EGYPTIAN ACADEMIC JOURNAL OF

BIOLOGICAL SCIENCES

TOXICOLOGY & PEST CONTROL

F

ISSN
2090-0791

WWW.EAJBS.EG.NET

Vol. 17 No. 1 (2025)

www.eajbs.eg.net

Citation: *Egypt. Acad. J. Biolog. Sci.* (F. Toxicology& Pest control) *Vol.17(1) pp1-11 (2025)*
DOI: 10.21608/EAJBSF.2025.410010

Egypt. Acad. J. Biology. Sci., 17(1):1-11 (2025)

Egyptian Academic Journal of Biological Sciences
F. Toxicology & Pest Control
ISSN: 2090 - 0791
http://eajbsf.journals.ekb.eg/

A predacious Efficacy of Some Predatory Mites on *Tetranychus urticae* Koch (Acari: Tetranychidae), That Infest Tomatoes Plants in The Light of Sustainable Development and Climatic Changes

Marwa, A. M. Abd-Allah[1]; Nevien, M. Gaber[1]; El-Sayed, M. A. Elsaiedy[2] and Ahmed A. Taha[3]

[1]Plant Protection Research Institute, Agricultural Research Centre (ARC), Giza, Egypt.
[2]National Research Centre, Dokki, Giza, Egypt.
[3]Central Laboratory for Organic Agriculture, Agricultural Research Centre (ARC), Giza, Egypt.

*E-mail: Marwa_asd2010@yahoo.com

ARTICLE INFO
Article History
Received:29/12/2024
Accepted:4/2/2025
Available:8/2/2025

***Keywords*:**
Biological control, predators, mites, pest control.

ABSTRACT

In the present study, the Phytoseiidae mite's species namely; (*Neoseiulus cucumeris, Neoseiulus californicus, Phytoseiulius persimilis, Typhlodrompis swirskii, Typhlodromus nigavi*) as well as vertemic as a bio-insecticide, *were* tested for controlling the phytophagous mites *Tetranychus urticae* Koch that infest tomato plants (Rogina cultivar) in Egyptian governorates namely, El-Beheira, El-Fayum and El-Ismailia. Obtained results indicated presence of significant differences among efficacies of all evaluated predators including vertemic, compared to untreated checks (control) and that *T. swirskii* was the highest potent treatment followed by *N, californicus* and vertemic which were significantly differed compared to the control (non-treated check, $P<0.001$).

INTRODUCTION

Due to the high contents of antioxidant-rich phytochemicals and essential nutrients, tomatoes (*Solanum lycopersicum* L.) present one of the highest economically important vegetable crops that are grown worldwide and widely consumed as fresh vegetables (FAO 2015). In Egypt, tomatoes are grown in most Governorates, and its cultivated areas were increasingly spread from the extreme north to the extreme south, reaching about 551 055.3 feddan, at the same time it provides suitable host plant for numerous pests and pathogens (diseases), (Adel, *et al*., 2018 and Shehawy, *et al*., 2021).

The massive implementation of chemical and pesticides in different pests and diseases' control strategies has resulted in several problems, and lead to major environmental systems challenges, especially under current events of climate changes. Therefore, more attention was paid during last decades for sustainable development, including integrated pest management factors that could be more environmentally safe and higher selective, and could help in minimizing the mis-usage of agricultural chemicals (Shehawy *et al*. 2021); (Qari & Shehawy 2020).

One of the principal pests that attack tomato plants is the cosmopolitan red spider mite *Tetranychus urticae* Koch (*T. urticae*) which infest and feed on more than 135 plant families including tomato cultivars (Dermauw *et al.*, 2012), fortunately, many predatory mites that belong to the western predatory mite, (*Typhlodromus*) were studied and found to present promising predators for polyphagous pest control (Marina *et al*., 2019) and (Tjosvold and Karlik 2003). In the same context, many scientists suggested the Phytocides mites as a very important polyphagous predators and considered it as an effective alternative approach to pesticides for controlling *Tetranychus urticae* on numerous of vegetable crops in field conditions or plant houses (Van Houten *et al*. 2005; Messelink *et al*. 2006).

Abden *et.al.*, (2021), stated that the predatory mite, *Typhlodromus sp.* is one of the most important biocontrol agents, while Phytosiid predatory mites is considered as one of the promising predators for controlling polyphagous pest (Marina *et al*., 2019). Also, *Amblyse*ius *swirskii* found to play an efficient role against red spider mite (Asadi *et al*., 2019). In addition, Víctor *et al*., (2017) suggested that the phytoseiidae mites could effectively regulate and control populations of red spider mite in the field. Mortazavi *et.al*., (2019) mentioned that *Amblyseius swirskii* is a well-known natural enemy (predator) that can be used for regulating and controlling phytophagous red spider mites and have a higher attack rate coefficient (α) on immature stages of the spider mites *Tetranychus urticae* than those of *E. frosti* which has higher attack rate (α) and feeding on their eggs (Bazgir *et. al.*, 2020).

The aim of the present study is to evaluate the reduction efficacy of certain predatory mites including *Neoseiulus cucumeris, Neoseiulus californicus, Phytoseiulius persimilis, Typhlodrompis swirskii, Typhlodromus nigavi* compared to the biocide vertemic, for controlling the phytophagous red spider mites infesting tomato plantations in Egyptian governorates namely, El-Beheira, El-Fayum and El-Ismailia.

MATERIALS AND METHODS

Experiment Locations:

This study was carried out during the period from November 2022 until April 2023 in several private fields scattered in Egyptian Governorates, El-Beheira, El-Fayum and El-Ismailia.

Evaluated Predatory Mites' Species:

The reduction efficiency of the five predators, namely, *Neoseiulus cucumeris* Oudemans, *Neoseiulus californicus* McGregor, *Phytoseiulius persimilis, Typhlodrompis swirskii* Scheuten and *Typhlodromus nigavi* Scheuten (Mesostigmata: Phytoseiidae), were evaluated.

Mass Rearing:

Rearing of predator mites were carried out as methods which were described by Afifi *et al*. 2013 and Abd El-Salam *et al*. (2019), where small bean plants were planted and artificially infested with the spider mites *Tetranychus urticae* then used for production of each species separately in greenhouses with the dimensions of 5m width and 7m length with average temperature between 25–30 °C and relative humidity 65±10 %. The predatory mites were collected when the population increased. Each treatment was applied by 4 periods with 30 days intervals between them. The first release of the studied treatment was applied at the first week after sowing in the three governorates.

Bioinsecticide:

The bio-insecticide derived from *Streptomyces avermitilis*. named Vertemic® 1.8 % EC with registration number in Egypt, 466 (CAS registration 71751-41-2), by

Egyptian Ministry of Agriculture, for controlling spider mite on tomato plants was also evaluated and compared. It was applied as recommended at the rate of 40 ml/100L per Feddan

Experimental Locations:

The experimental fields were selected randomly in private farms in the abovementioned governorates. The Tomato hybrid (Rogina) was planted during the planting season (middle-November) in the three governorates. A total area of 1575m^2 was cultivated with Tomato plants (for each governorate).

Experimental Design and Plantation:

For this work, the factorial complete randomised block design was chosen. Each experimental area was divided into many plots (seven) with three replicates each. (plot = 30 × 3 × 1.75 m), equivalent to 157.5 m^2 for each treatment and control. Safe area was left between each two plots. Each plot contains 525 tomato seedlings. Predators were released at rate of approximately 2625 predators/plot (five predators/plant) according to (Afifi *et al*. 2015). Finally, all agricultural practices tomato crop were performed as recommended during the cultivation season.

Regarding the bio-insecticide, the vertemic was calibrated according to treated plot size. A 15-l volume sprayer machine (Hand Sprayer-16 litres) was used, and spraying was performed twice during the season, the first spray of the studied pesticides was applied at 1st week (first period) and 11th week (before third period).

Data Recording:

Randomized samples of 300 leaves from each plot (100 leaves × 3 replicates) were regularly weekly taken, early in the morning starting from the 1st week after treatment until the week no. 21, beside the one that was taken before treatment. Samples were transferred to the laboratory for investigation and counting numbers of *T. urticae* both adults and immature stages, using magnifier lens according to Al-Karboly and Al-Anbaki 2014.

Data Analysis:

All recorded data were analysed using the computer software package SPSS. Comparisons between means treatments were depended on the F and LSD tests at α=0.05, while reduction %, were evaluated by Henderson & Tilton equation (1955).

RESULTS AND DISCUSSION

Effect of Tested Predator Mites on Red Spider Mites' Population:

As shown in Table (1), reduction in the spider mites population density in the three tested governorates, caused by *Neoseiulus cucumeris, Neoseiulus californicus, Phytoseiulius persimilis, Typhlodrompis swirskii, Typhlodromus nigavi* predators and Vertemic respectively, after different exposure periods were presented.

In El-Beheira Governorate, the reduction % of the red spider mite adults were 39.43, 41.91, 26.59, 60.28, 22.012and 71.43% respectively, after the first 4 weeks (1st period), while by reaching the last period (17th–21st week) the reduction % recorded 59.74, 98.85, 52.32, 100. 47.95 and 81.41% for the same predators respectively, after the 21 weeks, the total recorded reduction with the same predators was 52.19, 83.77, 42.25, 90.71, 38.35 and 82.48 %, respectively with F-value at α = 0.05 of 104.26 (d.f. 6 & 119), indicating presence of significant difference between treatments.

In El-Fayoum Governorate, the reduction% of red spider mite adults with same abovementioned reduction agents gave 40.94, 47.60, 31.65, 59.48, 15.32 and 76.83% respectively after first exposure periods, and 55.11, 83.54, 48.05, 94.01, 22.80 and 89.78% respectively after the second period, while after the last period of treatment, 65.0,

95.56. 54.48. 99.96. 38.84 and 88.50% were recorded, and finally, a total reduction percentage in numbers of red spider mite *T. urticae* after treatment was recorded as 57.51, 84.6, 49.19, 91.72, 30.26 and 86.75% respectively, with F-values at α = 0.05 was 153.8** (dF: 6 and 119) indicating also presence of significant difference between treatments in Fayoum Governorates.

In El-Ismailia Governorate, after first exposure periods, 46.86, 67.99, 38.32, 84.28, 33.93 and 75.50% respectively, was recorded, then 65.68, 93.57, 58.19, 98.63, 48.3 and 85.82% respectively after the second period, 65.55, 99.43, 54.25, 100.00, 43.25 and 69.49% after the last period of treatment with the same factors respectively, and final reduction of 64.22, 92.83, 53.65, 97.144, 41.67 and 78.15% respectively, as well as *F*-values at α = 0.05 was 156.23** (d.F. : 6 and 119) indicated that there was a significant difference between all treatments.

Table 1. Reduction percentages and average of red spider mite, *Tetranychus urticae* nymphs and adults, infested tomato plants (Rogina hybrid) after treatment with bio-control agents in Behira, Fayoum and Isamailia Governorates respectively.

Period	Treatment	*Neoseiulus cucumeris*	*Neoseiulus californicus*	*Phytoseiulius persimilis*	*Typhlodrompis swirskii*	*Typhlodromus nigavi*	vertemic	Control
Behera Governorate								
Pre treatment		324.52	326.15	325.2	329.14	323.16	325.9	325.88
1st period	Mean	222.41	214.39	270.13	147.93	285.20	105.34	368.78
	Reduction%	39.43	41.91	26.59	60.28	22.012	71.43	
2Sec Period	Mean	206.24	55.08	248.87	28.42	261.625	51.015	433.33
	Reduction%	52.20	87.29	42.44	93.50	39.11	88.22	
3rd period	Mean	213.05	24.254	261.46	0.052	275.89	64.11	462.844
	Reduction%	53.77	94.76	43.39	99.98	39.89	86.14	
4th period	Mean	160.44	4.57	190.42	0.00	206.57	74.40	400.25
	Reduction%	59.74	98.85	52.32	100	47.95	81.41	-
General Mean		199.00^{C}	67.89^{B}	240.86^{D}	39.20^{A}	255.53^{E}	73.22^{B}	417.99
General Reduction		52.19	83.77	42.25	90.71	38.35	82.48	-
F, Value		104.26** (df, 6 and 119)						
P. Value		0.0001 (highly significant)						
Fayoum Governorate								
Pre treatment		408.51	410.17	410.18	414.35	411.28	412.1	407.35
1st period	Mean	288.60	257.1	335.37	200.83	416.6	114.2	487.34
	Reduction%	40.94	47.60	31.65	59.48	15.32	76.83	-
2Sec Period	Mean	262.605	96.6	305.17	35.52	454.70	60.29	583.43
	Reduction%	55.11	83.54	48.05	94.01	22.80	89.78	-
3rd period	Mean	281.51	38.41	328.5	2.332	469.92	82.86	713.97
	Reduction%	60.68	94.65	54.30	99.67	34.81	88.52	-
4th period	Mean	247.55	31.52	323.55	0.23	435.86	82.06	705.90
	Reduction%	65.0	95.56	54.48	99.96	38.84	88.50	-
General Mean		269.45	98.05	323.48	53.24	445.24	84.75	632.36
General Reduction		57.51	84.60	49.198	91.72	30.26	86.75	-
F, Value		153.8** (dF: 6 and 119)						
P. Value		0.0001 (highly significant)						
Ismailia Governorate								
Pre treatment		190.23	191.12	190.4	193.12	191.61	191.7	190.35
1st period	Mean	126.95	76.81	147.48	38.12	158.98	58.98	239.05
	Reduction%	46.86	67.99	38.32	84.28	33.93	75.50	
2nd Period	Mean	108.86	20.48	132.72	4.40	165.19	45.3	317.43
	Reduction%	65.68	93.57	58.19	98.63	48.30	85.82	
3rd period	Mean	112.73	5.032	163.78	0.142	233.56	68.78	384.9
	Reduction%	70.69	98.69	57.46	99.96	39.71	82.25	
4th period	Mean	120.12	1.984	159.69	0.00	199.334	107.2	348.9
	Reduction%	65.55	99.43	54.25	100	43.25	69.49	-
General Mean		117.09	23.57	152.12	9.49	192.29	72.08	327.52
General Reduction		64.22	92.83	53.56	97.144	41.67	78.15	-
F, Value		156.238** (df, 6 and 119)						
P. Value		0.0001 (highly significant)						

Generally, analysis of variance (ANOVA) and least significant difference (LSD) values at α =0.05 indicated that *T. swirskii* was the highly potent treatment followed by

N, californicus and vertemic was differed compared with the untreated control significantly (*P*<0.001). Indeed, it was clear that *N.cucumeris* caused higher reductions in *T. urticae* population than in other treatment and control treatments.

Illustrated data in both Table 2 and Figure 1, showed analysis (ANOVA) for the three selected locations (governorates), predatory mites and interaction between predatory mites. The analysis results indicated that there were differences between the effect of the evaluated predatory mites and Vertimec, against red spider mite on tomatoes plants compared with the control in the governorates significantly (F. Value = 17.915) at α=0.05 or less and probability value (P. value < 0.0001).

These results in the same line with those previously reported by Marcela *et.al*. (2019) who stated that *Amblyseius swirskii* is a well-known natural enemy (predator) that can be used for regulating and controlling phytophagous red spider mites (TSSM). Also, the predatory mites *A. swirskii* and other predator mites were evaluated for their reduction efficacy against different polyphagous mites two spotted red mites' stages. Moreover, Nomikou *et al*. (2002) mentioned that, Phytoseiidae mites reduced the attack of *T. urticae* density in tomatoes cultivars in greenhouse.

Table 2. Summation squares, mean square, calculated F. and probability values in the three Governorates after treatment of *Tetranychus urticae* (red spider mite) infested tomatoes plants.

Source	Type III Sum of Squares	Df	Mean Square	F	P. Value
Governorate	1338232.67	2	669116.33	202.018*	0.0001
Species	7538189.14	6	1256364.85	379.319**	0.0001
Governorate * species	712067.10	12	59338.92	17.915**	0.0001
Error	1182442.31	357	3312.16		
Total	25142805.69	378			

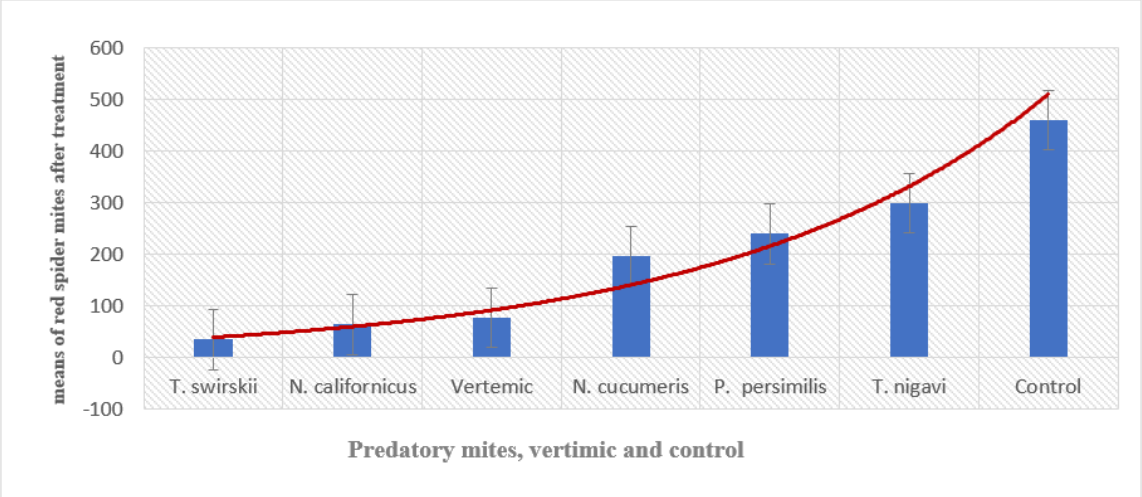

Fig. 1. Efficacy of predatory mites and vertemic on *T. urticae* eggs in the three selected locations (governorates) Means of remained individuals.

Means & LSD test for obtained data indicated reduction of *T. urticae* with different biocontrol agents in the three locations (governorates), as shown in Table (3).Obtained results indicated that there were significant differences among all treatment except between vertemic and *N. californicus* in all three Governorates compared with

untreated control, in this respect, *T. swirskii* was found to be highly effective followed by vertemic and *N. californicus* followed by *N. cucumeris* followed by *P. persimilis* then *T. nigavi.*

The significant difference between Governorates regarding the efficacy of tested predatory mites could probably due to climatic changes nevertheless, the pattern found to be conserved where *T. swirskii* was highly effective followed by vertemic, then *N. californicus* was highly effective followed by *N. cucumeris, P. persimilis* then *T. nigavi* compared with control.

Table 3. Means and LSD of biocontrol tested agents against Tetranychus urticae (red spider mite) infested tomatoes crop in three Governorates (El-Bahira, El-Fayoum and El-Ismailia).

Species	Mean	95% Confidence Interval		Test	(I) Species	(J) Species	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
		Lower Bound	Upper Bound							Lower Bound	Upper Bound
Californ	63.181[b]	47.778	78.583	LSD = 18.82	*T. swirskii*	Californ	-29.20[b]	11.076	.009	-50.99	-7.42
Control	459.293	443.891	474.696			Control	-425.32*	11.076	.000	-447.10	-403.53
Cucumeris	195.182[c]	179.780	210.584			Cucumeri	-161.21[c]	11.076	.000	-182.99	-139.42
Nigavi	297.689[e]	282.287	313.091			Nigavi	-263.71[e]	11.076	.000	-285.49	-241.93
Persimil	238.820[d]	223.418	254.222			persimil	-204.84[d]	11.076	.000	-226.62	-183.06
Swirskii	33.977[a]	18.575	49.379			Vertemic	-42.81[b]	11.076	.000	-64.59	-21.02
Vertemic	76.784[b]	61.382	92.186								
Based on observed means. The error term is Mean Square (Error) = 3312.16											
*. The mean difference is significant at the .05 level. & mean sample size (N)=54											

Means with the same litter is not significantly different, whereases means with the different litters is significantly different at alph= 0.05

Effect of Tested Bio Control Agent on Produced *Tetranychus urticae* Eggs:

As shown in Table (4), the reduction % and average of produced *Tetranychus urticae* (red spider mite) eggs after treatment with the tested bio-control agents in Beheira, Fayoum and Isamailia Governorates, are shown.

In Beheira governorate, the number of eggs after treatment with *N. cucumeris N. californicus, P. persimilis, T. swirskii, T. nigavi,* and Vertemic respectively, after different periods showed that the population reduction % in red spider mite eggs on tomatoes plants were 38.79, 46.10, 29.34, 75.64, 20.80 and 69.10% after the first 4 weeks (first period), and 60.77, 92.86, 51.93, 99.96, 49.18 and 79.37% after the last period (17th–21st week) , and the general reduction after 21 weeks of treatments were 63.98, 92.77, 53.326, 97.12, 41.01 and 77.96 %, respectively. Whereas F-values at $\alpha = 0.05$ was 126.272 (d.f. 6 & 119), indicated that there was a significant difference between all treatments against red spider mite's eggs on tomatoes plants.

In El-Fayom governorate, number of *T. urticae* eggs after treatment with *N. cucumeris, N. californicus, P. persimilis, T. swirskii, T. nigavi* and Vertemic respectively, after different exposure periods showed that the reduction % in red spider mite eggs on tomatoes plants were 48.93, 56.74, 37.57, 79.03, 32.520 and 73.76% after the first 4 weeks (first period), and 55.82, 80.09, 41.74, 90.05, 38.77 and 87.00%, after the second period Moreover, it was 72.78, 94.79, 62.96, 99.95, 57.75 and 80.92% after the last period and the general reduction were 52.40, 83.81, 41.96, 90.93, 38.77 and 82.42%. as well as F-value at $\alpha = 0.05$ was 170.76** (dF: 6 and 119) that indicated that there was a significant difference between treatments in Fayoum Governorates.

In El-Ismailia governorate, the number of *T. urticae* eggs after treatment with *N. cucumeris, N. californicus, P. persimilis, T. swirskii, T. nigavi* predators as well as

Vertemic respectively, after different exposure periods showed that the reduction % in red spider mite eggs on tomatoes plants were 44.40, 69.84, 32.66, 84.56, 30.79 and 74.82% respectively after the first 4 weeks (first period), and 61.99, 92.40, 44.38, 97.97, 37.97 and 85.09%,after the second period Moreover, it was 71.70, 99.10, 57.72, 100.00, 49.17 and 72.22%, after the last period and 57.39, 84.51, 48.95, 91.68, 29.94 and 86.69% respectively, as well as F-value at $\alpha = 0.05$ was 172.23** (d.F:6 and 119) that indicated that there was a significant differences between all treatments.

Table 4. Reduction % and average of produced *Tetranychus urticae* (red spider mite) eggs after treatment with bio-control agents in Beheira, Fayoum and Isamailia Governorates.

Period	Treatment	*Neoseiulus cucumeris*	*Neoseiulus californicus*	*Phytoseiulius persimilis*	*Typhlodrompis swirskii*	*Typhlodromus nigavi*	vertemic	Control
Beheira Governorate								
Pretreatment		330.15	331.12	331	335.12	331.06	332.2	332.62
1st period	Mean	217.25	191.88	251.46	87.77	281.87	110.36	357.62
	Reduction%	38.79	46.10	29.34	75.64	20.80	69.10	
2Scc Period	Mean	191.38	64.25	232.50	24.61	256.52	54.60	412.2
	Reduction%	53.22	84.34	43.32	94.07	37.47	86.73	
3rd period	Mean	192.29	51.29	259.15	9.834	278.81	77.61	452.3
	Reduction%	57.16	88.60	42.42	97.84	38.06	82.81	
4th period	Mean	149.81	27.332	184.02	0.124	194.62	79.26	384.768
	Reduction%	60.77	92.86	51.93	99.96	49.18	79.37	
General Mean		117.09	23.57	152.12	9.49	192.29	72.08	327.52
General Reduction		63.98	92.77	53.32	97.12	41.01	77.96	
F, Value		126.27						
P. Value		0.0001						
Fayoum Governorate								
Pretreatment		423.81	425.25	420.71	438.21	423.1	422.2	423.71
1st period	Mean	229.87	195.36	278.96	97.57	303.26	117.67	450.06
	Reduction%	48.93	56.74	37.57	79.03	32.52	73.76	
2Scc Period	Mean	204.23	92.31	267.35	47.55	282.54	59.86	462.19
	Reduction%	55.82	80.09	41.74	90.05	38.77	87.00	
3rd period	Mean	207.63	59.68	270.49	12.62	305.65	87.38	483.58
	Reduction%	57.07	87.70	43.66	97.47	36.70	81.86	
4th period	Mean	155.40	29.80	209.89	0.28	240.82	108.53	570.84
	Reduction%	72.78	94.79	62.96	99.95	57.75	80.92	
General Mean		199.00	67.89	240.86	39.20	255.53	73.22	417.99
General Reduction		52.40	83.81	41.96	90.93	38.77	82.42	
F, Value		170.76						
P. Value		0.0001						
Ismailia Governorate								
Pretreatment		185.86	186.12	186.24	188.18	186.80	187.23	185.85
1st period	Mean	124.53	67.62	151.12	35.005	155.79	56.80	223.96
	Reduction%	44.40	69.84	32.66	84.56	30.79	74.82	
2nd Period	Mean	106.21	21.26	155.7075	5.74	174.18	41.94	279.41
	Reduction%	61.99	92.40	44.389	97.97	37.97	85.09	
3rd period	Mean	102.72	8.13	188.196	0.322	216.25	65.01	339.13
	Reduction%	69.71	97.60	44.623	99.90	36.55	80.97	
4th period	Mean	97.49	3.09	145.97	0.00	176.01	96.39	344.52
	Reduction%	71.70	99.10	57.72	100.00	49.17	72.22	
General Mean		269.45	98.05	323.48	53.24	445.24	84.75	632.36
General Reduction		57.39	84.51	48.95	91.68	29.94	86.69	
F, Value		172.23						
P. Value		0.0001						

Data mentioned in Table (5), showed the statistical analysis of variance (ANOVA) among the three different locations (Governorates), predatory mites efficacy and interaction between predatory mites efficacy and the three Governorates. The bio statistical analysis indicated that among the three Governorates, there were significant differences in the effect of the five predatory mites' species and Vertemic against red spider mite eggs on tomatoes plants compared with the control (F. Value = 117.915) at α=0.05 and probability value (P. value < 0.0001). While F. value was 445.35 at α=0.05 between bio-control agents' efficacy, therefore there is significant differences among bio-

control agents in their efficacy on red spider mites' eggs. Given results are approved with those obtained by Nomikou *et al*., (2001a) and Hagler *et al*., (2004) who concluded that the Predator mites; *A. swirskii* was the most effective bio-control agent for *T. ureticae*. In addition, the same observation was registered by Arthurs *et al*., (2009) who concluded that *N. cucumeris*, is useful as a biocontrol agent for two spotted spider mites, and *Amblyseius swirskii* represents also the rational common predatory for two spotted spider mites Al-Zyoud (2014).

Table 5. Analysis of variance for the red spider mite eggs in tomatoes plants (Rogina sultivar) after treatment with biocontrol agents in Beheira, Fayoum and Isamailia Governorates.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Governorate	479174.17	2	239587.08	117.97	.0001
Bio-control	5426568.91	6	904428.15	445.35	.0001
Governorate * species	184549.40	12	15379.11	7.57	.0001
Error (within)	725003.64	357	2030.82	-	-
Total	17659935.31	378	-	-	-

Finally, data illustrated in Figure (2) and Table (6), showed the means and LSD test on the red spider mite *T. urticae* after treatment with the five biocontrol agents as well as Vertemic, on tomatoes plants in the three different Governorates. The general means in the three Governorates of red spider mite eggs was 63.47, 163.3, 238.40, 215.5, 24.24 and 80.29 after treatment with *N. californicus*, *N. cucumeris*, *T. nigavi*, *P. persimilis*, *T. swirskii* and Vertemic compared with untreated control mean (400.30).

These results indicated that there is significant difference between all treatment efficacy except between vertemic and *N. californicus* efficacy in all three Governorates compared with untreated control, and that *T. swirskii* was highly effective followed by vertemic and *N. californicus* followed by *N. cucumeris* followed by *P. persimilis* then *T. nigavi* and the LSD value was14.38.

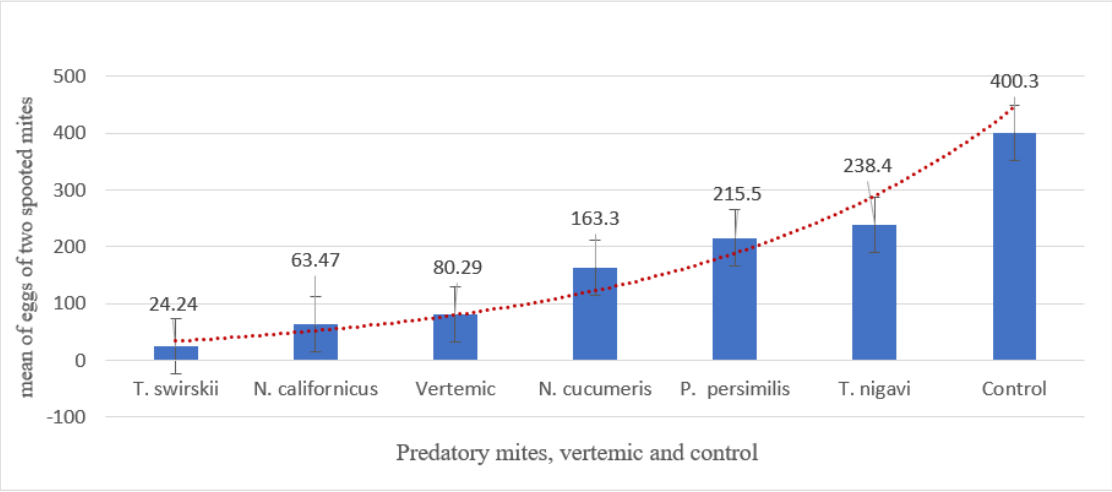

Fig 2. Means of red spider mite's eggs in Beheira, Fayoum and Ismailia Governorates after treatment with different predatory mites and vertemic.

Table 6: Means and LSD test of different predatory mites against the red spider mite eggs and Vertemic on tomato plants in Beheira, Fayoum and Isamailia Governorates.

Species	Mean	95% Confidence Interval		Test	(I) Species	(J) Species	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
		Lower Bound	Upper Bound							Lower Bound	Upper Bound
N. californicus	63.47 [b]	51.41	75.53	LSD = 14.38	*T. swirskii*	*N. californicus*	-39.23*	8.673	.000	-56.29	-22.18
N. cucumeris	163.3 [d]	151.2	175.4			*N. cucumeris*	-139.11*	8.673	.000	-156.16	-122.05
T. nigavi	238.4 [f]	226.4	250.5			*T. nigavi*	-214.23*	8.673	.000	-231.29	-197.18
P. persimilis	215.5 [e]	203.4	227.5			*P. persimilis*	-191.26*	8.673	.000	-208.32	-174.20
T. swirskii	24.24 [a]	12.18	36.30			vertemic	-56.06*	8.673	.000	-73.11	-39.00
Vertemic	80.29[c]	68.23	92.35								
Control	400.3	388.2	412.3			Control	-376.09*	8.673	.000	-393.14	-359.03
The error term is Mean Square (Error) = 2030.823.											
a. Uses Harmonic Mean Sample Size = 54.000.											

Means with the same litter is not significantly different, whereases means with the different litters is significantly different at alph= 0.05

CONCLUSION

Tetranychus urticae still represent a severe phytophagous mite infesting tomato cultivars in Egypt. The massive dependence on chemical insecticides has resulted in emergence of resistant *Tetranychus urticae* populations, and presenting a true challenge regarding sustainable development in agriculture. Thus, the current investigations of the selected predatory mites, in three Egyptian governorates, were conducted to provide a compatible agent that could be applied to minimize dependence on various chemical insecticides. This study indicated a promising role of phytosiid predatory mites, including *T. swirskii and N, californicus* as well as Vertimec, in regulating and controlling of red spider mites in tomatoes field. Finally, from this primarily work, it can be concluded that more extended evaluation of the tested predatory mites should be conducted in other governorates nationwide during different seasons, before their certified recognition as biological agents in different integrated control strategies for *T. urticae* in Egypt.

Declarations

Ethical Approval: Not applicable.

Competing Interests: The authors declare that they have no competing interests.

Authors' Contributions: MA, NG, SE and AT did the conceptualization. MA, NG, SE and AT contributed in the formal analysis. MA, NG and SE took part in the investigation. MA wrote the original draft. NG and AT did the writing–review and approved the final manuscript. All authors read and approved the final manuscript.

Funding: No funding was received.

Availability of Data and Materials: All datasets analyzed and described during the present study are available.

Acknowledgements: we appreciate the effort of Prof. Dr. Ayman Aly Shehawy for helping us in Data analysis**.** (Plant Protection Research Institute, ARC.)

REFERENCES

Abden, M. H.; Abdallah, A. M. and Wafaa M. Gaber (2021). Biological Aspects of *Typhlodromus athisae* Porath and Swirski When Fed on Red Spider Mite, *Tetranychus urtica* Koch and Brown Citrus Mite, *Eutetranychus orientalis* (klein). *Egyptian Academic Journal of Biological Sciences,A.Entomology,* 14 (1):141-145.

Adel, H.; Gaffar, S.A. and Toman, A. (2018). Effectiveness of three bio-rational products and a traditional insecticide against Thrips spp. and *Bemisia tabaci* attacking tomato fields in Kafr El-Sheik Governorate, *Egypt. Agricultural Science,* 9: 1538–1552.

AL-Karboly, H. and AL-Anbaki, H. (2014). Efficacy of tow sampling methods for monitoring, control and estimating seasonal abundance of onion thrips, *Thrips tabaci* Lindeman (Thripidae: Thysanoptera) on onion in Iraq. *Journal of Agricultural Technology,* 10(1): 243–251.

Al-Zyoud F. A. (2014). The most common predators of *Bemisia tabaci* (Genn.), Biology, predation, preferences, releases and alternative food resources, combined use, current efforts and future perspectives. *Journal of Biological Control,* 28(1): 1–16.

Arthurs, S.; McKenzie C.L.; Chen, J.; Doğramaci, M.; Brennan, M.; Houben, K. and Osborne, L. (2009). Evaluation of *Neoseiulus cucumeris* and *Amblyseius swirskii* (Acari: Phytoseiidae) as biological control agents of chilli thrips, (Thysanoptera: Thripidae) on pepper. *Biological Control,* 49: 91-96.

Asadi, P.; Sedaratian-Jahromi, A.; Ghane-Jahromi, M. and Haghani, M. (2019). How Spiromesifen affects some biological parameters and switching behaviour of predatory mite *Amblyseius swirskii* (Acari: Phytoseiidae) when feeding on different ratios of mixed preys. *Persian Journal of Acarology,* 8(3): 239–251.

Bazgir, F.; Shakarami, J. and Jafari, Sh. (2020). Functional response of the predatory mite *Amblyseius swirskii* (Acari: Phytoseiidae) to *Eotetranychus frosti* (Tetranychidae) and *Cenopalpus irani* (Tenuipalpidae). *Acarologia,* 60(1): 30-39.

Dermauw, W.; Ilias, A.; Riga, M.; Tsagkarakou, A.; Grbic, M.; Tirry, L.;Van Leeuwen, T. and Vontas, J. (2012). The cys-loop ligandgated ion channel gene family of *Tetranychus urticae*: implications for acaricide toxicology and a novel mutation associated with abamectin resistance. *Insect Biochemistry and Mollecular Biology,* 42(7):455-465.

FAO, FAOSTAT Database on Production and FAO Statistics Division, (2015). Food and Agriculture Organization of the United Nations, Rome. Available online at http://faostat.fao.org/ site/339/default.aspx. Accessed 28 Aug 2015.

Hagler, J.R.; Jackson, C.G.; Isaacs, R. and Machtley, S.A. (2004). Foraging behavior and prey interactions by a guild of predators on various lifestages of *Bemisia tabaci*. *En-tomophaga,* 13: 323-329.

Marcela, Massaro, Gilberto J. and De Moraes (2019). Predation and oviposition potential of Brazilian populations of the predatory mite *Amblyseius tamatavensis* (Acari: Phytoseiidae) on eggs of *Bemisia tabaci* (Insecta: Hemiptera). *Acarologia,* 59 (1): 120-128.

Marina, F.C.; Barbosa, M. P. and Elaine C. P. (2019). Functional response of *Amblyseius tamatavensis* Blommers (Mesostigmata: Phytoseiidae) to eggs of *Bemisia tabaci* (Gennadius) (Hemiptera: Aleyrodidae) on five host plants. *Biological Control,* 138:1049-9644.

Messelink, G.J.; Vansteenpaal, S.E.F. and Ramakers, P.M.J. (2006). Evaluation of phytoseiid predators for control of western flower thrips on greenhouse cucumber. *Biological Control,* 51:753-768.

Mortazavi, N.; Fathipour, Y. and Talebi, A.A. (2019). The efficiency of *Amblyseius swirskii* in control of *Tetranychus urticae* and *Trialeurodes vaporariorum* is affected by various factors. *Bulletin Entomology Research,* 109(3): 365-375.

Nomikou, M.; Janssen A.; Schraag R. and Sabelis M.W. (2001a). Phytoseiid predators as potential biological control agents for *Bemisia tabaci*. *Experimental and Applied Acarology*, 25: 270–290.

Nomikou, M.; Janssen, A. and Schraag, R. (2002). Phytoseiid Predators Suppress Populations of *Bemisia Tabaci* on Cucumber Plants with Alternative Food. *Experimental and Applied Acarology,* 27, 57.

Qari, S.H.; Khalil, A.H.; Abdelfattah, N.A.H. and Shehawy, A.A. (2020). Effect of different plant extracts and nanoparticles on *Thrips tabaci* (Lind.) (Thysanoptera: Thripidae) under field conditions and their allelopathic potential on the onion, *Allium cepa* L. using bioassays and RAPD analysis. *Egyptian Journal of Biological Pest Control*, 30(13): 1-8.

Shehawy, A. A.; Maklad, G.H. Ismail and El- Elsaiedy S.M.A. (2021). Predacious Effect of Some Predatory Mites on *Thrips tabaci* Lindeman (Thysanoptera: Thripidae) Infesting Rogina Tomato Hybrid, *African Entomology,* 29(1): 12-223.

Víctor, E.; Tello, M.; Miguel, E. Z. M. and Angélica, M. S. P. (2017). Functional response of *Cydnodromus picanus* (Acari: Phytoseiidae) on red spider mite, *Tetranychus urticae* (Acari: Tetranychidae). *Acta Agronomica Journal*, 66 (2): 275-281.