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STUDY OF SEASONAL PRESENCE, PERCENTAGE, AND SEVERITY INFESTATION OF TWO-SPOTTED MITE *TETRANYCHUS URTICAE* (ACARI: TETRANYCHIDAE) AND THE ESTIMATION OF THE ECONOMIC LOSS IN CUCUMBER *CUCUMIS SATIVUS*

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Abstract

The study was conducted at the Mistry of Agriculture - plant protection department, Baghdad- Iraq. The study aimed to investigate the seasonal presence, percentage and severity of the two-spot mite *Tetranychus urticae* infestation, and estimate the economic loss of the cucumber (Fall 2019). The results revealed the two-spot mite started to emerge on the cucumber *Cucumis sativus* in the first week of October to the second week of December 2019. The percentage of the plants infested by *T. urticae* was 40%, the leaves infestation was 26.6%, and the severity of the infection was 4.1 in the first week of October. Our study showed increasing all the measured characteristics gradually till 100% leaves and plants infection 80 severity of infestation was in the second week of December. The study reported about 30% cucumber yield loss. The average yield of a single infested plant (570 g/plant) significantly less than the control (823.5 g/plant).

Key words : *Tetranychus urticae,* Acari: Tetranychidae, *Cucumis sativus.*

Introduction

Cucumber, *Cucumis sativus* is an important vegetable crop and is widely cultivated in Iraq and the world, it is a monoecious plant, climber or creeper, and it is believed that the cucumber is one of the oldest vegetables cultivated by man as stated in ancient documents (Wehner and Guner, 2004). Due to *C. sativus* contains many nutritions such as calcium, potassium, vitamin C, B1, and B2, which makes it an important crop (Arnaout, 1980). Cucumber planted area for 2018 was 69502 Dunums and the total yield reached ~149, 302 Tons (Central statistical organization, 2019). Many pests infest the cucumber which decreases the yield, one of the most important pests is the two-spot mite, *Tetranychus urticae* (Acari: Tetranychidae). *T. urticae* attacks about 150 plants species at the field and about 300 plant species at the greenhouse, the most recent list of the plant families host showed that it affects 1,200 plant species belonging to 70 genus (Al-Mallah, 2015), Gerson and Aranowitz (2013) reported that *T. urticae* is responsible for 80% loss of the planted area. The *T. urticae* feeds on the chlorophyll in the cells of the lower surface of the leaves and the damage appears on the upper surface of the leaf in the form of white or yellow spots, and with sever infestation, the spots turn to brown color and the *T. urticae* secretes silk webs during on the plant which accumulates dirt causing dryness leaf and eventually dies, severe infestation may lead to plant death (Al-Mallah, 2015).

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Materials and methods

Cucumber, Rashid cultivar (Delta Seeds company, Dutch), was planted in an area of 450 m^2 on 9/11/2019, at the plant protection department - Mistry of Agriculture, Baghdad (Abu Ghraib) - Iraq. The experiment was conducted in Randomized Complete Block Design (RCBD), three repeaters, each rep. 3 rows 15 m each (Sahuki and Waheeb, 1990). The seeds were planted

directly on both sides of each row, 30 cm between every two seeds. All the recommendations were done (Al-Sahaf, 2011).

1. Seasonal presence of *T. urticae*

The seasonal presence and population density of *T. urticae* were determined via weekly sampling program, which started from the second week of September till the second week of December 2019. The sampling was done by taking 30 leaves randomly (cross-sectional) from the total planted area, placed the leaves in paper bags, and transferred directly to the laboratory. *T. urticae* density was calculated for each stage by using an optical microscope. The numbers of the different mite stages were calculated in each of the examined plant leaves.

2. Calculating the average of the infestation and severity of *T. urticae*

Ten plants were sampled weekly from the total planted area (cross-sectional) to find the percentage and severity of the *T. urticae* infestation. Also, in this examination, the total number of leaves/each plant and the number of infected leaves were calculated and recorded in special forms (previously prepared).

The percentage of the infested plants = the number of the infested plants / the total number of plants × 100.

The percentage of the infested leaves = the number of the infested leaves / the total number of plants × 100.

Also, in this study, the severity of the infestation was calculated using the equation of McKinney (1923) and the following criterion was given according to the number of tunnels for each infested leaf.

In this study, a standard for the infestation severity was designed based on the average number of mite/leaf (Fall 2019).

Table 1: Infestation severity standard based on the average number of mite/leaf.

Category	The number of mite/leaf
0	0
1	1-5
2	6-15
3	16-25
4	26 more

Infestation Severity =

$$\frac{(\text{The no. of leaves of a degree } 0 * 0) + - - + \text{The no. of leaves of a degree } 3 * 3)}{\text{The highest degree} * \text{Total number of leaves}} \times 100$$

3. The economic loss calculation

The economic loss was calculated in the total yield of the cucumber fruits (Infested by *T. urticae*) using Paired Treatment Experiments (Dent, 2000), whereby a group of plants was treated with a specialized pest control a pesticide, while the second group is left for the natural infestation, One block (sector) was selected and treated regularly every 15 days with a specialized pesticide for mite control, Vertimec acaricide/insecticide (active ingredient abamectin 1.8 EC) 2.5 ml/5 liters concentration. A total of 20 plants were selected 10 from the treated and 10 from the non-treated block (sector) to find out the yield for each plant.

The equations below were used for estimating the economic loss

The yield without infestation per the unit area (kg) = the number of plants × average of the treated plants (kg)

The yield with infestation per the unit area (kg) = the number of plants × the average of the untreated plants (kg)

The economic loss per the unit area (kg) = the yield without infestation (kg) - the yield with infestation (kg).

% The economic loss =

$$\frac{\text{The yield without infestation (kg)} - \text{The yield with infestation (kg)}}{\text{The yield without infestation (kg)}}$$

a = the average yield of treated plants (g)

b = the average yield of untreated plants (g)

Los = the economic loss (g)

L = % of the economic loss

Los/Plant = a - b

Results and Discussion

1. Seasonal presence of *T. urticae*

The data of Fig. 1 showed the seasonal presence estimation and the adult mite population density (Fall 2019), which indicated the *52*infestation on cucumber plants was in the first week of October (Temp. 39, 20.4 ° C day, night; RH 29.8%). The infestation number was gradually increased which reached 29.64 adult/leaf in the fourth week of the same month (Temp. 31.1, 17.8 ° C day, night; RH 50.2%). The highest peak of the *T. urticae* adults during the season was 56.07 adult/leaf in the second week of November (Temp. 28; 12.4 ° C day, night; RH 48.5%), after that, the peak started to decline gradually till the last week of November (26.36 adult/leaf) (Temp. 22.2, 5.3 ° C day, night; RH 43.2%). The lowest peak of *T. urticae* adult was in the second week of December (12.11 adult/leaf) (Temp. 19.4, 8.6 ° C day, night; RH 74.1%).

The data of Fig. 1 showed that the density of the

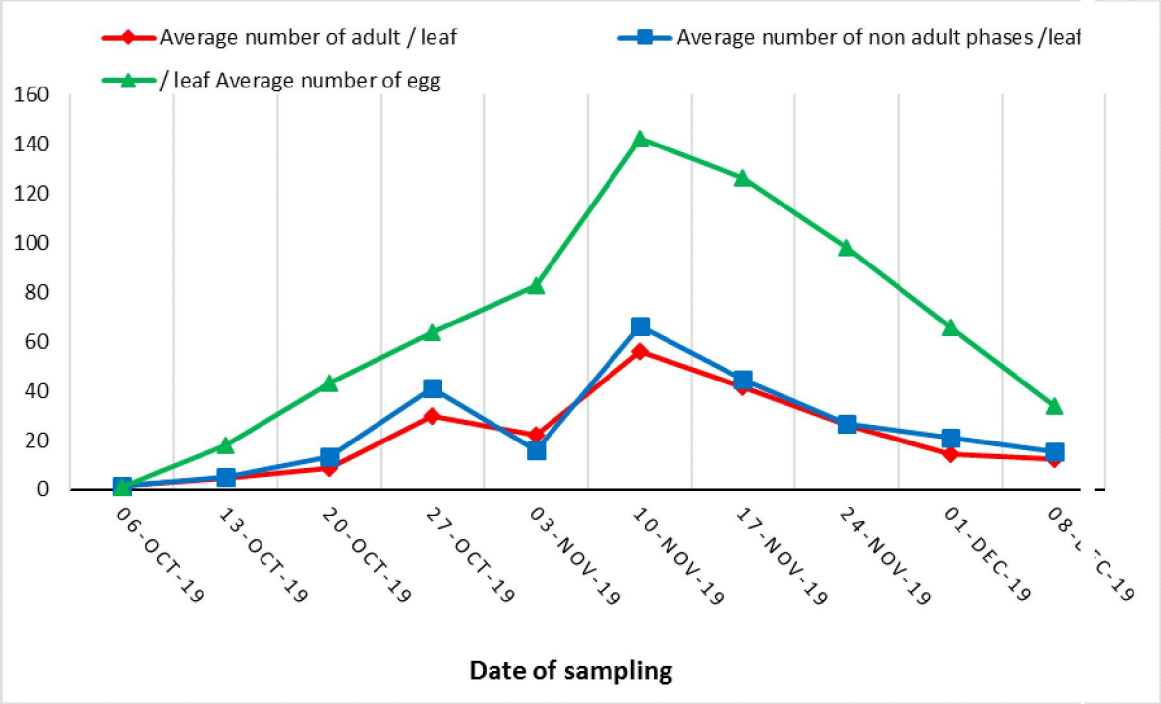

Fig. 1: Seasonal presence of *Tetranychus spp* on cucumber (Fall 2019).

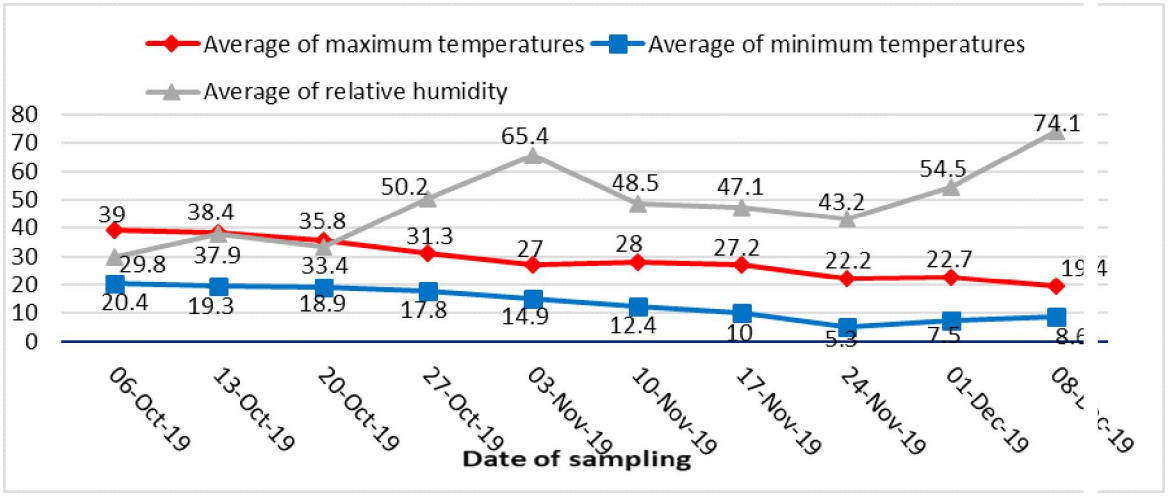

Fig. 2: Maximum and Minimum temperatures and relative humidity (Fall 2019).

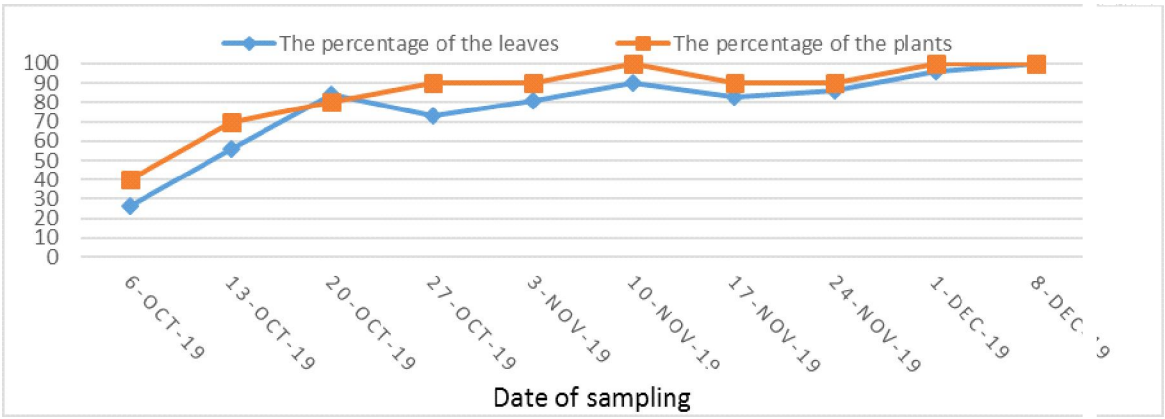

Fig. 3: The percentage of the leaves and plants *of Tetranychus spp* and severity on cucumber (Fall 2019).

mobile stages (larvae and nymphs) and the eggs were similar to the density of the adults. The highest number of the larvae and the nymphs in (66.22 individual/leaf) and the average number of the eggs is 142.11 egg/leaf. The lowest average of the larvae and the nymphs were recorded in the second week of December (15.15 individual/leaf) and the egg 34.1 egg/leaf, by the end of the growing season.

We conclude from the results that the *T. urticae* is a very important pest on cucumber (existing at the entire growing season). However, the density was fluctuating according to environmental conditions and the effectiveness of the biological control agent. Moreover, this pest, as an adult stage, enters a dormant phase on the remaining plants or the bush (weed) close to the field. Our results are in agreement with Al-Mallah and Abdullah (1990), which states that the average of the *T. urticae* life cycle (egg - adult) 31.1 days (Temp. 25 ± 1 ° C; RH 60 ± 1%); the average of egg-laying for an adult female was 81.7 eggs, the incubation period for each of the egg, larva, nymph, adult requires an average of 6.2, 2.3, 13.3, and 6.1 days, respectively. Our results are in agreement with a study conducted by Fayoud (2007), that study highlighted the average of the developmental stages of the two-spot mite on the cucumber from egg to the adult (11.22 days) (Temp. 25 ± 4 ° C; RH 65% ± 5), the adult female can lay 4.47 egg/day, an adult requires a pre-oviposition period on a vegetable host last for two days as. The reason for that is the average of eggs increases with increasing the host richness Increases; however, if host richness is not good enough, the plant is going to be subjected to wilt and damage due to the feeding of the mite. These results are in agreement with Marjorie (2011) study, that mentioned the life cycle of the *Tetranychus* spp mite could last from 3 up to 5 days (Temp. 25 - 30 ° C), as the female lays more than 30 egg/day for a week, approximately; however, it depends on temperature, and the average female life cycle ranges from 7-10 days.

2. The percentage of the infestation and severity of *T. urticae*

The data of Fig. 3 showed the percentage of the leaves and plants *Tetranychus* app infestation which indicated the first week of October 2019 was the first appearance of the infestation, as the infestation percentage of plants 80%, the leaves 44%, (Temp. 39, 20.4°C day, night; RH 29.8%). The infestation percentage of plants and leaves increased to 100% in the first week of December Temp. 19.4, 8.6 ° C day, night; RH 74.1%). Interestingly, the *Tetranychus* spp accompanied the cucumber crop from the beginning of its growth, which clearly affected the growth and yield of the crop.

The infestation percentage considers as a standard descriptive which may not reflect the damage of the pest to a crop. Therefore, the standard severity of the infestation must be used in order to be more meaningful of the damage and the relationship between the arthropod and the plant. And the results of the table 2 showed that the infestation severity appeared very low (4.1) at the beginning of the growing season, and then, the population density of the mite started to increase, the infestation severity appeared very high (86), at the second week of November. The conclusion of that is 95% of the plant leaves contain 86 mite/leaves.

Table 2: Severity *Tetranychus urticae* on cucumber (Fall 2019).

Severity	The date of sampling
4.1	6/10/2019
36	13/10/2019
61	20/10/2019
65	27/10/2019
57	3/11/2019
86	10/11/2019
80	17/11/2019
83	24/11/2019
84	1/12/2019
80	8/12/2019

3. The economic loss calculation

Table 3 shows that the average yield of the treated plant (823.5 g/plant) and the untreated plant (570 g/plant) during the growing season. From the calculation of the economic loss, the following is observed:

The economic loss per plant (g) = the average of the

Table 3: Average of the treated plants g) and average of the untreated plants (g) on cucumber (Fall 2019).

The average and weight yield/ plant(g)		Date of yield
The treated plant	The untreated plant	
62.5	38.6	27/10/2019
57.5	29.4	30/10/2019
95	42.3	3/11/2019
118	57.2	7/11/2019
87.7	76.8	10/11/2019
116.8	109.7	13/11/2019
52.8	48.4	17/11/2019
55.2	44.6	20/11/2019
53.5	39.7	24/11/2019
66.5	46.8	28/11/2019
32.2	21	1/12/2019
25.8	15.5	4/12/2019
823.5	570	Total

treated plants - the average of the untreated plants

= 823.5-570 =253.5 g / plant

% of the economic loss per plant =

$$\frac{\text{The average of the treated p.(g) - The average of the untreated p.(g)}}{\text{The yield with infestatio n}} \times 100$$

% The economic loss =

$$\frac{823.5 - 57}{823.5} \times 100 = 30.7\%$$

The yield without infestation per the unit area (kg) = the number of plants x average of the treated plants (kg)

= 720 * 0.823 =592.5 g/450m^2

The yield with infestation per the unit area (kg) = the number of plants x the average of the untreated plants (kg)

= 720*0.570=410.4 kg/450 m^2

/450 m2=592.5-410.4=182.1 kg/450 m^2 % of the economic loss

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