

Population density of aphids and spider mites on cotton using three scouting methods and its relation to some biotic and abiotic factors

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ABSTRACT

The present study was carried out at Sakha Agric. Res. Station during 2002 and 2003 cotton seasons to study the population densities of cotton aphid, *Aphis gossypii* (Glover), spider mites, *Tetranychus* spp. and their associated predators as well as prevailing climatic factors (daily mean temperature and relative humidity). The obtained results revealed that, in both seasons, the aphid population recorded the highest number during August using three techniques (complete leaf, one inch in the main vein of the leaf and one inch between the two main veins of the leaf). In each of the two techniques of scouting (complete leaf and one inch in main vein of the leaf), the highest peaks were recorded on August 4 and August 14 in the first and second seasons, respectively. While these peaks were recorded on August 18 and 7, in both seasons, in the case of one inch between two main veins of the leaf, The spider mite recorded the highest number during July for the three scouting techniques in both seasons, the highest peak was recorded on July 21 in complete leaf and one inch in the main vein of the leaf in the first season. While it was on July 14 in one inch between two main veins of the leaf in the first season and was on July 10 in the same method in the second season. Also, the population of associated predators recorded the highly number during July and August in both seasons. Positive significant correlation occurred between aphid and total predators only in the first season and spider mite in both seasons. In both seasons, the temperature induced insignificant effect on aphids and spider mites on the three scouting techniques except on aphids in the complete leaf and spider mites in one inch in main vein of the leaf for the first season. Relative humidity had significant positive effect only in the first season. Joint effect of predators and weathering factors was found remarkably high on the density of spider mites than aphids during the two seasons.

Key words: Aphids, spider mites, cotton, scouting techniques, population density, biotic factors, abiotic factors

INTRODUCTION

Cotton is the main cash crop in Egypt and its export contributes substantially towards the country income of foreign exchange. Aphids and spider mites are considered of the most important sucking pests that attack cotton plants causing extensive reduction in yield and quality (Taha *et al.*, 2001 and Slosser *et al.*, 2002). The integrated management of these pests on cotton should take all factors that contribute to the development of pest status into consideration. The natural enemies and climatic conditions are of the most important factors affecting the population dynamics of these pests (Godfrey and Leser, 1999).

Several workers have studied the effect of similar factors on the population dynamics of aphids and spider mites such as: Bleih, (1981); El-Behiery *et al.*, (1985); Mourad (1992); Salem *et al.*, (1993); El-Mezayyen and Abou Attia (1996); Nassef *et al.*, (1996 a,b); Abo Shaeshae (2001) and Abo Sholaa (2001).

Therefore, the present study was carried out to evaluate the population density of aphids and spider mites on cotton plants and its relation to the associated predators and some climatic factors during seasons of 2002 and 2003.

MATERIALS AND METHODS

Experiments were conducted at the Farm of Sakha Agric. Res. Station during the two growing cotton seasons of 2002 and 2003, to survey the population densities of aphids and spider mites and their associated predators. An area of one feddan (4200 m²) was chosen and divided into 4 plots of ¼ fed. The cotton variety of Giza 89 was sown during the first week of April in both seasons. Normal agricultural practices were followed without any pesticidal treatments during the whole experimental period.

1. Population fluctuation of aphids, *Aphis gossypii* and spider mites, *Tetranychus* spp.: Weekly samples of 25 plant leaves were chosen early in the morning at random from each plot. For counting of both aphids and spider mites, sampled leaves were examined by three techniques: complete leaf, one inch on one main vein of the leaf and one inch between the two

main veins of the leaf. These techniques were followed on the three different plant levels. The spider mites counted by using hand-lens of 10 x.

2. Population fluctuation of the associated predators: For counting the associated predators in cotton fields in weekly samples, two plants were shackled on shake sheet (piece of clothes 75 x 75 cm) and the predators which failed on the sheet were counted. The considered predators were *Chrysopa* spp., *Coccinella* spp., *Scymnus* spp., *Orius* spp., *Paederus alfieri* and true spiders.

3. Climatic factors: For studying the effect of climatic factors (daily mean temperature and relative humidity) on the population density of the considered aphids and spider mites, the daily mean of the two factors provided by Meteorological Department at Sakha Agricultural Research Station. The weekly means of the two weathering factors were calculated to determine correlation and regression coefficient values between these factors and predators and both of aphids and spider mites population using a computer program (MREG2).

RESULTS AND DISCUSSION

1. Population density of aphid, *Aphis gossypii* Glover and spider mites, *Tetranychus* spp. on cotton plants: The data presented in Table (1) show the population density of both aphids and spider mites on cotton plants during 2002 season. Aphid started to appear at the first week of June whereas the number recorded in complete leaf was 2.7 insects/25 leaves compared to one inch in main vein of the leaf and one inch between two main veins of the leaf that received 1.1 and 2.1 insects, respectively. Also, the highest cotton aphid number was recorded during July and August on the three techniques. Therefore, the insect population was fluctuated showing two peaks on complete leaf technique, the highest peak (1738.2 insect / 25 leaves) was recorded on August 4. The second peak (1566.3 insect / 25 leaves) was recorded on August 18, while aphid population was showing one peak in one inch in main vein of the leaf and in one inch between two main veins of the leaf technique, the recorded peak (266.0 and 148.3 insects / 25 leaves, respectively) occurred on August 4 in one inch in main vein of the leaf and on August 18 in one inch between two main veins of the leaf.

Table (1): Mean numbers of *Aphis gossypii* (Golv.) and *Tetranychus* spp. per 25 cotton leaves during 2002 season.

Inspection date	Aphids			Spider mites		
	Complete leaf	One inch in main vein of the leaf	One inch between two main veins of the leaf.	Complete leaf	One inch in main vein of the leaf	One inch between two main veins of the leaf.
May 26	0.0	0.0	0.0	2.5	3.2	2.4
Mean	0.0	0.0	0.0	2.5	3.2	2.4
June 2	2.7	1.1	2.1	7.2	4.4	4.0
9	5.3	2.1	0.0	10.4	4.0	6.4
16	2.0	1.4	0.7	9.2	5.5	5.2
23	16.3	0.4	0.0	22.4	20.5	4.4
30	14.0	2.3	2.5	38.0	19.4	10.3
Mean	8.1	1.5	1.1	17.4	10.8	6.1
July 7	15.3	3.3	4.3	53.4	18.5	16.3
14	275.0	13.7	12.0	329.4	31.5	43.5
21	604.7	26.2	16.3	446.0	47.4	35.0
28	1171.3	52.5	52.3	128.5	23.2	28.4
Mean	516.6	23.9	21.2	239.3	30.2	30.8
Aug. 4	1738.2	266.0	87.5	41.5	14.5	13.2
11	1394.3	172.4	118.4	34.4	19.4	12.2
18	1566.3	78.7	148.3	24.3	24.3	11.5
25	215.4	16.5	11.3	0.5	9.5	8.5
Mean	1228.6	133.4	91.4	25.2	16.9	11.4
Sept. 1	21.2	0.4	4.2	8.2	2.5	5.0
8	134.0	8.0	5.5	29.4	4.4	6.3
15	95.0	3.4	4.0	7.4	8.3	4.4
22	167.0	8.2	17.2	2.4	5.5	5.5
29	271.0	12.4	22.4	2.5	3.2	8.0
Mean	137.6	6.5	10.7	9.9	4.8	5.8
General mean	405.69	35.09	26.8	63.03	14.2	12.04

Concerning spider mites, data revealed that, the appearance of infestation with spider mites was on late May in three techniques. Where the recorded number were 2.5, 3.2 and 2.4 individuals / 25 leaves on complete leaf, one inch in main vein of the leaf and on one inch between two main

veins of the leaf, respectively. The maximum number of spider mites was recorded on July in the three techniques, the highest peak was on July 21 in complete leaf and on one inch in the main vein of the leaf technique, recorded 266.0 and 47.4 individuals / 25 leaves, respectively, while it was on July 14 in one inch between two main veins of the leaf technique (43.5 individual / 25 leaves).

In 2003 cotton season, the population of aphid and spider mites took a trend similar to that of 2002 (Table 2). The initial occurrence of aphid was noticed in last week of May on the three techniques. Also, the highest number was recorded during July and August on the three techniques. Results also indicated that there were three peaks for aphids on complete leaf, the highest peak was on July 24 and August 14 (1156.2 and 1560.4 insects / 25 leaves), respectively and the third peak was in August 28 (270.4 insects / 25 leaves). But, it was on July 24 and August 14 (70.3 and 262.3 insects / 25 leaves), respectively, on one inch in main vein of the leaf. The highest peak (145.0 insect / 25 leaves) was obtained on August 7 in one inch between two main veins of the leaf. The results agreed with the findings of Mourad (1992), Salem *et al.* (1993). Abo-Sholoha (2001) reported that the maximum number of aphids was in August. Also, El-Mezayyen and Abou Attia (1996) found that the highest cotton aphid populations occurred during July and August. Besides, Taha *et al.* (2001) indicated that, population of aphid, *Aphis gossypii* recorded two small peaks on May and July.

With regard to spider mites, in 2003 cotton season, the population of spider mites showed a similar trend to that of 2002. It started to appear at late May on the three techniques of scouting, recorded 5.1, 1.2 and 2 individuals / 25 leaves on complete leaf, one inch in main vein of the leaf and on one inch between two main veins of the leaf, respectively. Also, the maximum number of population was recorded on July, where the highest peak was on July 10 recorded 145.0, 45.3 and 42.2 individuals /25 leaves, respectively on the three techniques. These results agreed with that reported by El-Beheiry *et al.* (1985) who found that the highest number of mites was recorded in late July and early August. Nassef *et al.*, (1996 a) reported that common red spider mites have a broad during the growing season, the maximum number was in July and August. Taha *et al.* (2001) showed that the highest number of common red spider mite, *T. arabis* occurred during May and August.

Table (2): Mean numbers of *Aphis gossypii* (Golv.) and *Tetranychus* spp. per 25 cotton leaves during 2003 season.

Inspection date	Aphids			Spider mites		
	Complete leaf	One inch in main vein of the leaf	One inch between two main veins of the leaf.	Complete leaf	One inch in main vein of the leaf	One inch between two main veins of the leaf.
May 22	2.0	1.1	2.0	5.1	1.2	2.0
29	16.2	2.5	3.2	11.2	2.0	5.4
Mean	14.1	1.8	2.6	8.2	1.6	3.7
June 5	14.4	2.4	4.0	10.5	6.2	4.2
12	15.5	4.0	5.2	20.4	18.0	3.2
19	18.0	2.0	4.5	35.2	20.4	9.0
26	26.2	1.5	15.3	50.3	19.3	13.0
Mean	18.5	2.9	7.3	29.1	15.9	7.4
July 3	27.4	2.4	16.4	120.2	20.4	10.0
10	260.0	21.2	50.5	430.0	45.3	42.2
17	598.0	48.3	45.0	325.0	33.2	40.4
24	1156.2	70.3	85.4	35.5	10.0	12.3
31	172.0	36.5	115.3	38.5	13.2	10.2
Mean	442.7	35.7	62.5	189.8	24.4	23.02
Aug. 7	1380.2	110.5	145.0	30.4	22.2	12.4
14	1560.4	262.4	12.0	10.2	2.4	2.0
21	230.2	16.4	6.5	5.4	2.2	3.0
28	270.4	4.5	8.4	25.5	5.3	7.5
Mean	860.3	98.45	42.9	17.9	8.03	6.2
Sept. 4	28.2	8.4	4.4	9.2	2.5	2.4
11	98.5	4.0	18.0	2.2	1.5	3.0
18	160.0	2.4	22.2	1.5	1.5	3.2
25	130.3	5.3	25.4	1.4	2.0	1.5
Mean	104.3	5.03	17.5	3.6	1.9	2.5
General mean	324.4	33.1	30.7	59.6	12.7	9.8

2. Population fluctuation of the presented predators: The obtained results in Table (3) showed the population fluctuation of certain predators associated with pests in cotton field. These results revealed that the

population densities of predacious insects were low in the first season than in the second ones, whereas the high numbers were recorded on July during the two seasons.

3. Effect of some weather factors and associated predators on *A. gossypii* and *Tetranychus* spp. in cotton field: The statistical analysis in Table (4) summarizes the effect of temperature, relative humidity and the predators as well as its combined effect on the population of *Aphis gossypii* and *Tetranychus* spp. in cotton field during 2002 and 2003 seasons.

3.1. Effect of temperature: In both seasons, the temperature induced insignificant effect of aphid, *A. gossypii* and *Tetranychus* spp. on the three scouting techniques of the leaf except on the aphid on the complete leaf and spider mite on one inch in main vein of the leaf in the first season, as it showed significant positive effect. Generally, this means that the temperature was within the optimum range for the population activity of these pests.

3.2. Effect of relative humidity: The results revealed that in the first season, the effect of R.H. on aphid was significantly positive on the complete leaf and on one inch in main vein of the leaf and it was high significant positive effect on the population on one inch between two veins of the leaf. This means that the relative humidity was out of the optimum range for the population activity of aphid, but it has insignificant negative effect on spider mites. In the three scouting techniques, during the second season, the effect of R.H. on aphid was insignificant by positive for the three techniques. Also, R.H. induced insignificant by negative effect on spider mite in the three techniques. These contradiction between the results of the two climatic factors in the two successive seasons attract out the attention for presence of unknown masked effects of other climatic factors (i.e. wind speed and direction, short waves, pressure ... etc).

3.3. Effect of associated predators: The results indicated that the total predators had a superior effect on the two pests rather than temperature and relative humidity especially in the first season. Whereas, the effect of total predators on the two pests (aphid and spider mites) was significant and highly significant positive effects on the three scouting techniques were

Table (3): Mean numbers of associated predators/25 leaves on cotton plants during 2002 and 2003 seasons.

Sampling date	Season 2002						Sampling date	Season 2003					
	<i>Chrysopa</i> spp.	<i>Coccinella</i> spp.	<i>Scymnus</i> spp.	<i>Orius</i> spp.	<i>Psephenus</i> affinis	True spider		<i>Chrysopa</i> spp.	<i>Coccinella</i> spp.	<i>Scymnus</i> spp.	<i>Orius</i> spp.	<i>Psephenus</i> affinis	True spider
May 26	0.0	0.0	0.0	0.0	0.0	0.0	May 22	0.0	0.0	0.0	0.0	0.02	2.2
							29	0.0	0.0	0.0	0.0	1	0.3
Mean	0.0	0.0	0.0	0.0	0.0	0.0	Mean	0.0	0.0	0.0	0.0	0.6	1.3
June 2	0.0	0.0	0.0	0.0	0.0	0.0	June 5	0.0	0.0	0.0	0.0	0.2	1.1
9	0.0	0.0	0.0	0.0	0.0	0.0	12	0.0	0.0	0.0	0.0	0.2	2.0
16	0.0	0.0	0.0	0.0	0.0	0.0	19	0.0	1.0	11.0	6.0	11.0	75.0
23	0.0	1.1	8.1	4.1	21.1	60.0	26	0.2	3.1	14.1	15.0	31.0	90.0
30	0.0	2.1	11.1	12.0	42.4	75.0							
Mean	0.0	0.64	3.8	3.2	12.7	27	Mean	0.05	1.03	6.3	5.3	10.6	42.03
July 7	0.0	0.2	14.1	19.0	63.2	89.2	July 3	0.4	4.0	16.0	24.2	74.0	105
14	0.0	1.1	33.0	13.0	51.4	108.0	10	0.0	0.0	45.0	18.4	62.0	120
21	0.0	1.1	70.0	27.0	39.0	57.5	17	0.2	1.0	78.0	32.0	55.2	65.4
28	0.0	1.1	74.2	21.0	35.2	65.4	24	0.2	1.0	82.0	28.2	49.0	78.2
							31	1.0	0.0	95.0	18.4	41.2	92.2
Mean	0.0	0.9	47.8	20.0	47.2	80.03	Mean	0.36	0.48	100	24.2	26.3	92.2
Aug. 4	0.0	0.2	80	14.4	31.5	73.5	Aug. 7	1.1	1.1	110.2	13.3	25.4	75.4
11	0.0	0.2	100	9.2	19.0	61.5	14	0.0	0.2	60.5	3.0	12.0	60.2
18	1.0	0.2	119	2.4	7.0	49.4	21	1.1	1.1	135.2	23.5	30.5	85.4
25	0.0	0.2	48	19	22.0	71.2	28	1.1	2.0	2.0	1.1	1.1	48.0
Mean	0.3	0.2	86.8	11.3	19.9	63.9	Mean	0.83	1.1	76.9	10.2	17.3	67.3
Sept. 1	0.0	0.2	101	0.2	0.0	35.0	Sept. 4	4.0	1.2	42.0	3.2	22.2	18.4
8	3.0	0.4	31	33.2	16.4	24.0	11	3.0	0.2	4.2	41.2	1.1	28.0
15	2.0	0.4	2.1	1.5	0.0	40.0	18	11.0	0.2	18.0	28.0	12.0	54.2
22	8.0	0.2	13	22.0	8.0	37.4	25	19.0	0.4	8.2	15.4	8.4	65.4
29	15.0	2.0	5.1	10.5	6.2	46.0							
Mean	5.1	0.64	30.4	13.5	6.12	36.5	Mean	9.3	0.5	18.1	21.9	10.9	41.5
General mean	1.5	0.73	32.07	10.8	18.9	46.4	General mean	22.6	0.85	37.9	14.2	22.9	55.8

Table (4): Simple correlation (r), partial regression (b) and explained variance (EV%), values between each of *Aphis gossypii* or *Tetranychus* spp. population and predators and the two climatic factors (Temp. and R.H.) on three scouting techniques of cotton plant during 2002 and 2003 seasons.

Seasons	Pests	Variable	Complete leaf			One inch in main veins of the leaf			One inch between two main veins of the leaf		
			(r)	(b)	EV%	(r)	(b)	EV%	(r)	(b)	EV%
2002	Aphid	Temp.	0.564*	83.66	43.71	0.375	5.657	31.33	0.444	0.336	35.19
		R.H.	0.561	41.64		0.507*	7.500*		0.575**	4.727**	
		Predators	0.566*	2.18		0.485*	0.400		0.511*	0.185	
	Spider mite	Temp.	0.263	2.696	40.3	0.553*	2.166	64.34	0.438	1.272	58.52
		R.H.	-0.015	-13.392		-0.256	-0.937		-0.152	-1.094	
		Predators	0.544*	1.339		0.746**	0.118		0.693**	0.119	
2003	Aphid	Temp.	-0.247	-112.30	31.01	0.161	-10.438	14.31	0.182	-7.221	35.12
		R.H.	0.347	35.278		0.243	3.272		0.125	0.986	
		Predators	0.445	2.850		0.290	0.244		0.559*	0.269	
	Spider mite	Temp.	0.115	7.895	38.66	0.238	3.449	52.2	0.137	-0.231	42.65
		R.H.	0.231	-7.721		-0.263	-1.274		-0.158	-0.522	
		Predators	0.503*	0.89		0.538*	0.062		0.579**	0.084	

* = Significant ** = highly significant

noticed. During the second season, the effect of total predators on aphid was insignificant by positive on the complete leaf and on one inch in main vein of the leaf, but it was significantly positive for one inch between two main veins of the leaf. Also, the predators induced significant and highly significant positive effects on spider mites on the complete leaf, on one inch in main vein of the leaf and on one inch between two main veins of the leaf.

3.4. The combined effect of temperature, relative humidity and the predators: In general, the combined effect (percentage of explained variance) of the three factors on aphid and spider mite were higher in the first season than in the second one. Also, it was more obvious on spider mite than aphid during the two seasons. The three factors affected on aphid by 43.71, 31.33 and 35.19 % for the complete leaf, one inch in main vein of the leaf and one inch between two main veins of the leaf, respectively in the first season, and by 31.01, 14.31 and 35.12 % in the second season. The effect of three factors on *Tetranychus* spp. population in the first season was 40.3, 64.34 and 58.42 % on the three techniques, respectively, while it was 38.66, 52.2 and 42.65 %, respectively in the second season. However, the effect of temperature and relative humidity on the population of aphids and spider mites on cotton plant varied from season to another. El-Mezayyen and Abu Attia (1996) and Abo-Sholua (2001) found that temperature correlated significantly and positively with aphids. Bleih (1981) found that correlation between cotton aphids and temperature was negative while it was positive with relative humidity. Taha *et al.* (2001) reported that there was negative correlation between aphids population with minimum temperature and positive correlation between mite population and maximum relative humidity. Abo-Shaeshae (2001) found that, the population densities of predators and aphid were positively significant correlation.

Generally, the obtained results indicated that the occurred increase in the population density of predators have the same trend of sucking insects during the two seasons of this study. This means that the population of the predators considered very important in biological control. Also, the best method to estimate the population density of aphids and spider mites in the field was scouting the number on the complete leaf in the plant.

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