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(Original Article)

Population Density of the two-Spotted Spider Mite, *Tetranychus urticae* (Koch), and its Effect on the Susceptibility of some Cucumber Cultivars in Summer and Winter Plantation

Tarek M. Abo-Elmaged[1*]; Sanaa M. S. Shehata[2]; Maged. Z Embarak[2]; Mohamed, A. I. Ahamed[1], and Sayed, A. Eraky[1]

[1]Department of Plant Protection, Faculty of Agriculture, Assiut University, Assiut, Egypt.
[2]Plant Protection Research Institute, Agricultural Research Center, Dokki, Giza 12618, Egypt.

*Corresponding author: tarek.adam@agri.aun.edu.eg
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Abstract

Population activity of the two-spotted spider mite, *Tetranychus urticae* (Koch) inhabiting cucumber plants was studied during two successive seasons of 2020 and 2021 at Manflout and Qusia districts, Assiut governorate, Egypt. The eight tested cucumber cultivars slightly differed in population densities of *T. urticae* stages (motile and immotile) in both seasons and areas. The obtained results showed that the spider mite *T. urticae* activity increased in summer plantation during the two studied seasons. Bahie and Barcoda cultivars showed the highest numbers of the pest all stages in Manflout during the summer of 2020, with an average of 30.86 individuals for Bahie cultivar and 40.47 individuals for Barcoda one. Meanwhile, 39 and Barcoda cultivars gave an average of 38.04 and 23.20 individuals at Qusia during both studied seasons. The current study found that all cucumber cultivars were sensitive to the infestation with the two-spotted spider mite, but the sensitivity varies from one cultivar to another.

Keywords: *Cucumber, Mites, Population density, Susceptibility.*

Introduction

The cucumber, (*Cucumus sativus* L.) is an important vegetable crop in Egypt and the world, it is cultivated for local consumption and exportation. Cucumber plants are usually infested by the two-spotted spider mite, *Tetranychus urticae* Koch (Shalaby *et al.,* 2013 and Abo-Elmaged *et.al*., 2021). In Egypt, the cultivated area of cucumber has increased over past years for both local consumption and exportation, reaching about 49702 feddan (1 feddan = 4200 m^2) with 45667 tons production (FAO 2015).

The two-spotted spider mite, *T. urticae* is one of the most important pests inhabiting cucumber plants during all growing stages, vegetative, flowering, and fruiting (Miodrag, 2011; Kanika *et al.,* 2014; Abou El-saad 2015; Thomas and Denmark, 2016 and Abo-Elmaged *et.al*., 2021). The present work was carried out

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to study the effect of planting date (the two studied years, March 2020 to January 2022 during the summer and winter plantations) on the population density of *T. urticae* on cucumber cultivars in addition to studying the susceptibility degree of some cucumber cultivars to the infestation with the pest.

Material and Methods

The present studies were conducted at two experimental farms, Manflout (25 km) and Qusia (45 km) north of Assiut city during two successive seasons, (2020 and 2021) in Assiut Governorate, to study mite fauna infesting cucumber plants.

In each experimental site, an area of about a quarter feddan was chosen and divided into plots, each 3.5 m. long by 3.0 m. wide (1/400 feddan (6 rows/plot)).

Each experimental field was set up as split-plot design, with cucumber cultivar as a main plot treatment and planting date as a sub-plot treatment. Each treatment was replicated 4 times. Eight cucumber cultivars were tested (i.e., Bahie, Barcoda, Emprator, Giza1, 178, Hayel, 39 and Go'ara) and cultivated in two planting dates, summer and winter seasons. The regular conventional agricultural practices were normally performed, and no pesticides were used during the study periods.

After three weeks of transplanting, weekly samples of 10 leaves/plot were taken early morning. The two-spotted spider mite, *T. urticae*, which is considered a phytophagous mite species, samples were separately kept in polyethylene bags and transferred to the laboratory for more careful investigation by the aid of stereoscope microscope of 40-100X magnification force. Numbers of *T. urticae* individuals (egg and motile stages) were counted and recorded.

The susceptibility degrees of the tested cucumber cultivars to the two- spotted spider mite, *T. urticae* infestation were recorded according to Chiang and Talekar (1980) and Nosser (1996).

Chiang and Talekar (1980) and Nosser (1996) indicated that infestation is dependent on the mean number of *T. urticae* individuals per cultivar. The cucumber cultivars that had mean number of *T. urticae* more than Mn+Uc (where Mn= General mean number of *T urticae* individuals and Uc = Unit change in cucumber cultivars) have been considered highly susceptible (HS); ranging from (Mn) to (Mn+Uc), susceptible (S); less than Mn to (Mn – Uc), relatively resistant (RR); ranging from < (Mn – Uc) to (Mn – 2Uc), moderately resistant (MR) and less than (Mn – 2Uc) were considered resistant (R).

Data obtained were statistically analyzed by using the F-test. The means were compared according to Duncan's multiple range test (Snedecor and Cochran, 1971).

Results and Discussion

1. Population density of *T. urticae*

Cucumbers grow quickly within a short time from planting date to the harvest. The main growth stages of cucumber were emergence, vine tip-over,

flowering, and fruit harvest. In general, the number of days from planting to harvest was about 60 days.

The population density of *T. urticae* infesting cucumber plants was recorded by taking weekly samples during the two studied seasons (2020 and 2021) in Manflout and Qusia districts.

Data in Tables (1, 2, 3, and 4) show the mean numbers of spider mite, *T. urtica* (all stages) on eight cucumber cultivars in both districts.

In the 2020 season at Manflout, the spider mite, *T. urtica* started its infestation at high density in early summer season and then increased gradually to reach the peak of infestation for both eggs and motile stages.

The average numbers of the pest (all stages) on cucumber cultivars ranged from 26.10 ind./leaf (on Barcoda cultivar) to 30.86 ind./leaf (on the Bahie cultivar), without significant differences among the eight studied cultivars during the 2020 summer season in Manflout distinct. While, in the winter season in this region, the pest numbers were very low due to the weather conditions that were not suitable for the development of this mite species. (Table 1).

Table 1. Average numbers of *T. urticae* individuals/leaf, on some cucumber cultivars during two planting dates at Manflout district, Assiut, season (2020)

Cultivar	The average number of mite individuals/leaf								
	Egg stage			Motile stages			All stages		
	Planting date		(2) Grand average (C.)	Planting date		Grand Average (C.)	Planting date		Grand average (C.)
	Summer	Winter		Summer	Winter		Summer	Winter	
Bahie	(1) 11.72 ab	0.59 c	6.15 *A*	19.14 a	0.72 b	9.93 *A*	30.86 a	1.31 b	16.08 *A*
Barcoda	9.14 b	0.25 c	4.69 *A*	16.96 a	0.92 b	8.94 *A*	26.10 a	1.17 b	13.64 *A*
Emprator	10.35 ab	0.75 c	5.55 *A*	17.56 a	0.97 b	9.26 *A*	27.91 a	1.71 b	14.81 *A*
Giza1	12.41 ab	0.93 c	6.67 *A*	14.41 a	0.87 b	7.64 *A*	26.82 a	1.80 b	14.31 *A*
178	9.98 ab	0.72 c	5.35 *A*	17.72 a	0.88 b	9.30 *A*	27.69 a	1.60 b	14.65 *A*
Hayel	9.42 ab	0.52 c	4.97 *A*	20.09 a	0.91 b	10.50 *A*	29.51 a	1.42 b	15.47 *A*
39	12.71 a	0.39 c	6.55 *A*	16.28 a	0.94 b	8.61 *A*	29.0 a	1.34 b	15.17 *A*
Go'ara	9.33 b	0.51 c	4.92 *A*	17.80 a	1.03 b	9.41 *A*	27.13 a	1.54 b	14.33 *A*
Grand avg. (P.D.)	10.63	0.58		17.50	0.91		28.13	1.49	
L.S.D =	1.033			1.830			2.214		

(P.D.): planting date, (C.): cultivar.
(1) Means followed by the same small letter(s) are not significantly different at 0.05 level of probability.
(2) Means followed by the same capital letter(s) within the same column are not significantly different at 0.05 level of probability.

In Qusia distinct during the same season (summer 2020), the Giza l cultivar recorded the highest mean number (35.94), and the Barcoda cultivar recorded the lowest one (27.11 ind./lead), with some slight differences between cucumber cultivars. The winter season in Qusia during 2020 also showed a noticeable increase compared to Manflout distinct (Table 2).

Table 2. Average numbers of *T. urticae* individuals/leaf, on some cucumber cultivars during two planting dates at Qusia district, Assiut, season (2020)

Cultivar	The average number of mite individuals/leaf								
	Egg stage			Motile stages			All stages		
	Planting date		(2) Grand average (C.)	Planting date		Grand average (C.)	Planting date		Grand average (C.)
	Summer	Winter		Summer	Winter		Summer	Winter	
Bahie	(1) 11.63bcd	1.52 e	6.57 *ABC*	17.66 bc	7.78 d	12.72 *A*	29.28 bc	9.07 d	19.17 *A*
Barcoda	10.62 cd	0.95 e	5.78 *BC*	16.50 c	3.27 d	9.89 *A*	27.11 c	4.22 d	15.67 *A*
Emprator	14.08 ab	1.20 e	7.64 *AB*	21.78 abc	3.42 d	12.60 *A*	35.86 ab	4.62 d	20.24 *A*
Giza1	15.55 a	0.56 e	8.06 *A*	20.39 abc	3.30 d	11.85 *A*	35.94 ab	3.87 d	19.90 *A*
178	12.06 bcd	0.51 e	6.29 *ABC*	21.86 abc	3.54 d	12.70 *A*	33.92 abc	4.05 d	18.99 *A*
Hayel	13.34 abc	0.47 e	6.90 *ABC*	23.58 ab	3.81 d	13.69 *A*	36.92 ab	4.28 d	20.60 *A*
39	12.80 abcd	0.77 e	6.79 *ABC*	25.24 a	3.06 d	14.15 *A*	38.04 a	3.84 d	20.94 *A*
Go'ara	9.83 d	0.39 e	5.11 *C*	19.72 abc	4.47 d	12.09 *A*	29.55 bc	4.86 d	17.20 *A*
Grand avg. (P.D.)	12.49	0.796		20.84	4.082		33.33	4.849	
L.S.D =	0.965			1.972			2.394		

(P.D.): planting date, (C.): cultivar.
(1) Means followed by the same small letter(s) are not significantly different at 0.05 level of probability.
(2) Means followed by the same capital letter(s) within the same column are not significantly different at 0.05 level of probability.

During the 2021 summer season, cucumber cultivations in Manflout showed an increase in the average number of mites compared to the 2020 summer season (Table 3). The highest average number was recorded for the Barcoda cultivar (40.47 ind./leaf), and the lowest number was 20.54 ind./leaf recorded for the 39 cultivars, with a significant difference between the Barcoda cultivar and the remaining ones. As for the rest cultivars, no differences were recorded between them.

Table 3. Average numbers of *T. urticae* individuals/leaf, on some cucumber cultivars during two planting dates at Manflout district, Assiut, season (2021)

Cultivar	Average number of mite individuals/leaf								
	Egg stage			Motile stages			All stages		
	Planting date		(2) Grand average (C.)	Planting date		Grand average (C.)	Planting date		Grand average (C.)
	Summer	Winter		Summer	Winter		Summer	Winter	
Bahie	(1)8.66 ab	1.66 c	5.16 *A*	16.81 b	3.57 c	10.19 *AB*	25.47 b	5.23 c	15.35 *AB*
Barcoda	9.13 a	0.92 c	5.02 *A*	31.34 a	3.50 c	17.42 *A*	40.47 a	4.41 c	22.44 *A*
Emprator	8.80 ab	1.29 c	5.04 *A*	15.76 bc	2.60 c	9.18 *AB*	24.56 b	3.89 c	14.22 *AB*
Giza1	6.90 b	1.13 c	4.01 *A*	15.55 bc	2.52 c	9.03 *AB*	22.45 b	3.64 c	13.05 *B*
178	8.02 ab	1.75 c	4.89 *A*	15.23 bc	2.92 c	9.07 *AB*	23.25 b	4.67 c	13.96 *AB*
Hayel	8.78 ab	1.49 c	5.14 *A*	15.53 bc	3.71 c	9.62 *AB*	24.31 b	5.20 c	14.75 *AB*
39	7.08 ab	1.30 c	4.19 *A*	13.47 bc	2.62 c	8.04 *B*	20.54 b	3.92 c	12.23 *B*
Go'ara	7.43 ab	1.30 c	4.37 *A*	13.62 bc	2.77 c	8.20 *B*	21.06 b	4.06 c	12.56 *B*
Grand avg. (P.D.)	8.098	1.353		17.17	3.03		25.26	4.38	
L.S.D =	0.644			3.925			4.014		

(P.D.): planting date, (C.): cultivar
(1) Means followed by the same small letter(s) are not significantly different at 0.05 level of probability.
(2) Means followed by the same capital letter(s) within the same column, are not significantly different at 0.05 level of probability.

The data in the current study confirmed with those of Karimi *et al*. (2006), Karaman *et al*. (2007), Amro (2008), El-Saad and Embarak (2009), Abd El-Wahed and El-Halawany (2012), Riahi *et al*.(2013), Abo-Elmaged *et al*. (2021), and Bouchelta and Allam (2023), who recorded that, the highest numerical density of this pest and its development occurs at temperatures ranging between 25-30 °C, wholly in agreement with the present study.

The results in (Table 4) show the mean number of pest individuals on cucumber cultivars during summer 2021 in Qusia distinct. It was noted the average numbers were low compared to the summer season of 2020, and this may be due to the differences in environmental conditions from year to year. The highest average number was recorded on Barcoda variety (23.20 ind./leaf), and the lowest one was recorded in 38 cultivar (11.98 ind./leaf), with some slight differences between cucumber cultivars. The data of winter season of 2021 was similar to the winter of 2020 in terms of average pest count (Table 4).

Table 4. Average numbers of *T. urticae* individuals/leaf, on some cucumber cultivars during two planting dates at Qusia district, Assiut, season (2021)

Cultivar	The average number of mite individuals/leaf								
	Egg stage			Motile stages			All stages		
	Planting date		(2) Grand average (C.)	Planting date		Grand average (C.)	Planting date		Grand average (C.)
	Summer	Winter		Summer	Winter		Summer	Winter	
Bahie	(1) 7.96 b	1.54 d	4.75 *AB*	12.05 ab	3.90 f	7.98 *AB*	20.02 b	5.43 g	12.72 *AB*
Barcoda	9.28 a	1.59 d	5.43 *A*	13.93 a	3.40 f	8.66 *A*	23.20 a	4.98 g	14.09 *A*
Emprator	6.34 c	1.84 d	4.09 *BC*	10.38 bc	4.18 f	7.28 *AB*	16.72 cd	6.02 g	11.36 *BC*
Giza1	5.84 c	1.72 d	3.78 *C*	12.79 a	2.90 f	7.84 *AB*	18.62 bc	4.62 g	11.62 *BC*
178	5.27 c	1.53 d	3.40 *C*	12.76 a	3.22 f	7.99 *AB*	18.03 bc	4.74 g	11.39 *BC*
Hayel	5.37 c	1.62 d	3.50 *C*	9.39 cd	3.73 f	6.56 *BC*	14.77 de	5.35 g	10.06 *CD*
39	5.12 c	1.65 d	3.38 *C*	6.86 e	3.04 f	4.95 *D*	11.98 f	4.69 g	8.33 *D*
Go'ara	5.71 c	1.69 d	3.70 *C*	7.87 de	3.39 f	5.63 *CD*	13.57 ef	5.08 g	9.33 *D*
Grand avg. (P.D.)	6.362	1.647		10.75	3.469		17.11	5.112	
L.S.D =	0.4598			0.7438			0.3113		

(P.D.): planting date, (C.): cultivar

(1) Means followed by the same small letter(s) are not significantly different at 0.05 level of probability.

(2) Means followed by the same capital letter(s) within the same column are not significantly different at 0.05 level of probability.

2. The degree of susceptibility of eight cucumber cultivars to the infestation with two-spotted spider mite, *T. urticae*

Data in Table (5) summarizes the susceptibility of some cucumber cultivars based on the average number of the pest individuals on the leaves of cucumber plants for each cultivar in the Manfalout area. During the first season (summer 2020), the cultivars can be arranged in descending order based on their susceptibility to the pest infestation as follows: Hayel(20.09 ind./leaf), Bahie (19.14 ind./leaf), Go'ara (17.80 ind./leaf), 178 (17.72 ind./leaf), Emprator (17.56 ind./leaf), Barcoda (16.96 ind./leaf), 39 (16.28 ind./leaf), and Giza 1 (14.41 ind./leaf). It is evident that the eight tested cucumber cultivars are susceptible to the infestation with the mite species (*T. urticae*), but to varying degrees. The most

susceptible of these cultivars were Hayel and Bahie, while Barcoda, Giza l and 39 showed relative resistance. In the second season (summer 2021), the Bahie cultivar stayed the most susceptible one, while the rest cultivars gave relative (RR) or moderate resistance (MR). In the first and second winter seasons (2020 and 2021) in Manflout field (Table 5), although the pest was present in very small numbers in the winter season during the two studied years, the susceptibility of the cucumber cultivars was close to the season of development and activity of this pest.

Data in Table (6) show the susceptibility of the same cucumber cultivars grown at the same time in Qusia district. It was found that the obtained results were almost in the same trend as those grown in Manflout, whether in the summer or winter season, during the two years of the study. This is, wholly and partially, in agreement with results obtained by Ola and Hegab (2009), Embarek (2009), Ghallab *et al*. (2011), and Kanika *et al.* (2014), who serve as an ample guide to the current study.

Finally, it can be noted that all cucumber cultivars whether tested in this study or tested by some of the scientists mentioned above are susceptible to the infestation with *T. urticae* with high degree, which causes severe damage to the crop. Therefore, it is necessary to encourage natural enemies (predatory mites) to reduce the number of this pest and avoid using chemicals.

Conclusion

It could be seen that cucumber plants in the growing season, summer, suffer from high numbers of pests. Meanwhile, the plants in winter have less numbers of the two-spotted spider mite, (*T. urticae*). The present study showed that cucumber plants are severely affected by the two-spotted spider mite since a small number of predators such as mites occur, especially during summer plantation. Therefore, it is necessary to encourage predatory mites in different seasons to reduce damage caused by this pest. This work may help with some information to use in the integrated pest management programs for the control of cucumber mite.

Table 5. Average numbers [(a)] and susceptibility degrees of certain Cucumber cultivars to *T. urticae*, during the 2020 and 2021 seasons, at Manflout district, Assiut Governorate

Cucumber cultivars	2020				2021				MEAN			
	Summer		Winter		Summer		Winter		Summer		Winter	
	Mean ± SD	Sus. D.	Mean ± SD	Sus. D.	Mean ± SD	Sus. D.	Mean ± SD	Sus. D.	Mean ± SD	Sus. D.	Mean ± SD	Sus. D.
Bahie	19.14±6.09 a	S	0.72±0.34 a	RR	16.81±4.93 ab	S	3.57±1.82 a	S	17.97±5.47 a	S	2.14±0.89 a	S
Barcoda	16.96±3.64 a	RR	0.92±0.15 a	S	15.72±1.75 a	RR	3.50±1.65 a	S	16.34±1.42 a	RR	2.21±1.27 a	S
Emprator	17.56±6.81 a	S	0.96±0.32 a	S	15.76±4.73 ab	RR	2.60±1.64 a	RR	16.66±5.18 a	S	1.78±0.68 a	RR
Giza1	14.41±6.60 a	RR	0.87±0.29 a	S	15.55±4.57 ab	RR	2.51±1.24 a	RR	14.98±5.0a	RR	1.69±0.49 a	RR
178	17.72±6.95 a	S	0.88±0.24 a	S	15.23±4.78 ab	RR	2.92±1.33 a	RR	16.48±5.81 a	S	1.90±0.74 a	RR
Hayel	20.09±6.47 a	S	0.91±0.31 a	S	15.53±2.77 ab	RR	3.71±1.99 a	S	17.81±3.43 a	S	2.31±1.02 a	S
39	16.28±1.98 a	RR	0.94±0.38 a	S	13.47±3.82 b	MR	2.62±1.25 a	RR	14.88±1.75 a	RR	1.78±0.54 a	RR
Go'ara	17.80±6.33 a	S	1.03±0.26 a	S	13.62±2.50 b	MR	2.77±0.64 a	RR	15.71±4.18 a	RR	1.90±0.27 a	RR
Mean	17.495±5.41 **A**		0.905±272 B		15.212±3.60 **A**		3.024±1.398 **B**		16.353±3.96 **A**		1.934±0.73 **B**	
F-value	0.7464		0.6969		0.9091		1.5467		0.7918		0.8144	

(a) Based on 5 cucumber leaves / plot. Means followed by the same letter(s), in each column are not significantly different at 0.05 level probability, by Duncan's multiple range test. Means followed by the same **bold** capital letter, in each row, are not significantly different at 0.05 level probability, by Duncan's multiple range test. HS= Highly Susceptible, S= Susceptible, RR= Relatively Resistant, MR= Moderately Resistant, R= Resistant, Sus. D. = susceptibility degree.

Table 6. Average numbers [(a)] and susceptibility degrees of certain Cucumber cultivars to *T. urticae*, during the 2020 and 2021 seasons, at Qusia district, Assiut Governorate*

Cucumber cultivars	2020				2021				MEAN			
	Summer		Winter		Summer		Winter		Summer		Winter	
	Mean ± SD	Sus. D.	Mean ± SD	Sus. degree	Mean ± SD	Sus. D.	Mean ± SD	Sus. degree	Mean ± SD	Sus. D.	Mean ± SD	Sus. D.
Bahie	17.66±6.70 b	S	7.78±7.48 a	RR	12.05±1.48 ab	S	3.90±1.29 ab	S	14.86 ±3.10 ab	RR	5.73 ±3.22 a	HS
Barcoda	16.50±3.35 b	RR	3.27±0.64 cd	S	13.93±4.31 a	RR	3.39±1.02 abc	S	15.21 ±3.21 ab	RR	3.33 ±0.38 b	S
Emprator	21.78±3.92 ab	S	3.42±1.03 cd	S	10.38±2.98 bc	RR	4.18±0.95 a	RR	16.08 ±2.59 ab	S	3.80 ±0.70 ab	S
Giza1	20.39±6.99ab	RR	3.30±0.84 cd	S	12.79±2.87 ab	RR	2.90±0.34 c	RR	16.59 ±4.79 a	S	3.10 ±0.51 b	MR
178	21.86±5.66 ab	S	3.54±0.56 cd	S	12.76±2.95 ab	RR	3.22±0.86 abc	RR	17.31 ±4.16 a	S	3.38 ±0.57 b	RR
Hayel	23.58±2.70 a	S	3.81±1.1 c	S	9.39±1.81 cd	RR	3.73±1.36 abc	S	16.48 ±2.21 ab	S	3.77 ±0.83 ab	S
39	25.24±4.99 a	RR	3.06±0.89 d	S	6.86±2.87 e	MR	3.04±0.36 bc	RR	16.05 ±2.22 ab	S	3.05 ±0.58 b	MR
Go'ara	19.72±8.31 ab	S	4.47±0.73 b	S	7.87±2.37 de	MR	3.39±0.76 abc	RR	13.79 ±5.0 b	RR	3.93 ±0.73 ab	S
Mean	20.84±5.67 **A**		4.082±2.85 **B**		10.75±3.47 **A**		3.469±1.398 **B**		15.796 ±3.31 **A**		3.761±1.393 **B**	
F-value	2.9605		1.1882		10.6726		2.2394		1.8172		1.5804	

* See footnotes of table 5

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الكثافة العددية للحلم العنكبوتي ذو البقعتين (*Tetranychus urticae* Koch) وتأثيرها على حساسية بعض أصناف الخيار في العروة الصيفي والشتوي

طارق محمد أبو المجد[1]، سناء شحاته[2]، ماجد زاهي مبارك[2]، محمد أحمد إبراهيم[1]، السيد على محمد العراقى[1]

[1]قسم وقاية النبات، كلية الزراعة، جامعة أسيوط، أسيوط، مصر.
[2]معهد بحوث وقاية النبات، المركز القومي للبحوث، الدقي، الجيزة، مصر.

الملخص

تمت دراسة نشاط افراد الحلم العنكبوتي ذو البقعتين (Tetranychus *urticae* Koch) التي تتواجد على ثمانية اصناف من نباتات الخيار بمحافظة أسيوط خلال موسمين متتاليين لعامي 2020 و2021 في منطقتي منفلوط والقوصية. حيث تأثرت الكثافة العددية للأكاروس (الافراد الساكنة والمتحركة) بشكل طفيف على اصناف الخيار المختبرة خلال كلاً من موسمي ومنطقتي الدراسة. ولقد أظهرت النتائج المتحصل عليها أن نشاط الحلم العنكبوتي ذو البقعتين *T. urtica* زاد في العروات الصيفية خلال موسمي الدراسة، كما أظهر الصنف باهي والصنف باركود أعلى تعداد للآفة (للأفراد الساكنة والمتحركة) في منطقة منفلوط خلال صيف 2020 بمتوسط 30.86 فرداً للصنف باهي، 40.47 فرداً للصنف باركود. بينما أعطى الصنف 39 والصنف باركود متوسطاً بلغ 38.04 و23.20 فرداً في زراعات القوصية على التوالى.

ومن خلال الدراسة الحالية تبين أن جميع أصناف الخيار كانت حساسة للإصابة بالآفة، إلا أن الحساسية تختلف من صنف إلى آخر.

الكلمات المفتاحية: *الحساسية، الحلم، الخيار، الكثافة العددية.*