعية أو التقدير الحيوي في المعمل.

في تجربة الصوبة الزراعية، تفوق كل من مبيدات أجنر وهاي بوينت على المبيد انفيدور ضد البالغات والمراحل غير الناضجة خلال الأيام الثلاثة الأولى في كلا الموسمين التجريبيين. بعد ٢٤ ساعة، حقق أجنر وهاي بوينت أعلى فعالية مع نسب خفض ٩٥,٠٠ و٩٤,٨٦ في الموسم الأول و٩٧,٨٤ و٩٥,٧٦٪ في الموسم الثاني على التوالي. وفي الوقت نفسه، أعطى انفيدور نسب خفض أقل بلغت ٨٤,٩٣ و٨٣,٨٨٪ على التوالي. فيما يتعلق بالأطوار غير الناضجة، حقق مبيد أجنر وهاي بوينت وانفيدور انخفاضًا بنسبة ٩٥,٦٣٪ و٩٤,٢٦٪ و٨٣,٣١٪ بعد ٢٤ ساعة للموسم الأول و٩٤,٠٩ و٩٥,٧٩ و٨٠,٥٧٪ في الموسم الثاني على التوالي.

انخفضت الفعالية المتبقية تدريجيًا لتصل إلى ٦٢,٢٢ و٥٩,٧٢٪ لـ أجنر و٥٨,٣١ و٥٩,٣١٪ لـ هاي بوينت في كلا الموسمين. من ناحية أخرى، كان القتل الأولي لجميع المبيدات الحشرية ضد طور البيض منخفضًا بعد ٢٤ ساعة. ومع ذلك، بعد ٣ أيام، أظهر أجنر وهاي بوينت زيادة كبيرة في الفعالية، مع نسبة انخفاض (٨١,٢٤ و٥١,٦٠٪ في الموسم الأول) و(٧٣,٨٣ و٨١,٨٦٪ في الموسم الثاني)، على التوالي. أظهر مبيد انفيدور فعالية عالية فقط في اليوم السابع، مع فعالية متفاوتة خلال فترات الفحص.

كشفت الاختبارات الحيوية المعملية أن مبيد أجنر كان أكثر المبيدات الأكاروسية سمية ضد الحشرات البالغة والمراحل غير الناضجة بمؤشر سمية ١٠٠٪. أظهر مبيد هاي بوينت مؤشر سمية معتدل ضد البالغين والمراحل غير الناضجة، بينما كان مبيد انفيدور أقل فعالية. في حين كان أجنر وهاي بوينت أكثر المركبات سمية ضد البيض، وأظهرت النتائج أن مخاليط الأبامكتين هي أكثر المركبات سمية. تم اعتبار هاي بوينت وأجنر على أنهما أفضل من حيث الفاعلية ضد جميع مراحل العنكبوت الأحمر ذي البقعتين. بسبب الاستخدام المكثف للأبامكتين للقضاء على الأكاروسات والعديد من الحشرات الثاقبة الماصة، فمن الأفضل تجنب استخدامه المتكرر بمفرده أو في خلطات للسيطرة على *T. urticae* لأكثر من تطبيق أو تطبيقين في الموسم. تشير البيانات هذه إلى أن المبيدات الحشرية المناسبة للإدارة المتكاملة للآفات (IPM) لجميع مراحل *T. urticae* يمكن أن تكون أجنر وهاي بوينت.