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Vertical distribution of *Bemisia tabaci* Genn. and *Empoasca* spp. on cotton plants and its relation to some weather factors

El-Naggar, Jehan, B.; Aref, S. A. and A.M. Hamid
Plant Protection Research Institute, Agricultural Research, Center, Dokki, Giza

ABSTRACT

The vertical distribution of insect pests on the plant is one of the most important factors in any sampling plan. An experiment was carried out at Sakha Agriculture Research Station Farm to determine the population density of whitefly, *Bemisia tabaci* Genn. and jassid, *Empoasca* spp. on the three levels of cotton plant (upper, middle and lower) as well as its relation to some weather factors during 2002 and 2003 seasons. The obtained results revealed that in both seasons the population of *B. tabaci* (immature stages) induced the highest number during September on the three levels of cotton plants. In both seasons, the highest number of immature stages of *B. tabaci* was recorded on the middle plant canopy (264.07 and 234.36 individuals), followed by the lower level (207.87 and 217.34 individuals), while the upper level harbored the least number recorded (58.67 and 60.53 individuals). The population of *Empoasca* spp. recorded the highest numbers during July in both seasons on all plant canopy. The upper level exhibited the highest number of jassids recorded (90.06 and 92.13 insects) followed by the lower level that harbored (40.36 and 47.66 insects) in both seasons, while the least number took place on the middle level (13.59 and 16.36 insects). Generally, the temperature was within the optimum range for the population activity of the two insects. Also, the population of whitefly was more affected by relative humidity than jassid, especially in the second season. The combined effect of the two weather factors on these insects were less pronounced. These obtained results are important in programs of insect management in cotton fields, as the pesticides should be applied to the place where the insects are present.

INTRODUCTION

In Egypt, cotton is one of the major source of currency to the national income. The whitefly, *Bemisia tabaci* Genn. and jassid, *Empoasca* spp. are the most serious insects that attack cotton plants at the different growing stages causing severe damage in yield and quality (Henneberry *et al.,* 2000;

Abo-Sholoa, 2001 and El-Zahi, 2005). A satisfactory chemical control requires spray application technology that gives adequate coverage to insects that found on leaves of the different levels of the plant. Consequently, the determination of the vertical or spatial distribution of the insect pests is one of the most important factors in any sampling plan (Ekbom and Rumei, 1990). Also, more information concerning the relationship between these insects and the prevailing weather factors would be required to develop and utilize effective pest control strategies, as the environmental conditions at any location influence the level abundance (Dent, 1991).

The present work was carried out to study the vertical distribution of the two insects population on the different levels of cotton plant (upper, middle and lower) and its relation to some prevailing weather factors.

MATERIALS AND METHODS

The experiment was carried out at Sakha Agric. Res. Station Farm during two successive cotton seasons; 2002 and 2003. An area of one feddan was divided into four equal plots. The cotton variety Giza 89 was sown during the first week of April in both seasons. The usual recommended agricultural practices were applied throughout the growing season without using any chemical treatments.

Weekly samples of 25 leaves from every level (upper, middle and lower) were chosen at random from each plot in the morning and the numbers of jassid (nymphs) were carefully counted on the two leaf surfaces in the field. The same samples were transferred to the laboratory to count the immature stages of whitefly using the binocular microscope. The daily records of temperature and relative humidity throughout the inspection period were obtained from the Meteorological Department at Sakha Agric. Res. Station. The weekly means of the two weathering factors were calculated to determine correlation and regression coefficients values between these factors and both of whitefly and jassid population using a computer program (MREG2).

RESULTS AND DISCUSSION

1. Vertical distribution of whitefly, *Bemisia tabaci* and jassid, *Empoasca* spp. on cotton plants: The data presented in Table (1) and Fig. (1 and 2)

show the population density of immature stages of whitefly on the three levels of cotton plant during 2002 and 2003 seasons.

Table (1): Weekly mean number of *Bemisia tabaci* Genn. (immature stages) on the different levels of cotton plant during 2002 and 2003 seasons.

Inspection date		Season 2002			Inspection date		Season 2003		
		Upper	Middle	Lower			Upper	Middle	Lower
May	26	0.0	6.0	9.3	May	22	1.2	3.4	5.0
						29	1.5	8.0	12.4
Mean		0.0	6.0	9.3	Mean		1.35	5.7	8.75
June	2	2.0	6.5	8.0	June	5	3.0	4.5	12.2
	9	3.0	6.2	6.2		12	5.4	10.5	15.0
	16	1.0	8.2	24.2		19	1.1	6.4	28.2
	23	1.1	3.5	19.4		26	1.2	5.0	24.4
	30	1.0	3.0	19.2					
Mean		1.62	5.48	14.40	Mean		2.67	6.6	19.95
July	7	1.0	3.3	19.0	July	3	1.2	7.3	24.0
	14	1.5	3.3	36.2		10	2.0	9.5	25.0
	21	1.5	53.0	13.5		7	0.2	12.2	30.4
	28	5.3	39.2	77.2		4	2.4	56.2	40.5
						1	1.2	45.2	35.0
Mean		2.33	24.7	36.48	Mean		1.4	26.08	30.98
Aug.	4	9.4	25.2	50.4	Aug.	7	12.2	28.2	135.5
	11	8.0	36.4	124.0		4	10.3	54.5	220.2
	18	7.3	46.0	198.3		21	225.2	834.4	855.4
	25	177.4	860.2	293.0		28	390.5	970.0	955.0
Mean		50.53	241.95	166.43	Mean		159.55	471.77	541.53
Sept.	1	219.2	985.4	837.0	Sept.	4	242.0	815.3	485.5
	8	376.4	997.0	884.0		11	120.0	542.0	680.4
	15	150.2	790.0	468.0		8	105.4	590.0	315.4
	22	115.0	518.0	647.4		25	25.2	450.2	230.0
	29	34.3	633.0	215.3					
Mean		179.02	784.68	610.34	Mean		123.15	599.37	427.83
Seasonal mean		58.67	264.07	207.87	Seasonal mean		60.53	234.36	217.34
LSD at 5%			23.871		LSD at 5%			26.124	

The immature stages of whitefly started to appear at late May on the lower and middle levels of the plant with means of 9.3 and 6.0 insects / 25 leaves, respectively, while on the upper level they appeared one week late.

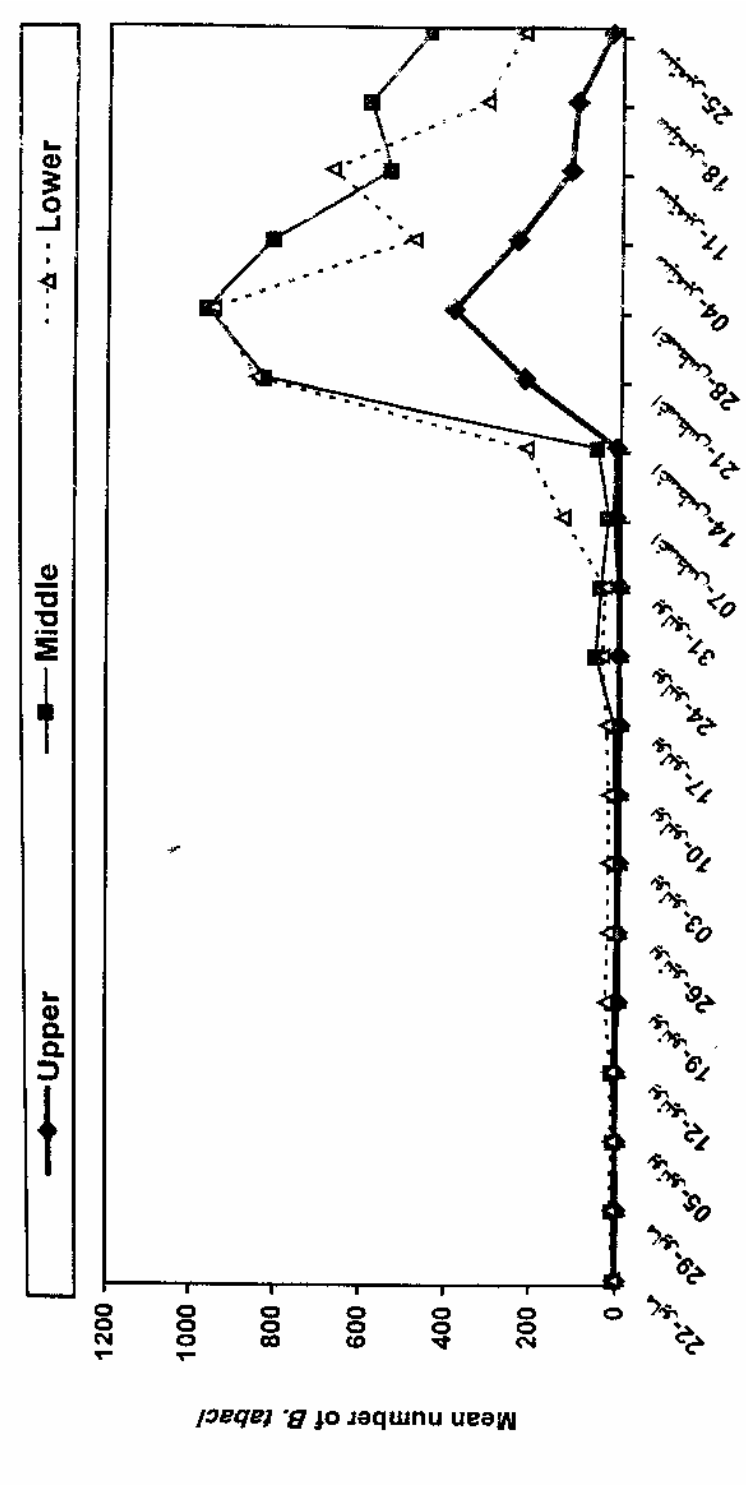

Fig. (2): Weekly mean number of *Bemisia tabaci* Genn. on the different levels of cotton plant during 2003 season.

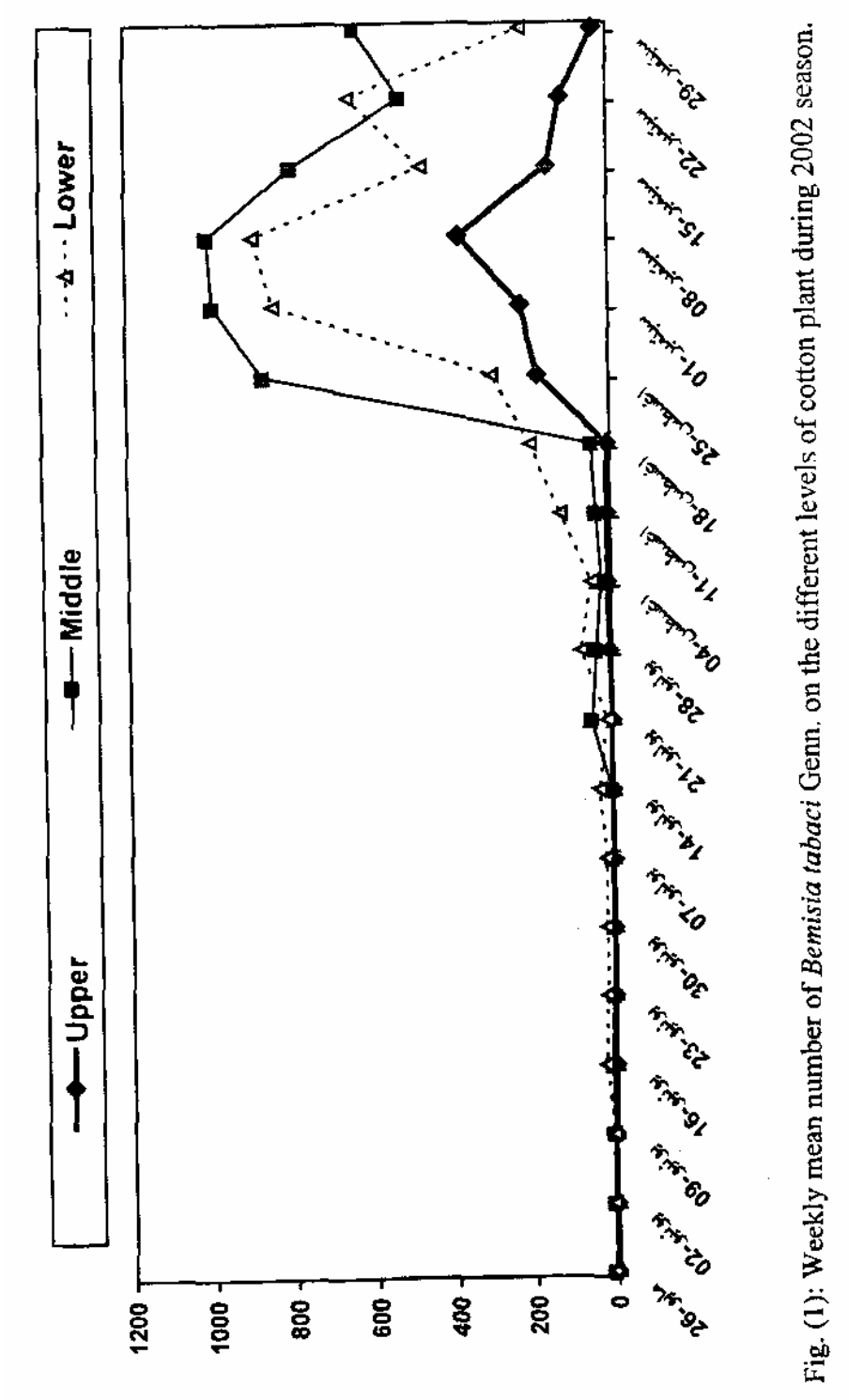

Fig. (1): Weekly mean number of *Bemisia tabaci* Genn. on the different levels of cotton plant during 2002 season.

The population fluctuated during June and July revealed high densities in the lower level compared to the middle and upper levels. Sharp increased in population took place during August but with high density in the middle level then lower and upper levels, and continued till the end of the season as recorded 610.34, 784.68 and 179.02 individuals during September on lower, middle and upper levels, respectively. This means that the sampling location for immature stages of whitefly on the same plant differs at the different periods of the season (Ekbom and Rumei, 1990).

Statistical analysis of the data showed significant differences among the density of immature stages in the three levels of the plant. The highest number was recorded on the middle level of the plant (264.07 individuals / 25 leaves) followed by the lower level (207.87 individuals), while the least number was found on the upper level (58.67 individuals).

In 2003, the population of whitefly (immature stages) took similar trend as 2002 (Table, 1 and Fig. 3 and 4). Data of immature stages recorded the highest density of 234.36 individuals on the middle level of the plant followed by the lower level that received 217.34 individuals, while the least number (60.53 individuals) took place in the upper level. These results agreed with the finding of Salem (1998) and Abo-Sholoa (2001) who indicated the greatest number of the whitefly on cotton plants in August and September. Taha *et al.* (2001) found that the adults of whitefly occurred during the fourth week of July and the second week of August in cotton field. Also, Ohnesorge *et al.* (1980) reported that eggs and nymphs of whitefly are distributed on the undersides of leaves on the lower and middle crop canopy.

As for jassid, *Empoasca* spp., the results in Table (2) and Fig. (3 and 4) indicate the population density on the three levels of the plant during 2002 and 2003 seasons. In the first season, the initial occurrence of jassid was noticed in the last week of May with relatively high in the upper level (11.3 insects/25 leaves) compared to the lower and middle levels that received 5.0 and 2.0 insects, respectively. The population gradually increased recording the highest number during July (177.1, 32.4 and 76.15 insects) for the upper, middle and lower levels of the plant, respectively. Then, gradual decline in the population occurred during August and continued till the end of the season (late September). During the second season, the similar trend of results as the first season was obtained. The

Table (2): Weekly mean number of *Empoasca* spp. on the different levels of cotton plants during 2002 and 2003.

Inspection date		2002 season			Inspection date		2003 season		
		Upper	Middle	Lower			Upper	Middle	Lower
May	26	11.3	2.0	5.0	May	22	8.0	4.4	2.5
						29	17.0	6.2	19.3
Mean		11.3	2.0	5.0	Mean		12.5	5.3	10.9
June	2	27.2	4.2	14.0	June	5	52.3	4.2	30.2
	9	41.4	5.3	23.2		12	72.4	4.5	24.0
	16	63.3	2.2	17.4		9	75.0	3.0	52.4
	23	88.2	1.0	38.3		26	118.0	2.4	55.5
	30	112.0	7.4	45.0					
Mean		66.42	5.82	27.58	Mean		79.43	3.53	40.53
July	7	135.4	35.2	50.0	July	3	120.5	13.0	65.5
	14	291.5	39.0	115.0		10	185.1	10.4	58.0
	21	164.2	39.4	82.2		17	125.40	12.5	45.0
	28	117.3	16.0	57.4		24	275.0	45.4	138.0
						31	89.2	20.3	54.0
Mean		177.1	32.4	76.15	Mean		159.02	20.3	72.1
Aug.	4	70.5	24.0	32.2	Aug.	7	205.4	35.2	25.2
	11	10.1	11.2	40.2		14	115.0	10.0	110.4
	18	182.0	28.4	98.0		21	50.4	12.0	38.0
	25	39.0	8.2	20.0		28	68.0	38.4	58.0
Mean		75.4	36.4	47.55	Mean		109.7	23.9	57.9
Sept.	1	81.0	23.5	42.0	Sept.	4	32.5	35.4	28.2
	8	47.0	18.0	18.2		11	45.5	22.5	43.0
	15	59.0	5.4	29.0		18	62.2	25.5	38.2
	22	57.0	15.4	27.3		25	35.4	6.0	18.4
	29	23.0	3.5	12.5					
Mean		53.4	13.16	25.8	Mean		39.9	22.35	31.95
Seasonal mean		90.06	13.59	40.36	Seasonal mean		92.13	16.36	47.66
LSD at 5%			21.835		LSD at 5%			16.080	

highest number of population took place during July with 159.02, 20.3 and 72.1 insects for the upper, middle and lower levels, respectively. The results also indicated significant differences among the population density of the

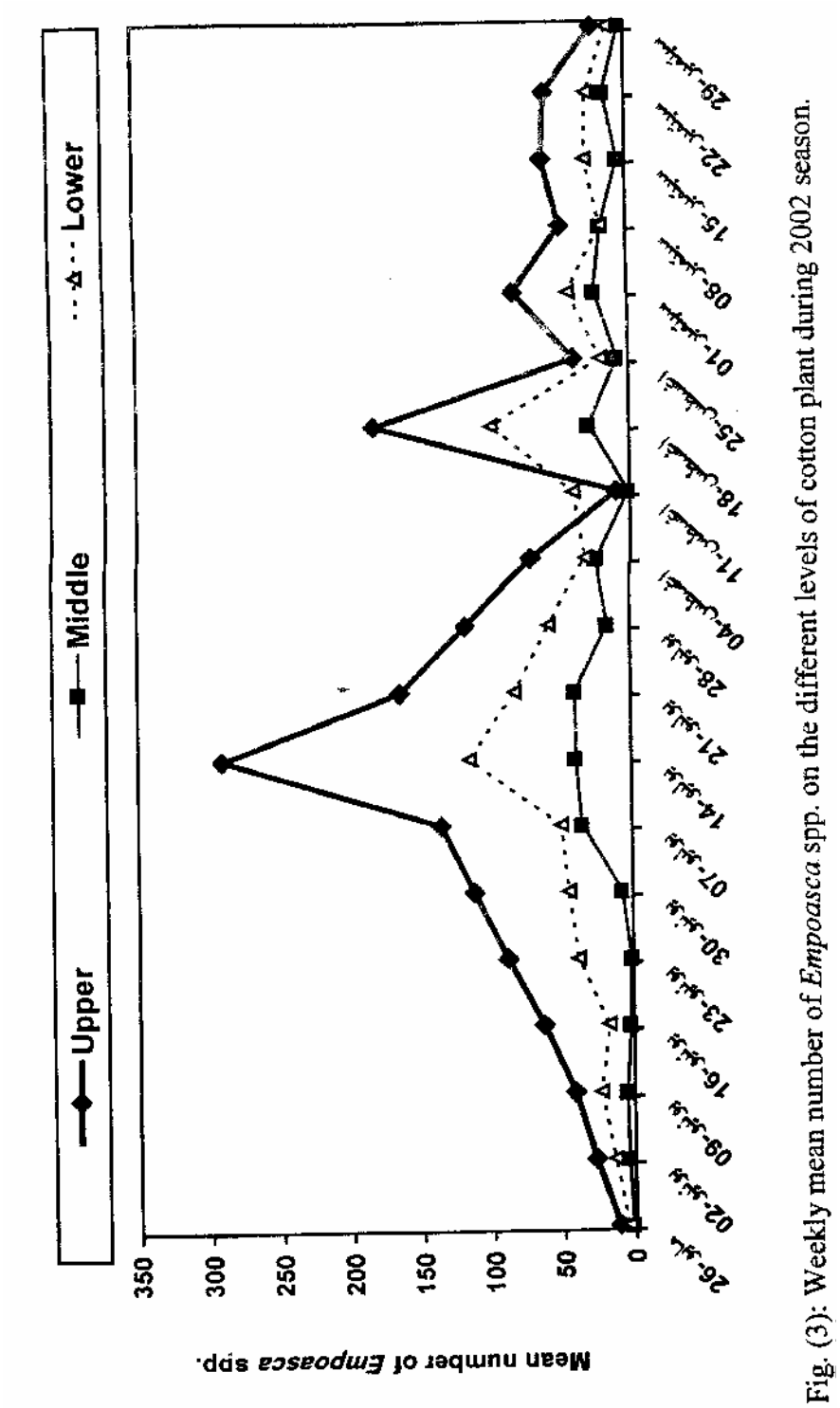

Fig. (3): Weekly mean number of *Empoasca* spp. on the different levels of cotton plant during 2002 season.

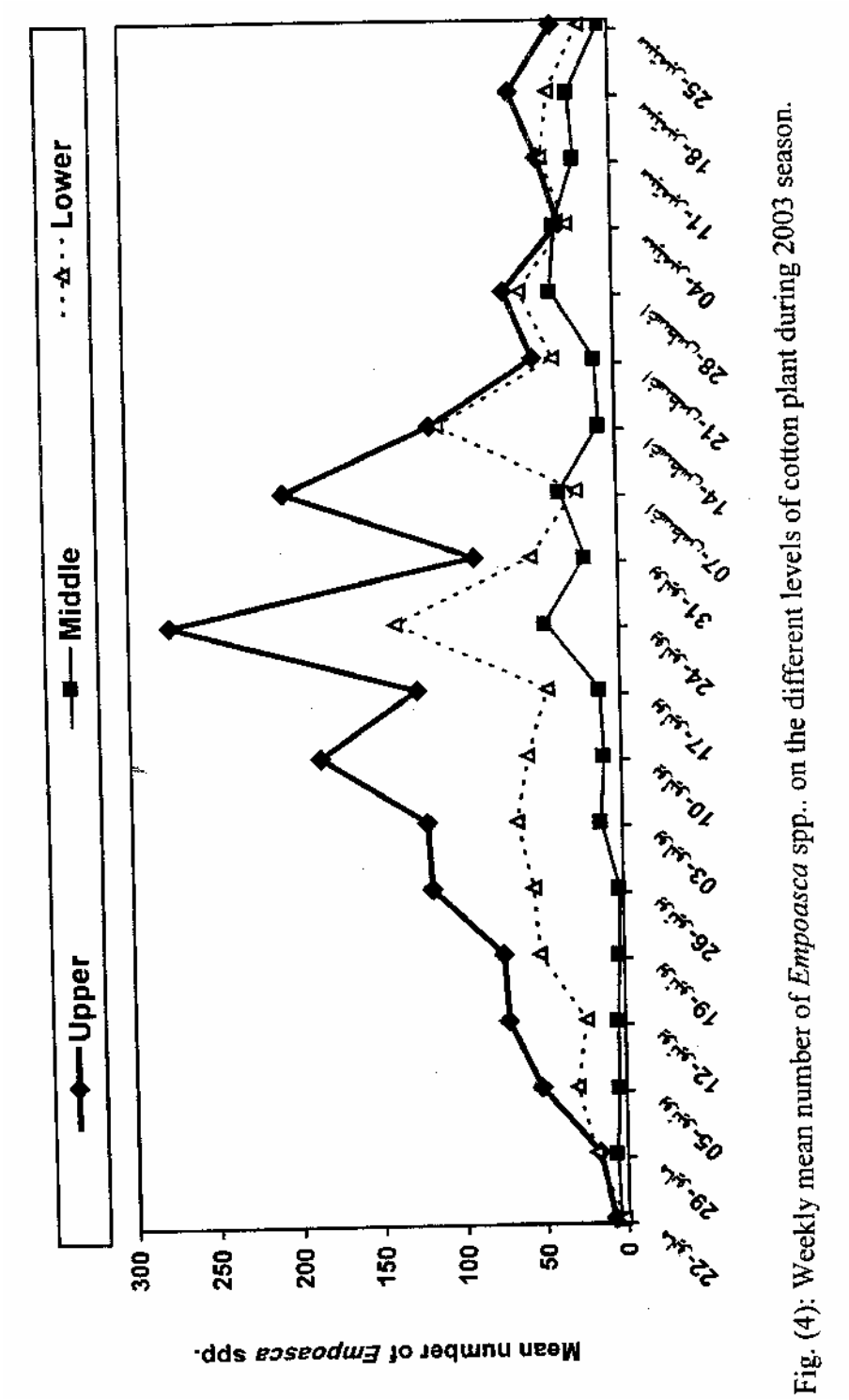

Fig. (4): Weekly mean number of *Empoasca* spp.. on the different levels of cotton plant during 2003 season.

insect on the three levels of the plant. The upper level exhibited the highest population with 90.06 and 92.13 insects in the first and second season, respectively, followed by the lower level that harbored 40.36 and 47.66 insects, in both seasons, respectively. The least population was observed on the middle level (13.59 and 16.36 insects).

The obtained results agreed with the finding of El-Mezayen and Abou-Attia (1996) and Abo-Sholoa (2001) who reported that, the highest population of jassid was recorded in cotton plant during July and August.

2. Effect of certain weather factors on *B. tabaci* and *Empoasca* spp. in cotton field: The statistical analysis in Table (3) revealed the effect of temperature and relative humidity as well as its combined effect on the population of *B. tabaci* and *Empoasca* spp. in cotton field during 2002 and 2003 seasons.

2.1. Effect of temperature: In both seasons, the temperature induced insignificant effect on *B. tabaci* and *Empoasca* spp. existing on the three levels of the plant. This generally means that the temperature was within the optimum range for the population activity of those insects.

2.2. Effect of relative humidity: The results revealed that the effect of relative humidity was more pronounced on the two insects than temperature, especially in the second season. In the first season, the effect of relative humidity on the two insects was insignificant on the three levels of the plant. During the second season, the effect of relative humidity on whitefly was significant positive for the three levels, as well as on jassids existing on the middle level. On the other hand, the relative humidity induced insignificant effect on jassid on the upper and lower levels.

2.3. The combined effect of temperature and relative humidity: In general, the combined effect of the two factors on these insects was relatively higher in the second season than in the first one. Also, the effect on immature stages of whitefly for the three levels was 12.36, 18.79 and 18.25 % in the first season and was 48.28, 31.19 and 35.76 % in the second one. The effect of the two factors on *Empoasca* spp. population in the first season was 19.03, 10.37 and 23.56 % on three levels, respectively. It was 20.42, 43.93 and 13.52 %, respectively in the second season. This means that there were many unconsidered factors affecting the population of the two insects such as other physical factors or/and natural enemies. However,

Table (3): Partial correlation (r), regression coefficient (b) and explained variance (EV%) between each of *Bemisia tabcci* Genn. or *Empoasca* spp. population and the two climatic factors (temp. and RH) on the three levels of cotton plants during 2002 and 2003 seasons.

Seasons	Insects	Climatic factors	Upper level (r)	Upper level (b)	Upper level EV %	Middle level (r)	Middle level (b)	Middle level EV %	Lower level (r)	Lower level (b)	Lower level EV %
2002	*Bemisia tabaci* Immature	Temp.	-0.320	-25.59	12.36	-0.413	-25.89	18.79	-0.416	-93.30	18.25
		R.H.	0.307	8.72		0.335	35.07		0.328	25.38	
	Empoasca spp.	Temp.	0.381	19.67	19.03	0.086	0.81	10.37	0.398	8.16	23.56
		R.H.	-0.009	-0.14		0.223	0.75		0.057	0.413	
2003	*Bemisia tabaci* Immature	Temp.	-0.048	-5.42	48.28	-0.336	-23.04	31.19	-0.117	-30.66	35.76
		R.H.	0.604**	12.68**		0.480*	33.05*		0.519*	32.64*	
	Empoasca spp.	Temp.	0.42	25.13	20.42	0.221	1.50	43.93	0.276	7.82	13.52
		R.H.	-0.159	-2.28		0.456*	1.11*		0.018	0.131	

* Significant at 5% level ** Significant at 1% level

the effect of temperature and relative humidity on the population of whitefly on cotton plant varied from season to another (Salama *et al.,* 1999). Also, Nasssef *et al.* (1996) found that temperature induced highly significant and negatively on whitefly, while it was positive and significant with relative humidity. Gupta *et al.* (1998) found that minimum temperature and evening relative humidity were significantly correlated with the whitefly population over time. Taha *et al.* (2001) reported that there was positive correlation and regression between whitefly population and minimum and average temperatures, as well as minimum and average relative humidity.

Finally, it can be concluded that jassids preferred the upper level of cotton plant, while the middle level was preferable to immature stages of whitefly. Also, the relative humidity had more effect on the population of whitefly than jassid especially in the second season. Thus, the gained results are important in insect management programs in cotton fields, as the pesticide should be applied to the right place where the insect is present.

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