Population Dynamic of the Two-Spotted Spider Mite, *Tetranychus urticae* Koch and its Associated Insect Predators on some Okra Varieties

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Abstract:

The current study focused on the two-spotted spider mite, *T. urticae* and its associated insect predators on some okra varieties, cultivated in the farm of the Faculty of Agriculture, Assiut University. In this study, the mite and three insect predators were surveyed on eight okra varieties. The simultaneous impact of certain environmental variable factors and other factors on the census of the mite pest and its predators revealed that, temperature, relative humidity and plant age were the most vital factors influenced the population densities of these species. On the other side, the sensitivity of okra varieties to the pest injury and the success of predation depend mainly on the intensity of the capillaries on the plant leaves. In the present study, it become clear that, the okra varieties with heavy capillaries leaves (such as: Lee and Askandrany) hinder predation of mite predators and at the same time is considered a refuge and protection of the mite pest.

The census of the two-spotted spider mite eggs and motile stages on okra varieties revealed that, all the pest stages increased to enumerate through the summer season and the least number was recorded during winter one, while the rest two seasons were inbetween.

Keywords: The two-spotted spider mite, okra varieties, population dynamics, insect predators.

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Introduction:

The two-spotted spider mite, *Tetranychus urticae* Koch is considered one of the most dangerous mite species of the family Tetranychidae. It is difficult to manage this group of pests by using chemical compounds because a kind of resistance can be developed within few years (Geoghiou, 1990). Therefore, it was necessary to use certain other control tactics such as the use of biological control agents or the use of the more resistant plant varieties and planting dates in order to decrease the number of this pest. The predaceous mite species belonging to the Mesostigmata and Prostigmata are among the most promising bioagent of spider mites. Certain authors studied the biology of predaceous mite species (Gerson and Smiley, 1990; Mc Murtry and Croft, 1997 and Osman, 2005); feeding capacity and activity (Fouly, 1997; Skirvin and Williams, 1999 and Osman, 2000) and the effectiveness of the predacious mite species on various crops in both greenhouses and open field (Pickett and Gilstrap, 1986 and El-Laithy, 1992). On the other hand, some insect species are also known to have the ability to control spider mites: predatory thrips, lady bugs and staphylinid species (Kishimoto, 2003 and Roy *et al*., 2003). The predaceous *Stethorus* species (Coleoptera: Coccinellidae) are acariphagous where they feed successfully on spider mites (Kishimoto, 2003 and Ragkou *et al*., 2004). However, the present study has focused on trying to combat the two-spotted spider mite through the use of certain okra varieties by measuring their susceptibility to the injury of this pest.

Materials and Methods:

The present work was carried out in order to study the interrelationships between the two-spotted spider mite, *T. urticae* Koch and its predators on certain okra varieties.

Seasonal abundance of the two-spotted spider mite, *T. urticae* and its associated predators inhabiting some okra varieties:

Experiments were conducted in the Experimental Farm of the Faculty of Agriculture, Assiut University, during the growing season of 2011.

a. Area of study:

The experimental sites chosen for the purpose of conducting the present study are rather mosaic agroecosystem that have been planted with vegetables, field crops and orchards. In each experiment site of okra varieties, an area of about quarter feddan was chosen and divided into plots, each of 3.5 m length and 3.0 m width (1/400 feddan).

Regular culture practices were applied as recommended for okra production and no pesticide treatments were used during the study period.

b. Okra varieties used:

Eight okra varieties were tested and cultivated in a single sowing date (i.e., April 4th 2011). The tested okra varieties (Lee, Kna, Boza Swan, Klemon sbenals, Baldy, Sbaa elst, Oraby and Askandrany) were obtained from the Agriculture Research Centre, Assiut, Egypt. All varieties were distributed in a randomized complete block design, and each variety was replicated five times.

c. Sampling and counting procedures:

Weakly samples of 3 leaflets were randomly picked up at early morning from each plot of all okra varieties. The top, middle and bottom

plant leaves were also taken into consideration.

Eggs and motile stages of mite and the associated predators were weekly counted during the studied period on all okra varieties.

d. Meteorological data:

Weekly means of temperature (max. and min.), relative humidity (max. and min.) and temperature at 5 cm depth under soil of okra plant (max. and min.) within inspected period were the tested meteorological factors in addition to the plant age for population analysis of okra phytophagous mite and the associated predators. Data were compared in order to distinguish the differential responses among the population density of the mite species. Records of abiotic factors were obtained from the Meteorological station located at the Exp. Farm, Fac. Agric., Assiut University.

e. Statistical analysis:

Data obtained were statistically analysed by using a randomized complete block design with five replicates. Means were compared according to Duncan's Multiple Range Test.

Results:

1. Seasonal abundance of the two-spotted spider mite, *T. urticae* and its associated insect predators inhabiting okra plants:

The seasonal activity of the pest on okra varieties was started during the period from May to November, 2011 (Table 1). The mite population on okra varieties sown during the first week of April was appeared at the 4th week after sowing (2nd week of May) with 24.66 individuals/3 leaves, then increased in number to reach it's the first peak of incidence during the third week of June (33.33 mite individuals/3 leaves). The second population peak of mite species was noticed during the second fortnight of August (41.01 individuals/3 leaves).

A gradual descent in mite population was started from the last week of August (35th standard week), till the second week of September (14.67 individuals/3 leaves). An increase in the population level was recorded during 38th till 42nd standard weeks, when reached to its maximum number (30.66 individuals/3 leaves), then declined gradually at 46th standard week to be 24.00 individuals/3 leaves**.**

Regarding of the mite insect predators, the lady bird beetle, *Coccinella undecimpunctata* L. population was noticed during the first week of May (0.33 individuals/plant), fluctuated in general during the growing season reached its population peak at the second fortnight of May (1.33 individuals/plant). The incidence of this species was noticed till the end of the crop period.

The scymnus lady beetle, *Scymnus punctillum* Mars. population was appeared during the first week of June (23rd standard week), with very low numbers during all the season.

Table (1): Seasonal abundance of the two-spotted spider mite, *T. urtice* and the associated insect predators inhabiting okra plants, during 2011 season.

Sampling date	Standard week	No. mite/3 leaves	No. predator/plant	
			Coccinellid	*Scymnus*
3/5/2011	18	0.00	0.33	1.00
10/5/2011	19	24.66	1.00	1.00
17/5/2011	20	25.32	0.00	0.33
24/5/2011	21	27.00	1.33	0.67
31/5/2011	22	29.01	0.33	0.67
7/6/2011	23	30.00	0.67	0.33
14/6/2011	24	32.01	0.33	2.00
21/6/2011	25	33.33	0.00	1.00
28/6/2011	26	18.66	0.33	0.00
5/7/2011	27	30.17	0.33	0.33
13/7/2011	28	30.00	0.50	0.00
20/7/2011	29	29.51	0.17	0.00
27/7/2011	30	29.18	0.33	0.17
3/8/2011	31	29.49	0.50	0.00
10/8/2011	32	36.00	0.67	0.00
17/8/2011	33	38.34	1.00	0.00
24/8/2011	34	41.01	0.33	0.00
31/8/2011	35	35.34	0.33	0.33
7/9/2011	36	31.32	0.00	0.00
14/9/2011	37	14.67	0.17	0.00
21/9/2011	38	25.68	0.33	0.00
28/9/2011	39	26.67	0.33	0.00
5/10/2011	40	27.33	0.67	0.00
12/10/2011	41	29.01	0.33	0.00
19/10/2011	42	30.66	0.00	0.00
26/10/2011	43	29.34	0.33	0.00
2/11/2011	44	27.99	0.33	0.00
9/11/2011	45	25.32	0.50	0.00
16/11/2011	46	24.00	0.33	0.00

Lady beetle, Scymnus population on crop was observed during the first week of May (1.00 individuals/plant) reached its maximum level (2.00 individuals/plant) at the second week of June 14th (24th standard week). Afterwards, the population declined steadily and sharply with a very low level (0.17 individuals/plant) and disappeared completely from the second week of July till the end of the period.

2. Simultaneous effect of certain environmental factors on the population fluctuation of the two-spotted spider mite, *T. urticae* and its associated insect predators on okra plants:

The numerical values of the correlation co-efficient have been presented in Tables 2-4. It is obviously indicated that, the maximum and minimum relative humidity showed negative correlations with the population of all stages of the two-spotted spider mite. However, all other tested factors (maximum and minimum temperature; maximum and minimum temperature at 5 cm of soil depth) as well as the plant age were positively correlated.

The multiple regression coefficients (R) for the season period were found to be (R= 0.6094, 0.6282, 0.6972). The results revealed that the weather factors were considered the limiting important factors responsible for 37.14, 39.47, 48.60% of the population changes of eggs, nymphs and adults, respectively.

Moreover, the numerical values of correlation co-efficient of the pre-

dacious insect species have been presented in Tables 5-7. The maximum and minimum relative humidity only showed positive correlations with the population of the common green lacewing**,** *Chrysoperla carnea*, Lady bird beetle, *C. undecimpunctata* and the scymnus lady beetle, *S. punctillum*. However, all other tested factors were negatively correlated.

The multiple regression coefficients (R) for the season period were found to be (R= 0.5203, 0.7289, 0.6621) with coefficients of determination of 27.07%, 53.12%, 43.84% for *C. carnea*, *C. undecimpunctata* and *S. punctillum*, respectively. The results proved that, the weather factors were considered the limiting factors of the population changes of the predaceous insects.

Table (2): Simple and partial correlations and relative efficiency of temperature (°C), relative humidity (%), temperature at 5 cm of soil depth and plant age in relation to the population of *T. urticae* eggs during the studied season.

Independent variable		Simple corr. (r)	Partial corr. (P. R)	Co-efficient of determination R^2 X100	Relative efficiency	Rank
Temperature (°C)	Maximum	0.32537	0.061	37.14%	0.369	7
	Minimum	0.37892	0.170		2.997	3
Relative humidity (%)	Maximum	-0.37438	0.235		5.859	2
	Minimum	-0.50355	0.441		24.203	1
Temperature 5cm (°C)	Maximum	0.16526	0.845		0.722	6
	Minimum	0.24123	0.114		1.317	5
Plant age		0.12519	0.128		1.679	4
Multiple correlation (R)		0.6094				

Table (3): Simple and partial correlations and relative efficiency of temperature (°C), relative humidity (%), temperature at 5 cm of soil depth and plant age in relation to the population of *T. urticae* nymphs during the studied season.

Independent variable		Simple corr. (r)	Partial corr. (P. R)	Co-efficient of determination R^2 X100	Relative efficiency	Rank
Temperature (°C)	Maximum	0.33418	0.010	39.46%	0.012	7
	Minimum	0.40574	0.140		2.223	3
Relative humidity (%)	Maximum	-0.38463	0.212		5.225	2
	Minimum	-0.51718	0.457		29.293	1
Temperature 5cm (°C)	Maximum	0.18103	0.093		0.967	5
	Minimum	0.26826	0.122		1.671	4
Plant age		0.19323	0.026		0.749	6
Multiple correlation (R)		0.6282				

Table (4): Simple and partial correlations and relative efficiency of temperature (°C), relative humidity (%), temperature at 5 cm soil depth and plant age in relation to the population of *T. urticae* adults during the studied season.

Independent variable		Simple corr. (r)	Partial corr. (P. R)	Co-efficient of determination R^2 X100	Relative efficiency	Rank
Temperature (°C)	Maximum	0.33816	0.003	48.60%	6.000	3
	Minimum	0.40624	0.106		1.036	6
Relative humidity (%)	Maximum	-0.40486	0.218		4.548	4
	Minimum	-0.53552	0.502		30.624	1
Temperature 5cm (°C)	Maximum	0.24438	0.092		0.746	7
	Minimum	0.38336	0.320		10.346	2
Plant age		0.15644	0.118		1.280	5
Multiple correlation (R)		0.6972				

Table (5): Simple and partial correlations and relative efficiency of temperature (°C), relative humidity (%), temperature at 5 cm depth (°C) and plant age in relation to the population of *C. carnea* adults on okra plant, during 2011 season.

Independent variable		Simple corr. (r)	Partial corr. (P. R)	Co-efficient of determination R^2 X100	Relative efficiency	Rank
Temperature (°C)	Maximum	-0.06663	0.179	27.07%	2.452	3
	Minimum	-0.37869	0.441		17.954	1
Relative humidity (%)	Maximum	0.00450	0.139		1.467	4
	Minimum	0.04072	0.086		0.551	6
Temperature 5cm (°C)	Maximum	-0.17174	0.114		0.972	5
	Minimum	-0.10041	0.215		3.599	2
Plant age		-0.22751	0.034		0.085	7
Multiple correlation (R)		0.5203				

Table (6): Simple and partial correlations and relative efficiency of temperature (°C), relative humidity (%), temperature at 5 cm depth (°C) and plant age in relation to the population of *C. undecimpunctata* adults on okra plant, during 2011 season.

Independent variable		Simple corr. (r)	Partial corr. (P. R)	Co-efficient of determination R^2 X100	Relative efficiency	Rank
Temperature (°C)	Maximum	-0.54119	0.144	53.12%	3.845	5
	Minimum	-0.66688	0.311		19.519	1
Relative humidity (%)	Maximum	0.25965	0.187		6.585	4
	Minimum	0.27136	0.232		10.349	3
Temperature 5cm (°C)	Maximum	-0.21170	0.041		0.312	7
	Minimum	-0.38133	0.048		0.413	6
Plant age		-0.60632	0.250		12.107	2
Multiple correlation (R)		0.7289				

Table (7): Simple and partial correlations and relative efficiency of temperature (°C), relative humidity (%), temperature at 5 cm depth (°C) and plant age in relation to the population of *S. punctillum* adult on okra plant, during 2011 season.

Independent variable		Simple corr. (r)	Partial corr. (P. R)	Co-efficient of determination R^2 X100	Relative efficiency	Rank
Temperature (°C)	Maximum	0.13466		43.84%	13.697	1
	Minimum	-0.23881			9.633	3
Relative humidity (%)	Maximum	-0.00045			2.470	5
	Minimum	0.21641			10.065	2
Temperature 5cm (°C)	Maximum	0.00618			2.120	6
	Minimum	-0.22235			5.691	4
Plant age		-0.10107			0.168	7
Multiple correlation (R)		0.6621				

3. Impact of okra varieties on the population size of the phytophagous mite and the associated insect predators:

Evaluation of resistance of the eight okra varieties (viz., Lee, Kna, Boza swan, Klemon sbenals, Baldy, Sbaa elst, Oraby, Askandrany) against the spider mite, *T. urticae* and

the associated predators was summarized in Tables (8-13).

a. Screening of okra varieties against the two-spotted spider mite, *T. urticae* eggs.

The Acari populations Table (8) at May (one month after sowing) revealed that, the Baldy and Kna varieties recorded less egg numbers of (9.99 and 11.34 eggs/3 leaves/month). Lee and Askandrany recorded the highest levels of (32.34 and 31.65 eggs/3 leaves/month). Klemon sbenals and Oraby were on par with each other by recording (23.01 and 20.31 eggs/3 leaves/month). Boza swan and Sbaa elst were on par with each other by recording (17.65 and 16.35 eggs/3 leaves/month).

At June, okra varieties (Kna and Baldy) recorded less egg numbers of (23.67 and 25.35 eggs/3 leaves/month). Lee and Askandrany recorded the highest levels of (54.36 and 51.66 eggs/3 leaves/month). Oraby and Klemon sbenals were on par with each other by recording (42.00 and 45.69 eggs/3 leaves/month). Sbaa elst and Boza swan were also on par with each other by recording (29.67 and 31.65 eggs/3 leaves/month).

At July, okra variety (Kna) recorded less egg numbers (35.67 eggs/3 leaves/month). Lee recorded high abundant of eggs (80.67 eggs/3 leaves/month). Askandrany, Klemon sbenals and Oraby were on par with each other by recording (67.68, 65.67 and 63.36 eggs/3 leaves/month, respectively). Baldy, Sbaa elst and Boza swan were also on par with each other by recording (41.67, 49.68 and 50.01 eggs/3 leaves/month, respectively).

At August, okra varieties (Kna and Baldy) recorded scarce (29.64 and 31.02 mite individuals/3 leaves/month). Lee harboured high population of eggs (63.66 eggs/3 leaves/month). Klemon sbenals and Oraby were on par with each other by recording 56.31 and 59.67 eggs/3 leaves/month. Boza swan, Askandrany and Oraby were also on par with each other by recording 53.34, 53.34 and 59.67 eggs/3 leaves/month, respectively.

Table (8): Screening of okra varieties against *T. urticae* eggs.

Month / Varity	May	June	July	Aug.	Sept.	Mean
Lee	32.34	54.36	80.67	63.66	0.00	46.20
Kna	11.34	23.67	35.67	29.64	0.00	20.06
Boza swan	16.65	31.65	50.01	53.34	0.00	30.33
Klemon sbenals	23.01	45.69	65.67	56.31	0.00	38.14
Baldy	9.99	25.35	41.67	31.02	0.00	21.61
Sbaa elst	16.35	29.67	49.68	52.35	0.00	29.61
Oraby	20.31	42.00	63.36	59.67	0.00	37.07
Askandrany	31.65	51.66	67.68	53.34	53.34	51.54
MEAN	20.21	38.01	56.80	49.92	6.67	34.32

LSD 5% (A) : 1.77 LSD 5% (B) : 1.40 LSD 5% (A*B) : 3.95

At September, okra variety (Askandrany) recorded high population of 53.34 eggs/3 leaves/month. Lee, Kna, Klemon sbenals, Baldy, Boza swan, Sbaa elst and Oraby were found to be significantly superior by recording 0.00 eggs.

Mean population of the five observations revealed that the varieties, Kna, Baldy and Sbaa elst recorded less abundant and the moderate ones

were shown with Boza swan, Klemon sbenals and Oraby. While, the highest population was recorded on Askandrany variety.

b.Screening of okra varieties against the two-spotted spider mite, *T. urticae* nymphs:

The Acari population (Table 9) at May (one month after sowing) indicated that, the Kna and Baldy recorded the least mite populations of 10.32 and 12.36 mite individuals/3 leaves/month. Lee and Askandrany recorded the highest ones (38.67 and 33.00 mite individuals/3 leaves/month).

Oraby and Klemon sbenals were on par with each other by recording 24.03 and 25.65 mite individuals/3 leaves/month. Boza swan and Sbaa elst recorded 16.68 and 20.67 mite individuals/3 leaves/month.

At June, okra variety (Kna, Baldy and Boza swan) recorded less mite populations of 24.66, 28.35 and 34.32 mite individuals/3 leaves/month, respectively. Lee and Askandrany recorded high population of mites (68.67 and 52.35 mite individuals/3 leaves/month, respectively). Sbaa elst, Oraby and Klemon sbenals recorded 40.35, 44.01 and 45.51 mite individuals/3 leaves/month, respectively.

At July, okra varieties (Kna and Baldy) recorded the least mite populations (38.01 and 45.00 acari/3 mite individuals/month). Lee and Askandrany recorded the highest ones (90.99 and 70.35 mite individuals/3 leaves/month). Boza swan, Oraby, Sbaa elst and Klemon sbenals recorded 55.65, 65.34, 65.01and 68.01 mite individuals/3 leaves/month, respectively.

Table (9): Screening of okra varieties against *T. urticae* nymphs.

Month / Varity	May	June	July	Aug.	Sept.	Mean
Lee	38.67	68.67	90.99	72.30	7.68	55.66
Kna	10.32	24.66	38.01	35.34	0.99	21.87
Boza swan	16.68	34.32	55.65	57.00	2.67	33.26
Klemon sbenals	25.65	45.51	68.01	67.35	3.00	41.90
Baldy	12.36	28.35	45.00	34.98	0.00	24.14
Sbaa elst	20.67	40.35	65.01	58.68	0.00	36.94
Oraby	24.03	44.01	65.34	60.36	0.00	38.75
Askandrany	33.00	52.35	70.35	55.35	55.35	53.28
MEAN	22.67	42.28	62.30	55.17	8.71	38.23

LSD 5% (A) : 1.90 LSD 5% (B) : 1.50 LSD 5% (A*B) : 4.25

At August, Baldy and Kna varieties recorded scarce mite populations (34.98 and 35.34 mite individuals/3 leaves/month). Lee and Klemon sbenals recorded high mite populations (72.30 and 67.35 mite individuals/3 leaves/month). While, Askandrany, Boza swan, Sbaa elst and Oraby recorded moderate mite population (55.35, 57.00, 58.68 and 60.36 mite individuals/3 leaves/month, respectively).

At September, Kna variety recorded the least mite population (0.99 mite individuals/3 leaves/month). Askandrany and Lee varieties recorded the highest ones (55.35 and 7.68 mite individuals/3 leaves/month). Boza swan and Klemon sbenals were on par with each other by recording 2.67 and 3.00 mite individuals/3 leaves/month.

Baldy, Sbaa elst and Oraby were found to be significantly superior by recording 0.00 mite individuals.

Generally, the mean population of the five observations revealed that okra varieties (Kna and Baldy) recorded less population size and the moderate ones were shown with Boza swan, Klemon sbenals, Sbaa elst and Oraby. While, the highest levels of population size were recorded on okra varieties of Lee and Askandrany.

c.Screening of okra varieties against the two spotted spider mite, *T. urticae* adults:

The mean adult population (Table 10) at May (one month after sowing) revealed that, varieties of Kna and Baldy recorded less mite populations (17.67 and 15.66 mite individuals/3 leaves/month). Lee and Askandrany recorded the highest ones (44.34 and 41.67 mite individuals/3 leaves/month).

While, Oraby and Klemon sbenals were on par with each other by recording 38.35 and 26.36 mite individuals/3 leaves/month. Boza swan and Sbaa elst were on par with each other by recording 24.00 and 25.71 mite individuals/3 leaves/month.

At June, okra varieties (Kna and Baldy) recorded less mite populations (28.35 and 30.66 mite individuals/3 leaves/month). Lee and Askandrany recorded the highest ones (77.34 and 59.34 mite individuals/3 leaves/month).

Table (10): Screening of okra varieties against *T. urticae* adults.

Month / Varity	May	June	July	Aug.	Sept.	Mean
Lee	44.34	77.34	104.34	92.01	5.34	64.67
Kna	17.67	28.35	40.65	44.01	3.00	26.74
Boza swan	24.00	40.68	63.03	60.87	5.01	38.72
Klemon sbenals	36.36	51.36	69.33	73.68	4.32	47.01
Baldy	15.66	30.66	47.37	39.69	4.32	27.54
Sbaa elst	25.71	42.69	72.66	71.67	5.67	43.68
Oraby	28.35	46.68	67.02	63.66	6.66	42.47
Askandrany	41.67	59.34	78.00	69.99	69.99	63.20
MEAN	29.22	47.14	67.80	64.45	13.04	44.33

LSD 5% (A) : 2.07 LSD 5% (B) : 1.64 LSD 5% (A*B) : 4.64

Boza swan, Sbaa elst, Oraby and Klemon sbenals were on par with each other by recording 40.68, 42.69, 46.68 and 51.36 mite individuals/3 leaves/month, respectively.

At July, okra varieties (Kna and Baldy) recorded scarce mite populations (40.65 and 47.37 mite individuals/3 leaves/month). Lee and Askandrany recorded the highest ones (104.34 and 78.00 mite individuals/3 leaves/month). Boza swan, Oraby, Klemon sbenals and Sbaa elst were on par with each other by recording 63.03, 67.02, 69.33 and 72.66 mite individuals/3 leaves/month, respectively.

At August, okra varieties (Baldy and Kna) recorded less mite populations (39.69 and 44.01 mite individuals/3 leaves/month). Lee and Klemon sbenals recorded the highest abundant of mite adults (92.01 and 73.68 adult individuals/3 leaves/month). Boza swan, Oraby, Askandrany and Sbaa elst were on par with each other by recording 60.87, 63.66, 69.99 and 71.67 mite individuals/3 leaves/month, respectively.

At September, okra variety (Kna) recorded the least mite popula-

tion (3.00 mite individuals/3 leaves/month). Askandrany recorded the highest mite population (69.99 mite individuals/3 leaves/month). Klemon sbenals and Baldy recorded 4.32 and 4.32 mite individuals/3 leaves/month. Boza swan, Lee, Sbaa elst and Oraby were on par with each other by recording 5.01, 5.34, 5.67 and 6.66 mite individuals/3 leaves/month, respectively.

From the previous results (Tables 8, 9 and 10), it could be generally concluded that the mean population of the five observations revealed that the okra varieties of Kna and Baldy recorded less population size, and the moderate ones were shown in case of Boza swan, Klemon sbenals, Sbaa elst and Oraby varieties. While, the highest population size was observed on varieties of Lee and Askandrany.

d. The associated insect predators:

1- The green lacewing, *C. carnea:*

The green lacewing population at May (one month after sowing) revealed that, varieties of Kna, Boza swan and Lee recorded less populations (1.67, 1.67 and 1.33 individuals/3 leaves/month, respectively). Sbaa elst and Askandrany recorded the highest ones (4.00 individuals/3 leaves/month). Oraby, Klemon sbenals and Baldy were on par with each other by recording (2.33, 2.33 and 2.67 individuals/3 leaves/month, respectively (Table 11).

At June, okra varieties (Kna, Lee, Klemon sbenals and Boza swan) recorded less populations (1.33, 2.00, 2.00 and 2.67 individuals/3 leaves/month, respectively), Baldy recorded high population (7.00 individuals/3 leaves/month). Sbaa elst, Askandrany and Oraby were on par with each other by recording 3.00, 3.33and 4.67 individuals/3 leaves/month, respectively.

At July, okra varieties (Kna, Lee, Boza swan and Klemon sbenals) recorded scarce green lacewing population (1.33, 1.67; and 2.33 individuals/3 leaves/month, respectively), Baldy and Oraby recorded high populations of (3.67 and 3.33 individuals/3 leaves/month). Sbaa elst and Askandrany were on par with each other by recording 3.00 individuals/3 leaves/month.

At August, okra varieties (Lee, Klemon sbenals and Sbaa elst) recorded less green lacewing populations (1.00 and 1.33 individuals/3 leaves/month, respectively). Kna recorded high populations (3.00 individuals/3 leaves/month). Boza swan and Baldy were on par with each other by recording (2.00 individuals/3 leaves/month). Oraby and Askandrany were also on par with each other by recording (2.67 and 2.33 individuals/3 leaves/month).

Table (11): Screening of okra varieties against the green lacewing, *C. carnea.*

Month / Varity	May	June	July	Aug.	Sept.	Mean
Lee	1.33	2.00	1.67	1.00	0.00	1.20
Kna	1.67	1.33	1.33	3.00	0.33	1.53
Boza swan	1.67	2.67	1.67	2.00	0.33	1.67
Klemon sbenals	2.33	2.00	2.33	1.33	0.33	1.67
Baldy	2.67	7.00	3.67	2.00	0.00	3.07
Sbaa elst	4.00	3.00	3.00	1.33	0.33	2.33
Oraby	2.33	4.67	3.33	2.67	0.33	2.67
Askandrany	4.00	3.33	3.00	2.33	2.33	3.00
MEAN	2.50	3.25	2.50	1.96	0.50	2.14

LSD 5% (A) : 0.97 LSD 5% (B) : 0.76 LSD 5% (A*B) : 2.16

At September, okra varieties (Kna, Boza swan, Klemon sbenals, Sbaa elst and Oraby) recorded less green lacewing populations (0.33, 0.33, 0.33, 0.33 and 0.33 individuals/3 leaves/month). Askandrany recorded high population (2.33 individuals/3 leaves/month). Baldy and Lee were found to be significantly superior by recording 0.00 individuals of green lacewing

Mean population of the five observations revealed that the varieties, Lee, Kna, Boza swan and Klemon sbenals recorded less populations and the moderate ones were observed with Sbaa elst and Oraby. While, the highest populations of green lacewing were recorded in varieties of Baldy and Askandrany.

2.The lady bird beetle, *C. undecimpunctata:*

Data in Table (12) recorded scarce coccinellid populations (2.33, 2.00 and 2.67 coccinellid/3 leaves/month, respectively) at May (one month after sowing) on varieties of Lee, Kna and Boza swan. Baldy and Oraby varieties showed high populations (5.00 and 5.00 coccinellids/3 leaves/month). Klemon sbenals, Askandrany and Sbaa elst were on par with each other by recording 3.00, 3.00 and 3.67 coccinellids/3 leaves/month, respectively.

At June, okra varieties (Lee, Klemon sbenals and Askandrany) recorded the least coccinellid populations (1.00, 1.67 and 2.33 individuals/3 leaves/month, respectively). Boza swan, Oraby and Baldy recorded the highest ones (3.67, 3.67 and 3.33 coccinellid/3 leaves/month, respectively). Kna and Sbaa elst were on par with each other by recording 3.00 individuals/3 leaves/month.

Table (12): Screening of okra varieties against coccinellid, *C. undecimpunctata.*

Month / Varity	May	June	July	Aug.	Sept.	Mean
Lee	2.33	1.00	1.67	1.33	0.00	**1.27**
Kna	2.00	3.00	3.00	1.33	0.00	**1.87**
Boza swan	2.67	3.67	4.00	1.67	0.33	**2.47**
Klemon sbenals	3.00	1.67	2.00	2.00	0.33	**1.80**
Baldy	5.00	3.33	1.00	1.67	0.00	**2.20**
Sbaa elst	3.67	3.00	4.67	4.00	0.67	**3.20**
Oraby	5.00	3.67	4.33	2.00	0.33	**3.07**
Askandrany	3.00	2.33	3.00	1.67	1.67	**2.33**
MEAN	**3.33**	**2.71**	**2.96**	**1.96**	**0.42**	**2.28**

LSD 5% (A) : 1.54 LSD 5% (B) : 1.22 LSD 5% (A*B) : 3.44

At July, okra varieties (Baldy, Lee and Klemon sbenals) recorded less coccinellid population (1.00, 1.67 and 2.00 individuals/3 leaves/month, respectively). Boza swan, Oraby and Sbaa elst recorded high populations (4.00, 4.33 and 4.67 individuals/3 leaves/month, respectively). Kna and Askandrany were on par with each other by recording 3.00 individuals/3 leaves/month.

At August, okra varieties (Kna and Lee) recorded scarce coccinellid populations (1.33 and 1.33 individuals/3 leaves/month). Oraby, Klemon sbenals and Sbaa elst recorded high populations (2.00, 2.00 and 4.00 coccinellid/3 leaves/month, respectively). Boza swan, Askandrany and

Baldy were on par with each other by recording 1.67 individuals/3 leaves/month.

At September, Oraby, Klemon sbenals and Boza swan recorded the least coccinellid populations (0.33 individuals/3 leaves/month). Sbaa elst and Askandrany recorded the highest ones (0.67 and 1.67 individuals/3 leaves/month). Baldy, Kna and Lee were found to be significantly superior by recording 0.00 coccinellid individuals.

Mean population of the five observations revealed that the varieties, Lee, Kna and Klemon sbenals recorded less populations and the moderate ones were observed in case of Boza swan, Baldy and Askandrany. While, the highest populations of coccinellid individuals were observed on varieties of Sbaa elst and Oraby.

3. The scymnus lady beetle, *S. punctillum*:

The coccinellid populations at May (one month after sowing) revealed that, varieties (Lee and Klemon sbenals) were on par with each other by recording 0.67 individuals/3 leaves/month. Kna, Boza swan, Sbaa elst,Oraby, Baldy and Askandrany were found to be significantly superior by recording 0.00 coccinellid individuals (Table 13).

Table (13): Screening of okra varieties against the scymnus lady bettle coccinellid, *S. punctillum.*

Month / Varity	May	June	July	Aug.	Sept.	Mean
Lee	0.67	0.00	0.67	0.67	0.00	**0.40**
Kna	0.00	0.33	0.00	1.33	0.33	**0.40**
Boza swan	0.00	0.00	0.67	1.00	0.00	**0.33**
Klemon sbenals	0.67	0.33	0.67	1.00	0.00	**0.53**
Baldy	0.00	0.00	0.67	0.67	0.00	**0.27**
Sbaa elst	0.00	1.00	1.67	5.33	0.00	**1.60**
Oraby	0.00	0.67	1.33	3.67	0.00	**1.13**
Askandrany	0.00	1.00	1.67	3.33	3.33	**1.87**
MEAN	**0.17**	**0.42**	**0.92**	**2.13**	**0.46**	**0.82**

LSD 5% (A) : 0.91 LSD 5% (B) : 0.72 LSD 5% (A*B) : 2.02

At June, the Kna and Klemon sbenals varieties indicated the least coccinellid populations (0.33 and 0.33 individuals/3 leaves/month). The Askandrany, Oraby, Baldy and Sbaa elst recorded the highest ones (1.00, 0.67, 0.00 and 1.00 individuals/3 leaves/month, respectively). Lee, Boza swan and Baldy were found to be significantly superior by recording 0.00 coccinellid individuals.

At July, Lee, Boza swan, Klemon sbenals and Baldy varieties were on par with each other by recording 0.67 individuals/3 leaves/month. The Sbaa elst, Askandrany and Oraby recorded the highest populations (1.67, 1.67 and 1.33 individuals/3 leaves/month, respectively). Kna variety was found to be significantly superior by recording 0.00 coccinellid individuals.

At August, Lee and Baldy varieties recorded the least coccinellid population (0.67 and 0.67 individuals/3 leaves/month). The Sbaa elst, Oraby and Askandrany recorded the highest ones (5.33, 3.67 and 3.33 individuals/3 leaves/month) respectively. Boza swan, Klemon sbenals and Kna were on par with each other

by recording 1.00 and 1.33 individuals/3 leaves/month, respectively.

At September, okra varieties (Askandrany and Kna) recorded the highest populations (3.33, 0.33 coccinellid/3 leaves/month). Lee, Sbaa elst, Klemon sbenals, Boza swan, Baldy and Oraby were found to be significantly superior by recording 0.00 coccinellid individuals.

Mean population of the five observations revealed that the varieties, Boza swan and Baldy recorded less population and moderate ones were recorded with Lee, Kna and Klemon sbenals. While, the highest population of coccinellid individuals were shown in varieties of Sbaa elst, Oraby and Askandrany.

Discussion:

1- Seasonal incidence of the two-spotted spider mite, *T. urticae*:

Population of mite on crop sown during first week of April appeared from 4th week after sowing (second week of May) with 24.66 mites/3 okra leaves and increased in number reached its peak incidence during third week of June (33.33/3 okra leaves). The results are in confirmation with the findings of Puttaswamy and Channabasavanna (1980) who reported that *T. ludeni* started building up during April and attained its peak during May-June. Similar results were reported by Rai *et al.* (1991); Kumar and Sharma (1993); Sugeetha (1998) and Gulati (2004). All of them studied the seasonal occurrence of mites on okra, during summer season. In the present study, the population started to build up its peak during second fortnight of August, then gradual decrease in mite population was recorded from the last week of August till the second week of September (14.67/3 okra leaves). There was an increase in the population during 38th till 42nd standard weeks reached its maximum (30.66/3 leaves) and thereafter the population declined gradually till it reached to the end of the season (46th standard week) (24.00 mites/3 leaves). These results are in agreement with Gulati (2004) who reported that mite population was maximum in the month of October, after that there was a gradual decline in mite population. Also, with that of Anitha (2007) who revealed that population of mite on autumn crop started during appearing from third week of August and there was a gradual increase in population from fourth week of August and reached its peak during fourth week of October.

2- Seasonal incidence of the insect predators:

On okra crops, coccinellid population was first noticed during first week of May (0.33 coccinellids/plant) and fluctuated in general during season reached its peak during the second fortnight of May (1.33 coccinellids/plant). The incidence was noticed till the end of the crop period. Literature pertaining to seasonal occurrence of coccinellid is scarce or absent, except that of Anitha (2007) who worked on okra is in close agreement with the present investigation, the author recorded, high population of lady bird beetle during the period from 3rd week of August to 2nd week of September.

3- Simultaneous effect of certain environmental factors on the population fluctuations of the two-spotted spider mite, *T. urticae* and its associated insect predators on okra plants:

a- The two-spotted spider mite:

The correlation studies between the two-spotted spider mite population and various parameters revealed a positive correlation with the maximum, minimum temperature; maximum, minimum temperature at 5 cm of soil depth, and plant age. However, maximum, minimum relative humidity are negatively correlated. The multiple regression coefficients (R) for the season period was found to be (R= 0.6972) with coefficient of determination of 48.6%. The results revealed that the climatic factors were responsible for 47.4% of the population changes. These results are corresponded with those obtained by Puttaswamy and Channabasavanna (1980) who mentioned that relative humidity and mean temperature, reduced the mite build up. Kumar and Sharma (1993) and Dhar *et al.* (2004) observed a significant correlation between the mite population and temperature. As the minimum temperature started increasing from April, the mite population also showed an increasing trend. The correlation between minimum temperature and mite population was significantly positive. Moreover, Anitha (2007) showed that the correlations between mite population and various weather parameters were significantly negative with minimum temperature (R= -0.422), morning relative humidity (R= -0.350) and total rainfall (R= -0.380), this indicated that, these variable factors act as a limiting factors for the build up of mite population. Whereas, correlation was positive and non-significant with afternoon relative humidity, indicating factors were not having any influence on mite population build up; Puttaswamy and Channabasavanna (1980) observed that mite population build up was correlated positively with low rainfall, whereas relative humidity and mean temperature reduced the mite build.

b- The associated predators:

The correlation between the predacious green lacewing population and various parameters revealed positive correlation with maximum, minimum of relative humidity. However, the maximum, minimum temperature; maximum, minimum temperature at 5 cm of soil depth, and plant age were negatively correlated with the population changes of *Chrysoperla*. These results are in agreement with the findings of Anitha (2007**)** who mentioned that, the correlation between various weather parameters and *Chrysoperla* population showed significant negative correlation with minimum temperature, morning and afternoon relative humidity and that total rainfall, indicating that, all these factors are not congenial for population build up of *Chrysoperla*. Whereas, correlation with maximum temperature is insignificantly positive.

Moreover, the correlation studied between the coccinellid population and the studied parameters revealed positive correlation with maximum, minimum relative humidity. However, the maximum, minimum temperature; maximum, minimum temperature at 5 cm of soil depth and plant age were negatively correlated. The results showed that the minimum temperature is the most limiting factor affecting coccinellid population in agreement with Anitha (2007) who recorded significant negative correlation with coccienllid population and temperature (maximum and minimum), while all other abiotic factors had non-significant

ones. Also, the same author revealed a significant negative correlation with both maximum (r= -0.322) and minimum temperature (r= -0.449), indicating an increase in maximum and minimum temperature decreases the population build up of coccinellid. Other parameters such as morning and afternoon relative humidity and total rainfall had no significant relationship with coccinellid population.

These seasonal incidence studies vary from region to region, also with sowing season, non-availability of alternate hosts during the off season, difference in host or due to the different weather parameters existing in different locations.

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التذبذبات العددية لأكاروس العنكبوت الأحمر ذو البقعتين ومصاحباته من المفترسات الحشرية علي بعض أصناف الباميا

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الملخص:

ركزت الدراسة الحالية علي أكاروس العنكبوت الأحمر ذو البقعتين ومفترساته المصاحبة علي أصناف الباميا المنزرعة بمزرعة كلية الزراعة جامعة أسيوط حيث تم حصر نوع الحلم وثلاثة من مفترساته الحشرية علي ثمانية أصناف من الباميا. ولقد أهتمت الدراسة الحالية بالنقاط التالية:

١- التأثير المتزامن لبعض العوامل البيئية المتغيرة وعوامل أخري علي تعداد الحلم العنكبوتي ومفترساته حيث وجد أن درجة الحرارة والرطوبة النسبية وعمر النبات كانت من أهم العوامل المؤثرة علي الكثافة العددية للآفة ومفترساتها.

٢- وجد أن حساسية أصناف الباميا للإصابة بالآفة ونجاح الافتراس يعتمد أساساً علي كثافة الشعيرات علي أوراق النبات حيث أن أصناف الباميا ذات الأوراق غزيرة الشعيرات مثل الصنفان Lee, Askandrany تعيق افتراس الآفة وفي نفس الوقت تعتبر ملجأ وحماية للآفة.

٣- كثافة الآفة العددية (طوري البيضة والأطوار المتحركة) علي أصناف الباميا تزداد خلال فصل الصيف وتقل في الشتاء بينما في موسمي الربيع والخريف فكانت الكثافة العددية بين الموسمين السابقين.