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(Original Article)

Toxicological Evaluation of Certain Pesticides on the two-Spotted Spider Mite, *Tetranychus urticae* Koch (Acari: Tetranychidae) on Cucumber Plants Under Field Conditions

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Abstract

The two-spotted spider mite, *T. urticae*, is a significant global agricultural pest. It has become highly resistant to numerous pesticides and is incredibly polyphagous. Herein, five pesticides were tested for their ability to control *T. urticae*: sulfoxaflor + spinetoram, emamectin benzoate, thiamethoxam, spirodiclofen, and etoxazole in the Manfalout and Qusia districts in Assiut Governorate, Egypt during the 2021 and 2022 seasons. The results revealed that all pesticides were effective on *T. urticae* based on the mean reduction percentage (the ranges were 62.75%-68.00%) during the 2021 season on cucumber plants in Manflout district. Further, the most potent pesticides in Qusia district were thiamethoxam, spirodiclofen, and emamectin benzoate and the mean reduction percentage were 63.39%, 58.31%, and 56.75%, respectively during the 2021 season. In 2022 season, the most toxic pesticides were thiamethoxam, etoxazole, and emamectin benzoate in Manflout district whereas, in Qusia district, the most powerful pesticides were spirodiclofen, etoxazole, and emamectin benzoate and the mean reduction percentage were 60.00%, 57.67%, and 56.75%, respectively. The tested pesticides are an effective tool that can be used in integrated pest management (IPM) programs against *T. urticae* on cucumber.

Keyword: *Etoxazole، Emamectin benzoate. Field evaluation، Spirodiclofen، Tetranychus urticae*

Introduction

Polyphagous pests like the two-spotted spider, *T. urticae*, is considered seriously harm crops both in Egypt and worldwide (Abdel-Hamid and AbdAllah, 2022; Zhang *et al*., 2022). Its host range includes more than 1100 plant species from 140 economically significant families (Dermauw *et al*. 2013; Wang *et al*., 2023). Both adult and immature stages of these mites can feed on plants, causing mesenchymal collapse, defoliation, and bronzing of the leaves (İnak *et al*., 2019). Further, severe infection can also result in plant damage (Havasi *et al*., 2022; Nezhadakbarimahani *et al*., 2023). Farmers typically utilize conventional synthetic pesticides due to their quick-acting properties to manage the pest (Kumari *et al*.,

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2017). Furthermore, pesticide resistance frequently appears within two to three years of high reproductive capacity, haploid sex determination, fast growth rate, short generation time, and frequent usage of both acaricides and pesticides (İnak *et al*., 2022).

Unfortunately, inadequate and improper application of pesticides can kill beneficial insects, increase the rate at which some pests reproduce, cause pesticide resistance, jeopardize human health, and eventually pollute the environment (Mavridis *et al*., 2022).

In this regard, the efficacy of five pesticides i.e., sulfoxaflor+spinetoram, emamectin benzoate, thiamethoxam, spirodiclofen, and etoxazole, in controlling *T. urticae* was evaluated in Manfalout and Qusia districts, Assiut Governorate during the two successful seasons of 2021 and 2022.

Materials and Methods

Experimental outlay and field activities

The study was executed at Manfalout and Qusia districts (north of Assiut city), during two successive seasons of 2021 and 2022 in Assiut Governorate to study the chemical control of the two-spotted spider mite, *T. urticae* inhabiting cucumber plants (variety of Barcoda) which cultivated at first half of February as spring season. Surface irrigation, fertilization and other practices were performed whenever it was necessary according to recommendations of the Ministry of Agriculture, Egypt in the commercial production of cucumber.

The experimental design was completely randomized design with 4 replicates for each treatment (6 treatments included 5 pesticides + control) and each replicate consisted of 3 rows, each row was 3.5 m long and 1 m wide. The distance between plants was 30 cm with a total area of 10.5 m^2/plot.

Tested pesticides

The tested pesticides were obtained from central pesticides laboratory (CPL) in Dokki, Giza, Egypt (Table 1).

Table 1. The used pesticides and their rates of applications were as follows

Trade Names and Formulations	Active ingredient	Rate of application / Fedd.
XXpire 40% WG	Sulfoxaflor+Spinetoram	120 g
Speedo 5.7% WG	Emamectin benzoate	80 g
Actara 25% WG	Thiamethoxam	80 g
Concor 24% SC	Spirodiclofen	30 cm^3
Baroque 20% SC	Etoxazole	15 cm^3

Full coverage of the cucumber plants was secured using a knapsack sprayer fitted with one nozzle. The four replicates of the check treatment were sprayed with water only.

Sampling and counting

A sample of 10 leaves/plot was taken before executing spray program. Samples were taken early morning after 1, 3, 7, and 15 days and kept in

polyethylene bags until they were thoroughly investigated in the laboratory. Counts of the alive individuals of the two-spotted spider mite, *T. urticae* (nymph and adult) were made under stereomicroscopic microscopic of 40-100 magnification force. Samples were continually taken till the end of the season. The average numbers of alive of the two-spotted spider mite individuals/plant were used as a criterion to evaluate the effectiveness of the tested insecticides after the four abovementioned periods, comparing with the check treatment. The reduction percentages of the *T. urticae* individuals on the cucumber plants were calculated using Henderson and Tilton's formula (1955) as follow:

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

Where:

Cb = Average numbers of alive of the two-spotted spider mite in control before spray.

Ta= Average numbers of alive of the two-spotted spider mite in treatment plots after spray.

Tb= average numbers of alive of the two-spotted spider mite in treatment plots before spray.

Ca= A verage numbers of alive of the two-spotted spider mite in control after spray.

Statistical analysis

Data obtained were statistically analyzed using a completely randomized design with four replications. Means were compared according to Duncan's Multiple Range test.

Results and Discussions

The effect of five pesticides (sulfoxaflor+ spinetoram, emamectin benzoate, thiamethoxam, spirodiclofen, and etoxazole) against *T. urticae* were evaluated. Reductions in percentages of numbers of *T. urticae* due to the application of tested pesticides in Manfalout district during season 2021 are shown in Table 2. In general, all selected pesticides were remarkably efficient based on the mean reduction percentage of 1, 3, 7, and 14 days after treatment in Manfalout district during 2021 season as followed: etoxazole (68.00%), spirodiclofen (66.38%), thiamethoxam (66.00%), emamectin benzoate (63.56%), and sulfoxaflor+spinetoram (62.75%).

The findings showed that, when applied to cucumber plants in the Manflout district during the 2021 season, all pesticides were effective against *T. urticae*, with mean reduction percentages ranging from 62.75% to 68.00%.

However, the obtained results indicated that etoxazole pesticide was the most effective one in reducing the number of the pest followed by thiamethoxam, spirodiclofen, emamectin benzoate, and sulfoxaflor+spinetoram, exhibiting 34.50, 32.75, 31.00, 29.75, and 22.75% reduction at first spray during the 2021 season on cucumber plants in Manflout district, respectively.

However, after 3 days of treatment, the etoxazole was the most potent

pesticides followed by spirodiclofen, thiamethoxam, emamectin benzoate, and sulfoxaflor + spinetoram and the reduction percentages were 63.50, 60.25, 57.00, 57.00, and 57.00%, respectively. Further, the order of the most toxic pesticide was changed after 7 days of treatment and thiamethoxam was the most toxic pesticides followed by etoxazole, spirodiclofen, sulfoxaflor+spinetoram, and emamectin benzoate and the reduction % was 84.75, 81.50, 81.25, 78.75, and 76.50%, respectively. Furthermore, after 14 days of treatment, spirodiclofen was the most potent pesticide followed by etoxazole, sulfoxaflor+spinetoram, emamectin benzoate, and thiamethoxam and the reduction percentages were 93.00, 92.50, 92.50, 91.00, and 89.50%, respectively.

Data in Table 3 illustrated the decrease in percentages of *T. urticae* infestation percentages that resulted from the use of pesticides, the effect of which appeared in the Qusia district during the 2021 season. Based on the mean reduction percentages of 1, 3, 7, and 14 days of treatment in the Qusia district during the 2021 season. All of the selected pesticides were significantly more effective than the control group. These pesticides were: thiamethoxam (63.38%), spirodiclofen (58.31%), emamectin benzoate (56.75%), sulfoxaflor+spinetoram (55.31%) and etoxazole (52.94%).

However, thiamethoxam, spirodiclofen, and emamectin benzoate were the most effective insecticides in Qusia district during the 2021 season, with mean reduction percentages of 63.39%, 58.31%, and 56.75%, respectively.

Further, the results showed that the pesticide thiamethoxam was the most successful in reducing the infestation (43.00% reduction) with the following pesticides showing the greatest reductions at the first spray during the 2021 season on cucumber plants in the Qusia district: emamectin benzoate, spirodiclofen, etoxazole, and sulfoxaflor+spinetoram, with the reduction percentages of 38.75, 31.25, 30.00, and 23.50%, respectively. After three days of treatment, however, thiamethoxam was continued the most effective one (66.75% reduction) followed by emamectin benzoate, spirodiclofen, etoxazole, and sulfoxaflor+spinetoram with reduction percentages of 55.25, 55.00, 52.00, and 52.00%, respectively. After 7 days of treatment, the most hazardous pesticides were still the same, thiamethoxam was still the most potent one (72.25% reduction) followed by spirodiclofen, emamectin benzoate, sulfoxaflor+spinetoram, and etoxazole and the corresponding reduction percentages were 68.75, 66.25, 66.00, and 64.50%, respectively. Moreover, sulfoxaflor+spinetoram was the most effective pesticide after a 14-day of treatment (79.75% reduction); the reduction percentages were 78.25, 71.50, 66.75, and 65.25%, respectively for etoxazole, sulfoxaflor+spinetoram, emamectin benzoate, and thiamethoxam.

Table 2. Reduction percentages of *T. urticae* on cucumber plants through four periods (days) by using different pesticides in Manfalout district, Assiut Governorate, during season 2021

Pesticides	Periods (days)				Mean ± SD [2]
	1	3	7	14	
Sulfoxaflor+spinetoram 40% WG	22.75±12.95 d [1]	57.00±8.72 c	78.75±6.65 ab	92.50±3.87 a	62.75±28.29 ***A***
Emamectin benzoate 5.7% WG	29.75±6.29 d	57.00±7.87 c	76.50±6.14 b	91.00±4.00 a	63.56±24.35 ***A***
Thiamethoxam 25% WG	32.75±13.07 d	57.00±14.88 c	84.75±10.60 ab	89.50±7.33 ab	66.00±25.87 ***A***
Spirodiclofen 24% SC	31.00±3.56 d	60.25±5.97 c	81.25±10.21 ab	93.00±4.32 a	66.38±25.02 ***A***
Etoxazole 20% SC	34.50±11.85 d	63.50±7.37 c	81.50±9.04 ab	92.50±7.05 a	68.00±24.05 ***A***
Mean of period ±SD [3]	30.15±10.05 **D**	58.95±8.84 **C**	80.55±8.26 **B**	91.70±5.09 **A**	

[1] Means followed by the same small letter (s) do not significantly different at 0.05 level of probability.
[2] Means followed by the same italic capital letter, within the same column, do not significantly different at 0.05 level of probability.
[3] Means followed by the same capital letter, within the same row, do not significantly different at 0.05 level of probability.

Table 3. Reduction percentages of *T. urticae* on cucumber plants through four periods (days) by using different pesticides in Qusia district, Assiut Governorate, during season 2021

Pesticides	Periods (days)				Mean ± SD [2]
	1	3	7	14	
Sulfoxaflor+Spinetora m 40% WG	23.50±4.66 f [1]	52.00±10.42 cd	66.00±10.95 abc	79.75±7.50 a	55.31±22.89***AB***
Emamectin benzoate 5.7% WG	38.75±7.63 def	55.25±9.22 bcd	66.25±14.25 abc	66.75±14.32 abc	56.75±15.75***AB***
Thiamethoxam 25% WG	43.00±16.31 de	66.75±4.50 abc	72.25±5.68 ab	71.50±3.32 ab	63.385±14.77***A***
Spirodiclofen 24% SC	31.25±9.71 ef	55.00±10.67 bcd	68.75±8.34 abc	78.25±4.43 a	58.31±19.82***AB***
Etoxazole 20% SC	30.00±7.35 ef	52.00±8.76 cd	64.50±14.80 abc	65.25±20.12 abc	52.94±19.17***B***
Mean of period ±SD [3]	33.30±11.29 **C**	56.20±9.758 **B**	67.55±10.460 **A**	72.30±12.092 **A**	

[1] Means followed by the same small letter (s) do not significantly different at 0.05 level of probability.
[2] Means followed by the same italic capital letter, within the same column, do not significantly different at 0.05 level of probability.
[3] Means followed by the same capital letter, within the same row, do not significantly different at 0.05 level of probability.

Data in Table 4 showed how the use of pesticides that have been proven successful in the Manfalout district during the 2022 season led to a decrease in the percentage of *T. urticae* infestations. In this regard, the mean decrease percentages of 1, 3, 7, and 14 days of treatment showed that all the chosen pesticides were significantly more successful than the control group. These pesticides included thiamethoxam (59.17%), etoxazole (58.42%), emamectin benzoate (56.08%), sulfoxaflor+spinetoram (48.17%), and spirodiclofen (38.75%). Furthermore, in the Manflout district, thiamethoxam, etoxazole, and emamectin benzoate were the most powerful pesticides according to the mean reduction percentages of 59.17%, 58.42%, and 56.08%, respectively.

However, the pesticide thiamethoxam was found to be the most effective one in reducing the infestation (49.33% reduction) followed by etoxazole, spirodiclofen, emamectin benzoate, and sulfoxaflor+Spinetoram demonstrated the largest reductions at the first spray during the 2022 season on cucumber plants in the Manfalout district, with reduction percentages of 47.33, 37.33, 13.67, and 5.67%, respectively. Following a three-day of treatment period, thiamethoxam

proved to be the most efficient pesticide with a reduction percentage of 62.00% followed by emamectin benzoate, sulfoxaflor+spinetoram, spirodiclofen, and etoxazole with reduction percentages of 59.33, 43.00, 36.00, and 36.00%, respectively. The most dangerous pesticides after 7 days of treatment was etoxazole (reduction percentage= 73.67), followed by sulfoxaflor+spinetoram, emamectin benzoate, thiamethoxam, and spirodiclofen with reduction percentages corresponding to 68.00, 64.00, 62.67, and 43.33%, respectively. Additionally, following a 14-day of treatment, emamectin benzoate was the most efficient insecticide (87.33% reduction) followed by etoxazole, sulfoxaflor+spinetoram, thiamethoxam, and spirodiclofen. The corresponding reduction percentages were 76.33, 76.00, 62.67, and 38.00%, respectively.

Table 4. Reduction percentages of *T.urticae* on cucumber plants through four periods (days) by using different pesticides in Manfalout district, Assiut Governorate, during season 2022

Pesticides	Periods (days)				Mean ± SD [2]
	1	3	7	14	
Sulfoxaflor+Spinetoram 40% WG	5.67±3.0342 g [1]	43.00±18.25 abcd	68.00±12.12 abcd	76.00±7.00 ab	48.17±30.27 ***AB***
Emamectin benzoate 5.7% WG	13.67±4.73 fg	59.33±7.51 abcd	64.00±13.00 abcde	87.33±6.66 a	56.08±28.81 ***A***
Thiamethoxam 25% WG	49.33±21.82 bcde	62.00±17.44 abcde	62.67±28.92 abcde	62.67±6.66 abcde	59.17±18.36 ***A***
Spirodiclofen 24% SC	37.33±13.80 ef	36.33±24.03 ef	43.33 ±14.43 de	38.00±9.16 ef	38.75±14.17 ***B***
Etoxazole 20% SC	47.33±11.01 cde	36.33±13.32 ef	73.67±17.04 abc	76.33±9.07 ab	58.42±20.97 ***A***
Mean of period ±SD [3]	30.67±21.37**C**	47.40±18.43**B**	62.33±18.66 **A**	68.07±18.74**A**	

[1] Means followed by the same small letter (s) do not significantly different at 0.05 level of probability.
[2] Means followed by the same italic capital letter, within the same column, do not significantly different at 0.05 level of probability.
[3] Means followed by the same capital letter, within the same row, do not significantly different at 0.05 level of probability.

Data in Table 5 provided the percentage reductions in *T. urticae* infestations in the Qusia district during the 2022 season as a result of the use of tested pesticides. All of the chosen pesticides were significantly more effective than the control group when measured by the mean percentage reduction after 1, 3, 7, and 14 days of treatment in the Qusia district during the 2022 season. The results were as followed: spirodiclofen (60.00%), etoxazole (57.67%), emamectin benzoate (56.75%), thiamethoxam (45.83%), and sulfoxaflor+spinetoram (40.00%).

Moreover, the most effective insecticides in the Qusia district were etoxazole, spirodiclofen, and emamectin benzoate, with mean reduction percentages of 60.00, 57.67, and 56.75%, respectively.

Further, the results showed that spirodiclofen was the most successful pesticide in reducing the infestation (32.33% reduction), with the following pesticides showing the greatest reductions at first spray during the 2022 season on cucumber plants in the Qusia district: emamectin benzoate, thiamethoxam, etoxazole, and sulfoxaflor+spinetoram, with respective reductions of 28.33, 27.67, 21.67, and 15.33%, respectively. The most effective pesticide, however, was

etoxazole after three days of treatment (65.00% reduction) followed by emamectin benzoate, spirodiclofen, thiamethoxam, and sulfoxaflor+spinetoram and the reduction percentages were 62.33, 60.67, 53.67, and 25.67%, respectively. Spirodiclofen was the most effective pesticide (70.33% reduction) after 7 days of treatment, followed by emamectin benzoate, etoxazole, sulfoxaflor+spinetoram, and thiamethoxam, and the reduction percentages were 65.67, 62.33, 54.33, and 41.33%, respectively. Additionally, following a 14-day treatment period, etoxazole was the most potent pesticide with reduction percentages of 81.67 followed by spirodiclofen, emamectin benzoate, sulfoxaflor+spinetoram, and thiamethoxam and the reduction percentages were 76.67, 70.67, 64.67, and 60.67%, respectively.

Table 5. Reduction percentages of *T.urticae* on cucumber plants through four periods (days) by using different pesticides in Qusia district, Assiut Governorate, during season 2022

Pesticides	Periods (days)				Mean ± SD [2]
	1	3	7	14	
Sulfoxaflor+Spinetoram 40% WG	15.33±3.79 f [1]	25.67±6.66 ef	54.33±19.35 cd	64.67±13.58 abc	40.00±23.58 ***B***
Emamectin benzoate 5.7% WG	28.33±12.50 ef	62.33±11.24 abcde	65.67±14.36 abc	70.67±9.29 abc	56.75±20.19 ***A***
Thiamethoxam 25% WG	27.67±4.93 ef	53.67±11.30 cd	41.33±10.79 de	60.67±19.55 bcd	45.83±17.12 ***B***
Spirodiclofen 24% SC	32.33±5.51 ef	60.67±2.31 bcd	70.33±2.52 abc	76.67±2.31 ab	60.00±17.95 ***A***
Etoxazole 20% SC	21.67±0.577 ef	65.00 ±11.00 abc	62.33±6.43 abc	81.67±13.65 a	57.67±24.38 ***A***
Mean of period ±SD [3]	25.07±8.3**C**	53.47±16.87**B**	58.80±14.74**B**	70.87±13.54**A**	

[1] Means followed by the same small letter (s) do not significantly different at 0.05 level of probability.
[2] Means followed by the same italic capital letter, within the same column, do not significantly different at 0.05 level of probability.
[3] Means followed by the same capital letter, within the same row, do not significantly different at 0.05 level of probability.

In general, all tested pesticides revealed significant potency towards *T. urticae* on cucumber plants. However, in agreement with our findings, Abo-Elmaged (2020) demonstrated that the general reductions of *T. urticae* on cucumber plants under field conditions in Assiut Governorate during spring plantation of 2017 season were 73.46 and 75.84% for thiamethoxam and for dinotefuran. Plus, Shaalan (2006) stated that thiamethoxam treatment significantly decreased the population density of two tested pests, *Thrips tabaci* L and *T. urticae* Koch, and increased the cucumber yield comparing with control treatment at Saqqara village in Giza governorate during two successive seasons (2013 and 2014).

However, emamectin benzoate showed powerful effects on *T. urticae* in the current study. In harmony with our findings, Eziah *et al.* (2016) found that emamectin benzoatewas the most effective pesticide among the tested pesticides against four field populations of *T. urticea* by spray application. Further, Tawfik and Elgohary (2015) stated that the tested acaricides, which had LT_{50s} of 1.77, 2.85, 3.16, 3.94, and 4.55 days, were arranged as follows in descending order of speed of action towards *T. urticae*: abamectin, emamectin benzoate, acequinocyl,

chlorfenapyr, and hexythiazox, respectively. The corresponding speed action indexes were, however, 100.00, 62.11, 56.01, 44.92, and 38.90%, respectively. Furthermore, Hassan and Hamad-Ameen (2019) emphasized that the spray approach produced the best results when spraying chlorphenapyr after a 24-hour treatment period, resulting in a 100% mite fatality rate. However, abamectin and asequinocyl showed miticidal effects with mortality rates of 87% and 77%, respectively of *T. urticae* on cucumber plants in Erbil region, Iraq. Moreover, İnak *et al*., (2019) observed that abamectin pesticide was considered as one of the most toxic pesticides on *T. urticae* collected from vegetable crops in Turkey. However, Prakash *et al*., (2022) found that abamectin was considered as one of efficacy pesticide on the occurrence of *T. urticae* in cucumber under protected cultivation based on the assessment of mite population after first, second, and third spraying. Further, Duchovskienė and Survilienė (2009) found that the effectiveness of abamectin (18 g/l 0.12 % and 0.1%) was 92.24–100% and 82.8–99.2%, respectively, against the two-spotted spider mites, *T. urticae,* in greenhouse cucumbers in 2005–2006. Plus, the effectiveness of the pesticide abamectin (18 g/l 0.075 % and 0.05 %) against the two-spotted spider mite was 81.0–100% and 72.4–94.0%, respectively. Furthermore, Duchovskienė (2007) stated that very effective results were obtained with the pesticide abamectin 18 g/l 0.12% against two-spotted spider mites, *T. urticae*: 93.9, 98.9, 98.7, and 98.1% – 3, 7, 14, and 21 days after the first treatment. After the first treatment, abamectin 18 g/l (0.1 and 0.075%) had an efficiency of over 90% against two-spotted spider mites in greenhouse cucumbers in 2005–2006.

On the other side, etoxazole pesticide presented efficacy on *T. urticae.* However, Li *et al*., (2014) found that etoxazole was toxic based on the LC_{50} values that calculated using probit analysis of the concentration-dependent mortality data against susceptible and resistant strains of carmine spider mite, *Tetranychus cinnabarinus* in vegetables in China. Plus, Koo *et al*., (2021) found that etoxazole pesticide was slightly toxic against the susceptible (S), etoxazole and pyridaben-resistant (ER and PR) strains of *T. urticae* compared to pyridaben pesticide. However, resistance to pyridaben and etoxazole was observed in all populations that were collected in the field.

Sulfoxaflor demonstrated high efficacy on sucking pests on cucumber plants. However, Zewain *et al*., (2013) stated that sulfoxaflor at 300 ml/ha was the most successful treatment for whiteflies, *Bemisia tabaci*, up to seven days after the second application, while sulfoxaflor at 100 ml/ha continued to be the least effective. Throughout the experiment, the other treatments showed less than 73% mortality. Further, Barrania *et al*., (2019) revealed that when used sulfoxaflor and flupyradifurone against *B. tabaci* and A. gossypii on cucumber plants, they showed outstanding and quick action activity, whereas acetamiprid showed the lowest reduction percentages during 2017 and 2018 summer seasons at Nubarya district, El-Beheira governorate. Furthermore, Babcock *et al*., (2011) exhibited that sulfoxaflor was effective against a wide range of sucking pests like whitefly, aphids, leafhopper and mirid bugs. Moreover, Prasad (2022) found that, as compared to other treatments, sulfoxaflor at 100 g a.i. /ha the largest reduction of

thrips (30.2%), followed by flonicamid at 75 g a.i. /ha (19.8%) and sulfoxaflor at 90 (19.8%), respectively. However, Wang *et al*., (2023) observed hormesis effects of sulfoxaflor on fecundity in susceptible *A. gossypii*.

On the other hand, spinetoram pesticide was potent in this study. However, Wang *et al*., (2016) reported that treating *T. urticae* with LC_{10} and LC_{20} of spinetoram shortened the time it took for an egg to become an adult and enhanced fertility. Whether treated eggs or adult females, the spinetoram LC_{10} and LC_{20} also lowered the mean generation time, egg duration, and larval duration while increasing the intrinsic and finite rate of increase and the net reproduction rate. Moreover, Wang *et al*., (2015) found that spinetoram was the second most toxic pesticide against *T. urticae* among the ten selected pesticides and the LC_{50} value was 4.9 mg/l.

Spirodiclofen pesticide was the most effect pesticide among the selected tested pesticides in the current study especially in Qusia district, Assiut Governorate, during season 2022. In agreement with this result, Nezhadakbarimahani *et al*., (2023) assessed the impact of a magnetic field on the acaricidal activity of spirodiclofen in relation to *T. urticae*. However, after the suspensions were subjected to a continuous 0.42 Tesla magnetic field, they were prepared using distilled water and well water. Additionally, the produced suspensions were subjected to additional treatments by means of a magnetic field. On days 7, 14, and 21 days, mites were counted immediately prior to the sprays. Interestingly, the treatments that had the highest values between days 7 and 21 (about 77%) were magnetizing the well water and acaricide mixture and magnetizing distilled water plus acaricide treatment. Further, Ahmed *et al*., (2021) demonstrated that every acaricides [(Agnar 20% SC (Abamectin 2% & Spirodiclofen 18%), penny 9% SC (Emamectin benzoate 1.5% & Indoxacarb 7.5%) and biomectin 5% EC (Abamectin 5%)] were examined significantly and affected the biological traits of *T. urticae*, including fertility, lifespan, and total lifespan under greenhouse condition. Treatment with agnar, penny, and biomectin at LC_{25} markedly decreased the *T. urticae* females' net reproduction (*R0*) and gross reproduction (*GRR*) rates. Thus, there was also an impact on the finite rate of rise (λ) and the intrinsic rate of increase (*rm*). The intrinsic rates of increase were 0.129, 0.113, 0.107, and 0.199 female offspring per female per day in the treatment groups and 0.119 in the control group. Furthermore, Marcic *et al*., (2011) revealed that, in examinations 6 and 10 DAT, spirodiclofen demonstrated 98.4 and 96.8% efficacy, clofentezine 95.4 and 93.4%, and bifenthrin 96.5 and 98.8% efficacy, respectively. The outcomes demonstrated that spirodiclofen is a good substitute for more traditional acaricides and is effective at controlling twospotted spider mite, *T. urticae,* on cucumbers in Serbia. Moreover, Rauch and Nauen (2002) found that spirodiclofen was toxic pesticide against four laboratory and several field derived strains of *T. urticae*. Saad *et al*., (2023) explored that during the first three days of the two experimental seasons against the two-spotted spider mite, *T. urticae* Koch, infesting cucumber plants, abamectine + spirodiclofen and abamectine + hexythiazox acaricides functioned better in the greenhouse experiment than spirodiclofen acaricide against the adult and immature stages. Following a 24-hour

period, the most effective products were abamectine + spirodiclofen and abamectine + hexythiazox, achieving percent reductions of 95.00 and 94.86 in the first season and 97.84 and 95.76% in the second, respectively. However, after 24-hour, the first kill of all acaricides against the egg stage was low. abamectine + spirodiclofen and abamectine + hexythiazox, on the other hand, demonstrated a considerable improvement in efficacy after three days, with decrease percentages of 81.24 and 51.60% in the first season and 73.83 and 81.86% in the second one). Only on the seventh day did spirodiclofen exhibit high performance; during the inspection periods, efficacy varied. Moreover, Marčić *et al*., (2012) found that, in the greenhouse trials, the treatments containing abamectin and the synthetic acaricides spirodiclofen and acrinathrin showed exceptionally high efficacy in managing and decreasing the population density of *T. urticae*. The abamectin-based products performed worse than other treatments in the field testing.

Conclusion

To sum up, the tested pesticides demonstrated clear effectiveness on the two-spotted spider, *T. urticae,* on cucumber crops under field conditions. Other molecular genetics and biochemical studies must be carried out in order to determine how the pest is affected. This study is a promising one that can be applied in integrated pest management programs to control pests on cucumber crops, especially under the field conditions of Assiut Governorate.

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تقييم سمية بعض المبيدات على اكاروس العنكبوت الاحمر ذو البقعتين *Tetranychus urticae* Koch (Acari: Tetranychidae) على نباتات الخيار تحت الظروف الحقلية

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الملخص

يعتبر اكاروس العنكبوت الاحمر ذو البقعتين، *T. urticae*، من الآفات الزراعية في مصر والعالم. نظرا لتواجده على العديد من العوائل النباتية ومقاومته الملحوظة للعديد من مبيدات الآفات المستخدمة. في هذه الدراسة، تم اختبار خمس مبيدات لقدرتها على مكافحة الافة وهم: سلفوكسافلور + سبينورام، إيمامكتين بنزوات، ثيامثوكسام، سبيروديكلوفين، وإيتوكسازول في مركزي منفلوط والقوصية بمحافظة أسيوط، مصر خلال موسمي 2021 ،2022. وقد أظهرت النتائج أن جميع المبيدات كانت فعالة على *T. urticae* بناء على متوسط نسب الخفض في تعداد الافة والتي تراوحت بين 62.75%، 68.00% خلال موسم 2021 على نباتات الخيار في مركز منفلوط. وكان أكثر المبيدات فعالية في مركز القوصية: مبيدات الثيامثوكسام والسبيروديكلوفين والإيمامكتين بنزوات حيث بلغ متوسط نسب الخفض 63.39% ،58.31% ،56.75% خلال موسم 2021, على التوالي. وفي موسم 2022 كانت أقوى المبيدات فعالية في مركز منفلوط هي ثيامثوكسام وإيتوكسازول وإيمامكتين بنزوات، بينما في مركز القوصية كانت أقوى المبيدات فعالية هي سبيروديكلوفين وإيتوكسازول وإيمامكتين بنزوات وبلغ متوسط نسبة الخفض 60.00%، 57.67%، ،56.75% على التوالي.

وبناءًا على ذلك، تعتبر المبيدات التي تم اختبارها أداة فعالة يمكن استخدامها في برامج المكافحة المتكاملة للآفات ضد اكاروس العنكبوت الاحمر ذو البقعتين، *T. urticae* على الخيار تحت الظروف الحقلية بمحافظة اسيوط.