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Factors affecting the population of *Thrips tabaci* Lind. (Thysanoptera:Thripidae) on onion crop in upper Egypt, with special reference to its chemical control

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ABSTRACT

The population fluctuation of onion thrips, *Thrips tabaci* Lind. affected by natural predators, and weather factors was studied in onion fields in Upper Egypt during 1999-2000 and 2000-2001 seasons. Different chemical control strategies of *T. tabaci* were also studied. The population of onion thrips was divided into five phases (P_1 to P_5) when December 1st was used as starting date. The migration of *T. tabaci* into onion fields (P_1) occurred within 6 days. The population increased to reach 10% of the maximum after about 51 days (P_2). Maximum population density occurred after 95 days (P_3) at maximum temperature 30.4°C, minimum temperature 9.0°C and R.H. 56.8%. After that, the population declined to 10% of the maximum (P_4) after 123 days and approximately vanished from onion fields (P_5) after about 163 days. The coefficient of daily rate of increase (α_1) was relatively lower than that of population decrease (α_2). They were 0.021 and 0.038 individual/day, respectively. The population fluctuation of associated predators,

the anthocorids, *Orius* spp. and the ladybird beetle, *Coccinella undecimpunctata* L. was also studied and was found to be coincided with the pest population. Generally, statistical analysis revealed that predators, maximum and minimum temperatures and relative humidity played the most important role in managing onion thrips population.To achieve an excellent chemical control against onion thrips, pirimiphos-methyl, furathiocarb, fluvalinate or pirimicarb were sprayed in Jan., 15 and Feb., 15.

INTRODUCTION

Onion plant, *Allium cepa* L. is considered an important vegetable crop in Egypt. It is cultivated for its bulbs which are used either for local consumption or assigned for exportation. The annual loss in onion crop due to the averages of pests is sometimes immeasurable (Krauthavsen, 1989).

Among many insect pests on onion fields, *Thrips tabaci* is the only pest of economic importance (Gupta *et al.*, 1991). Once plants are seriously infested with thrips, they soon change in colour (turn yellow) and start to deteriorate (Lall and Singh, 1968). Also, its role in the invasion of the fungal pathogen, *Alternaria porri* and subsequent development of the disease purple blotch was well known (McKenzie *et al.* 1993). Several authors have studied the population density and/or the population fluctuation of *T. tabaci* on cotton plants as affected by weather factors (El-Shaarawy *et al.*, 1975; Abdel-Fattah *et al.*, 1987; Hassanein *et al.*, 1995 and Gameel, 1998). To reduce the amount of insecticides used against *T. tabaci* in onion fields, more information about the behaviour and abundance of onion thrips as affected by changes in the abiotic and biotic factors are needed.

The present investigation was conducted to study the relative abundance of *T. tabaci* and to clarify the effect of temperature, relative humidity and associated natural predators on the occurrence of that pest during the two successive onion growing seasons of 1999-2000 and 2000-2001. The study was also conducted to throw some light on its chemical control.

MATERIALS AND METHODS

The present investigation was conducted at the Experimental Farm of Assiut University during two successive seasons of 1999/2000 and 2000/2001. An area of about 1/4 feddan was divided into plots of equal size (1/100 feddan) and was transplanted with onion (Giza 6 Mohassan) during the second week of November in both seasons. The normal agricultural practices were performed and no insecticides were used. Samples were periodically taken at seven days intervals from the beginning of December until maturity of the plants. Four plants were randomly taken from each plot (100 plants), each plant was carefully caged and separately sealed in a polyethylene bag. Samples were then examined in the laboratory under a stereomicroscope to record the numbers of onion thrips (nymphs and adults) and its predators. The meteorological data were obtained from the Meteorological Station located at Assiut Experimental Farm of Assiut University.

The relationships between the population of onion thrips and the meteorological factors, as well as the predators population, within the inspected periods were analyzed by using multiple regression analysis.

Population phase of onion thrips was described in days as phase 1 (P_1), phase 2 (P_2), phase 3 (P_3), phase 4 (P_4) and phase 5 (P_5), where:
P_1 = time needed to detect onion thrips, P_2 = time needed for the population to reach 10% of the maximum population density, P_3= time to attain the maximum population density, P_4 = time until the disappearance of 90% of the maximum population density and P_5 = time until the absolute disappearance of thrips. December first was the starting date of each population phase (P_1 to P_5).

Coefficients of daily rate of population increase (α_1) and decrease (α_2) were calculated according to Freier (1983):

$$\alpha_1 = \frac{0.9}{P_3 - P_2} \quad \& \quad \alpha_2 = \frac{0.9}{P_4 - P_3}$$

To study the effect of some pesticides, time and number of applications on the population of *T. tabaci*, an area of 1/2 feddan was divided into plots, (1/400 feddan each). Ten plants from each plot were randomly chosen and taken to the laboratory to count the numbers of alive thrips. The pesticides used were piriphos-methyl, carbofuran, furathiocarb, fluvalinate and pirimicarb (Table 1). The experiment was factorially arranged including 6 treatments (5 pesticides + check). Each treatment was replicated 4 times and tested in 6 programmes

(Table 2). In other words, each programme could be considered as an experiment by itself, with 6 treatments (including check) and 4 replicates. Full coverage of onion plants was secured by the use of knapsack sprayer fitted with one nozzle. Furadan 10% GR was only applied on the ground like the fertilizer just before irrigation.

Table (1): Pesticides tested on onion plants, *Allium cepa* against onion thrips, *Thrips tabaci* during 2001, Assiut.

Trade name	Chemical name	Rate of application
Pirimiphos-methyl 2- 50% EC	0-2-diethylamino-6-methylpyrimidin-4-yl 0,0-dimethyl phosphorothioate (IUPAC)	1 L./feddan
Carbofuran 10% GR	2,3-dihydro-2,2-dimethylbenzofuran-7-yl methyl carbamate (IUPAC)	1 kg./feddan
Furathiocarb 40% EC	butyl 2,3-dihydro-2,2-dimethylbenzofuran -7-yl N,N'-thio-dicarbamate (IUPAC)	400 m.L./feddan
Fluvalinate 24% EC	(RS)-α-cyano-3-phenoxybenzyl N-(2-chloro-α,α,α-trifluoro-p-tolyl)-D-valinate (IUPAC)	160 m.L/feddan
Pirimicarb 50% WP	2-dimethylamino-5,6-dimethyl-pyrimidin-4-yl dimethyl-carbamate (IUPAC)	150 g./feddan

Table (2): Programmes of pesticides application on onion plants, *A. cepa* against onion thrips, *T. tabaci* during 2001, Assiut.

Programmes	Date of applications				No. of applications
1	Jan., 15	-	-	-	1
2	-	Feb., 15	-	-	1
3	Jan., 15	Feb., 15	-	-	2
4	-	Feb., 15	Mar., 15	-	2
5	Jan., 15	Feb., 15	Mar., 15	-	3
6	Jan., 15	Feb., 15	Mar., 15	April, 15	4

The number of alive individuals of *T. tabaci* (nymphs and adults) was used as a criterion to evaluate the effectiveness of the pesticides tested within each programme. One count was performed just prior to the first spray of each programme. The post-treatment counts were made after one and two weeks from the date of the last application of each programme. These counts were conducted to represent the initial and actual effects of the pesticides used upon *T. tabaci*. Percentages of reduction of the *T. tabaci* individuals as a result of the pesticidal treatments, were calculated according to Handerson and Telton equation (1955).

$$\text{Reduction percentage} = \left(1 - \frac{t_a \times C_b}{t_b \times C_a}\right) \times 100$$

where:

t_a = treatment after spray.

C_b= check before spray,

t_b = treatment before spray, and

C_a = check after spray.

Data of the effect of the pesticides used on the population of the *T. tabaci*, were analyzed, and means were compared according to Duncan's Multiple Range test.

RESULTS AND DISCUSSION

The results presented in Tables 3 and 4 show the population fluctuation of *T. tabaci* L., its associated predators *Orius* spp. and *C. undecimpunctata* L., as well as the prevailing weather factors within the inspected dates.

Table (3): Population fluctuations of *T. tabaci* and associated predatory insects on onion crop at Assiut, 1999-2000 season.

Month	Date	No. of individuals of *Thrips tabaci* /plant	No. of predators/plant			Meteorological records		
			Orius spp.	*C. unde-Cimpunctata*	Total	Temperature (°C) Max.	Min.	R.H. %
Dec.	7	1.3	0.0	0.0	0.0	25.4	5.0	64.1
	14	1.5	0.0	0.0	0.0	24.8	5.8	67.2
	21	2.1	0.0	0.1	0.1	25.4	4.8	66.7
	28	4.4	0.0	0.2	0.2	24.6	2.8	67.7
Jan.	4	6.5	0.0	0.2	0.2	23.6	3.0	71.5
	11	7.0	0.0	0.3	0.3	29.4	4.2	54.3
	18	4.1	1.1	0.3	1.4	27.8	6.0	63.0
	25	10.6	1.2	0.4	1.6	20.8	5.2	66.1
Feb.	2	43.5	1.4	0.6	2.0	22.0	2.6	63.8
	9	41.6	1.9	1.1	3.0	21.8	1.0	61.5
	16	73.8	2.5	0.9	3.4	26.0	2.4	60.9
	23	76.3	2.0	1.8	3.8	21.4	4.0	59.9
March	2	88.9	4.1	2.6	6.7	28.2	2.8	52.9
	9	202.3	4.9	2.2	7.1	23.2	5.0	59.0
	16	79.6	3.9	2.9	6.8	27.8	6.0	47.4
	23	101.2	2.3	2.5	4.8	28.4	5.1	44.3
	30	59.4	3.2	2.0	5.2	29.6	5.0	45.9
April	7	44.1	2.0	2.2	4.2	31.4	7.4	45.2
	14	13.5	1.4	2.4	3.8	36.6	6.0	40.3
	21	9.9	1.4	2.1	3.5	37.6	8.8	43.5
	28	5.8	1.2	1.6	2.8	41.4	12.6	40.8
May	6	4.9	1.0	1.2	2.2	38.4	11.6	37.9
	13	2.2	1.0	1.2	2.2	40.6	13.2	33.4
	20	1.0	0.0	0.6	0.6	43.6	16.6	28.6
Total		885.5	36.5	29.4	65.9			
Mean		36.88	1.52	1.23	2.75			

As shown in Table 3, *T. tabaci* population started to appear on December, 7th (1.3 individuals/plant), and increased gradually in small numbers during December. The population increased in moderate numbers during January, then the population increased relatively in high numbers during February to reach its maximum (202.3 individuals/plant) on March, 9th. The population started to decrease gradually during April and reached the lowest level (1.0 individual/plant) on May 20th.

Table (4): Population fluctuations of *T. tabaci* and associated predatory insects on onion crop at Assiut, 2000-2001 season.

Month	Date	No. of individuals of *Thrips tabaci* /plant	No. of predators/plant			Meteorological records		
			Orius spp.	*C. unde-cimpunctata*	Total	Temperature (°C) Max.	Min.	R.H. %
Dec.	5	1.6	0.0	0.0	0.0	26.0	7.4	60.8
	12	1.4	0.0	0.0	0.0	32.4	7.0	61.4
	19	2.9	0.0	0.0	0.0	23.8	3.8	62.9
	26	4.8	0.0	0.2	0.2	22.6	4.0	65.4
Jan.	2	7.3	0.0	0.2	0.2	23.8	6.2	73.1
	9	8.1	0.0	0.3	0.3	24.2	4.8	70.9
	16	8.2	1.5	0.4	1.9	23.4	3.8	72.1
	23	17.0	1.9	0.6	2.5	23.4	3.2	60.4
	30	53.2	1.6	0.8	2.4	23.0	1.6	63.4
Feb.	6	73.9	2.0	1.1	3.1	24.6	1.4	61.3
	13	78.4	2.1	1.5	3.6	26.4	3.2	63.9
	20	88.2	2.4	1.8	4.2	26.2	6.0	54.1
	27	153.9	2.6	1.4	4.0	26.4	4.6	55.9
March	6	239.1	3.3	2.0	5.3	29.2	6.6	50.6
	13	341.7	5.1	3.3	8.4	30.4	9.0	56.8
	20	220.6	3.6	2.9	6.5	32.8	7.4	49.1
	27	79.2	3.2	2.7	5.9	29.0	6.8	51.2
April	3	16.5	2.9	2.3	5.2	32.2	8.2	45.3
	10	9.8	2.7	2.1	4.8	33.4	8.8	46.5
	17	8.1	2.1	2.0	4.1	38.2	10.2	40.1
	24	4.3	1.6	1.9	3.5	39.8	13.8	45.5
May	1	2.3	1.9	1.6	3.5	38.0	13.0	40.6
	8	1.1	1.3	1.4	2.7	41.6	17.8	37.1
	15	0.6	1.0	1.5	2.5	35.6	15.0	43.0
Total		1422.2	42.8	32.0	74.8			
Mean		59.26	1.78	1.33	3.11			

The predator population started late than the pest population. The anthocorid bugs, *Orius* spp., population started to appear 6 weeks later on January, 18th. Its population started with 1.1 individuals/plant and increased gradually to reach its peak (4.9 individuals/plant) on March, 9th, then the population decreased gradually till it completely vanished from the field on May20th.Concerning the coccinellid beetle, *C. undecimpunctata*, its population appeared four weeks earlier than *Orius* spp. population. Its population increased from 0.1 individual/plant on December 21st to reach its peak (2.9) a weak later than the peak of *Orius* spp. Then, the population decreased gradually till the end of the growing season.

Data presented in Table 5 show the multiple-regression analysis between the population density of *T. tabaci* and the weather factors as well as the predators. Simple correlation analysis revealed a significant positive effect of predators (X_4) on the pest population. On the other hand, the maximum temperature (X_1), minimum temperature (X_2) and relative humidity (X_3) had insignificant effect. However, the coefficient of determination (R^2) was 79.65 indicating that the four mentioned variables were together responsible for 79.65% of the changes in thrips population during 1999-2000 season. By dropping each variable (Table 5), step by step from the input the analysis data, to explain the gradual representative efficiency of each variable on the population changes of the insect pest, the studied variables can be arranged in descending order as follows: Predators, maximum temperature, minimum temperature and relative humidity, where their efficiencies were 66.84, 7.81, 4.98 and 0.02, respectively.

The data presented in Table 4 revealed that the general picture of the pest population during 2000-2001 season was almost the same of 1999-2000 season, but it was relatively higher (59.26 individual/plant). The initial infestation was also higher than that of the first season (1.6 individuals/ plant) and occurred on December, 5^{th}, the population then, increased gradually to reach its peak (341.7 individuals/plant) during the second week of March. After that, the population decreased gradually to reach the lowest level on May, 15^{th} (0.6 individual/plant).

The number of predators during this season was also higher (3.11 individuals/plant) than the first one. The *Orius* spp. appeared 6 weeks later than the pest population and 3 weeks later than the coccinellid beetle with an initial population of 1.5 individuals/plant on January 16^{th}. During this season, it was noticed that the peak of the pest population was exactly

Table (5): Multiple-regression analysis between total number of *T. tabaci*, biotic and abiotic factors during 1999-2000 season.

Biotic and abiotic factors	r	R	R^2x100	Decrease in R^2x100	Efficiency
Non	-	0.8925	79.65	-	-
Max. temp. (X_1)	-0.3423	0.8719	76.02	3.63	7.8152
Min. temp. (X_2)	-0.3263	0.8794	77.34	2.31	4.9791
Avg. R.H. (X_3)	-0.0360	0.8924	79.65	0.00	0.0171
Sum of predators (X_4)	+0.8074**	0.6971	48.60	31.05	66.8469

$YE = 81.5974 - 4.3995\ X_1 + 4.3559\ X_2 + 0.1170\ X_3 + 18.4461\ X_4$

** Significant at P = 0.01

synchronized with the peak of *Orius* spp. (5.1 individuals/plant) and the peak of *C. undecimpunctata* (3.3 individuals/plant). The population of both predators decreased gradually till the end of the growing season.

The data presented in Table 6, indicate that the simple correlation coefficient of natural enemies (predators) was positive and highly significant. The maximum and minimum temperatures and relative humidity had a negative and insignificant effect. The multiple-regression analysis revealed that the four studied variables were responsible for 70.33% of the changes in *T. tabaci* population. Most of the changes (64.24%) however, were due to the predators.

Table (6): Multiple-regression analysis between total number of *T. tabaci*, biotic and abiotic factors during 2000-2001 season.

Biotic and abiotic factors	r	R	R^2x100	Decrease in R^2x100	Efficiency
Non	-	0.8386	70.33	-	-
Max. temp. (X_1)	-0.0609	0.8354	69.79	0.54	0.5545
Min. temp. (X_2)	-0.1286	0.8315	69.14	1.19	1.2158
Avg. R.H. (X_3)	-0.0396	0.8129	66.08	4.25	4.3285
Sum of predators (X_4)	+0.7291**	0.2697	7.27	63.06	64.2355

$YE = 249.0459 - 3.6062\ X_1 + 6.0330\ X_2 + 4.3759\ X_3 + 40.9129\ X_4$

** Significant at P = 0.01

In general, the obtained results, indicated that predators, maximum temperature and minimum temperature during 1999-2000 season and predators and relative humidity during 2000-

2001 season played the most important role in regulating thrips population. Hassanein *et al.* (1995) found that temperature and relative humidity had a negative effect on thrips population.

The data of both seasons showed that the pest population was higher during the second season than the first one and this may arised from the prevailing weather factors and the movement of insect pests to neighbouring crops that thrips adults overwintering on it. Shrick (1951) reported that the thrips overwinter principally as adults on clover and lucerne, and onion become infested by the adults migration from clover, lucerne and other sources.

It is obvious that the pest population was low during the cold months (December and January) because adults only could be found (Ghabn, 1948). Edelson and Magaro (1988) found that *T. tabaci* required for its development from egg to ovipositing adult female 191.1 day-degree with a threshold temperature of 11.5°C. So, it is may suggested that the cold weather prevailing during December and January approximates to the lower development threshold and may explain the low population during these months.

The results also indicated that the maximum population density occurred during March and then the population decreased gradually till the end of the growing season, this may resulted from higher temperature after March, the predators activity and the maturity of onion plants became unsuitable for thrips feeding. So, fraction the insect pest population was possibly migrated to other suitable crops such as cotton. These findings are in full agreement with those who studied the pest population on onion (El-Serwiy *et al.* 1985; Lu and Lee, 1987; Afifi and Haydar, 1990; Haydar and Sherif, 1990 and Lorini and Dezordi, 1990). El-Serwiy *et al.* (1985) indicated that the pest population were affected by temperature and onion crop maturity as well as by predators activity. Lu and Lee (1987) found that, in the field, the population density of *T. tabaci* increased from November to April (especially during February and March) and fell sharply when temperatures were high. Afifi and Haydar (1990) noticed that small number of *T. tabaci* on onion up to early February and thereafter numbers increased until late March. Haydar and Sherif (1990) mentioned that *T. tabaci* began to build up its population in early February and reached a maximum during April. Lorini and Dezordi (1990) reported that the fluctuation of thrips population were related to climatic conditions, especially temperature and rainfall when the pest population density increased with an increase in temperature combined with lack of rain. Also with those who study the pest population on cotton (El-Nahal, 1958; Hassanein *et al.* 1971; Hosny and Shoeib, 1971, 1972; Khalil *et al.*, 1973; El-Shaarawy *et al.*, 1975; Habib *et al.* 1976; Abdel-Fattah *et al.*, 1987; Bleih, 1987; Hassanein *et al.*, 1995; Sewify *et al.*, 1996; Abou-Elhagag, 1998; Gameel, 1998 and Samhan, 1998) were found that the peak of thrips on cotton was during April and May or early June and this may be because of the migration to cotton and also because cotton was just planted during March.

Concerning the predators population, it is obvious that the population density of the anthocorid bugs, *Orius* spp. was higher than the population density of the coccienellid beetle, *C. undecimpunctata* in both seasons. McGregor (1942) mentioned that the anthocorid bugs, *Orius* spp. caused effective control of certain injurious insects, particularly thrips. Tawfik and Ata (1973) reported that *O. albidipennis* was very common on plants infested with aphids, thrips and other small insects working as control agent against these insects. Akramovskaya (1979) found that the *Orius* spp. adults preferred *T. tabaci* than the other preys. These findings confirm that *Orius* spp. are important in the biological control of *T. tabaci*. El-Heneidy *et al.* (1979) found that *Orius* spp. appeared to be the dominant predators in the clover and cotton fields followed by *C. undecimpunctata*.

The foregoing results also showed that the peak of the predators population was coincided with that of the pest population. This was in agreement with many other investigators (Kamal, 1951; Hafez, 1960; Hassanein *et al.*, 1969; Abdel-Kawi, 1971; Abdel-Galil, 1980; Samy, 1972; Habib *et al.* 1976; Tawfik *et al.*, 1976; El-Heneidy *et al.* 1979; Hamed *et al.* 1983; Abbas and El-Deeb, 1993; El-Maghraby *et al.* 1993; Nassef *et al.* 1996) who found that the peak of the predators population on cotton was synchronized with their preys and their peak occurred during late March, April, May and or early June.

Results in Table 7 show that the migration of *T. tabaci* adults from overwintering sites such as clover, lucerne, weeds and grasses grown near canals (Willcocks and Bahgat, 1937 and Shrick, 1951) into onion fields (P_1), occurred after 6±1.41 days (one week from the beginning of December). The population increased to become 10% (P_2) of the maximum population after 51.0 days (7 weeks from the initial infestation). This means that the population of *T. tabaci* tended to establish in onion fields during this time. The maximum population density of *T. tabaci*

Table (7): Population phase of *T. tabaci* (P_1, P_2, P_3, P_4 and P_5 in days), maximum number of thrips/plant (Max. No.), coefficient of daily rate of population increase (α_1) and decrease (α_2), and the duration of each population stage (P_3-P_1, P_3-P_2, P_4-P_3, P_5-P_3, P_5-P_1 and P_4-P_2 in days) on onion fields, Assiut, 1999-2000 and 2000-2001 seasons.

Variable	Growing season		Total	Mean±S.D.
	1999-2000	2000-2001		
P_1	7	5	12	6±1.41
P_2	51	51	102	51±0.00
P_3	92	98	190	95±4.24
Max. No.	202.3	341.7	544	272±98.57
P_4	131	115	246	123±11.31
P_5	165	162	327	163.5±2.12
P_3-P_1	85	93	178	89±5.57
α_1	0.022	0.019	0.041	0.021±0.002
P_3-P_2	41	47	88	44±4.24
P_4-P_3	39	17	56	28±15.56
α_2	0.023	0.053	0.076	0.038±0.02
P_5-P_3	73	64	137	68.5±6.36
P_5-P_1	158	157	315	157.5±0.71
P_4-P_2	80	64	144	72±11.31

(P_3) occurred after 95±4.24 days from the initial infestation (13-14 weeks), nearly during the second week of March. The peak of *T. tabaci* occurred during this period of the year is due to favourable weather conditions prevailing during this period that seems to be the optimum for development and reproduction of *T. tabaci* and to the suitability of the host plant. After reaching the population its maximum level, it declined to reach 10% of the maximum level (P_4) after 123±11.31 days (17-18 weeks). The population vanished from the onion fields (P_5) after 163.5±2.12 days toward the second half of May. The duration from the appearance of the thrips population up to disappearance (P_1 to P_5) was about 22-23 weeks. The most active period of development of *T. tabaci* population (P_2 to P_4) was about 10 weeks. Rate of population decrease (α_2) was about 2 times as higher as rate of increase (α_1); (0.076 individuals/day versus 0.041 individuals/day). This may give an evidence of the sudden decrease in the thrips population later in the season. The decline and disappearance of thrips later in the season may result from a combination of predators and the rapid drop in the suitability of host plant which makes thrips leaves onion to another suitable crops such as cotton plants. Many authors, as it mentioned earlier, found that the peak of thrips on cotton occurred during this period. Hassanein *et al.* (1995) found that *T. tabaci* started to appear in relatively high numbers when cotton seedling was about 21 days old.

Effect of some pesticides, time and number of sprays on the population of *T. tabaci* was planned to evaluate the effectiveness of the used pesticides and to determine the number of treatments required in the optimal time against *T. tabaci*.

Tables 8 and 9 show the percentages of reduction in *T.tabaci* after one and two weeks from the date of the last application of the tested pesticides of each programme, respectively. The reduction after 1 and 2-week may represent the initial and the actual effects of the pesticides upon this pest.

Regardless of time and number of sprays, data in Tables 8 and 9 indicated that pirimiphos-methyl, furathiocarb, fluvalinate and pirimicarb were equally effective and succeeded in reducing the number of *T. tabaci*. Their reduction could be considered about 100% after 1- and 2-week from the date of the last pesticides application in each programme. Data also revealed that carbofuran was the least effective one, since its reduction was about 69 and 84% after 1- and 2-week, respectively. The differences between the used pesticides and carbofuran after 1- and 2-week, were significant regardless of time and number of pesticides sprays.

Regardless of the used pesticides, data in Tables 8 and 9 indicate that the highest reduction in *T. tabaci* numbers was achieved by programme No. 6 (Jan., 15 + Feb., 15 + March, 15 + April, 15) and by programme No. 5 (Jan., 15 + Feb., 15 + March, 15) and they did not statistically differ after 1- or 2-week from the date of the last pesticides application of each programme. Also, the effectiveness of programme No. 5 was similar in reducing *T. tabaci* numbers to programme No. 4 (Feb., 15 + March, 15) and programme No. 3 (Jan., 15 + Feb., 15), when carbofuran was avoided. On the other hand, programms No. 1 and 2 (Jan., 15 and Feb., 15) were less effective against *T. tabaci* and they did not statistically differ after 1- or 2-week.

It is noticed from the obtained results, that 2-spray programme was generally effective than 1-spray programme schedules. Programme No. 5 and No. 6 were the most effective programmes tested and they exhibited equal reduction in

T. tabaci population as programme No. 3 or 4 after 1- or 2-week from the date of the last spray of each programme (tables 8 and 9). Therefore, it can be concluded that using of any pesticides tested except carbofuran in a two sprays programme (Jan., 15 + Feb., 15) or (Feb., 15 + March, 15) or in three sprays programme (Jan., 15 + Feb., 15 + March, 15) should achieve a successful control of *T. tabaci* population. Excessive chemical control increases the cost of pest management program and brought many problems such as, environmental pollution, emergence of new pests, pesticide resistance and threat to human health. In integrated pest management program, all available techniques and control measures should be used to manage pest populations so that economic damage of the crop is avoided and adverse effect on the environment are minimized (Anonymous, 1969). To solve these problems, one approach of integrated pest management is to minimize the use of pesticides and take full advantage of the naturally occurring predators and parasites (especially the forementioned results showed that the predators had a significant role in affecting the pest population). So, it could be recommended to use 2-spray programme (Jan., 15 + Feb., 15) since it was statistically as effective as three sprays programme. Especially, the foregoing results of the pest ecology (Tables 3 and 4), showed that the higher numbers of the pest population occurred during February and March.

The obtained results are in full synchronizing with the findings of Viswanathan and Regupathy (1987), Cermeli (1989), Aboul-Hagag (1995) and Ibrahim (1995). While it was disagreed with the results of Regupathy (1980) and Tsai *et al.*

Table (8): Percentage of reduction in *T. tabaci* population on onion crop after 1-week from the date of the last pesticide application of each programme during 2000-2001 season, Assiut.

Programme No.	Application time	Reduction (%)					Mean*
		Actellic	Deltanet	Furadan	Mavrik	Pirimor	
1	Jan., 15	96.633	100.00	73.364	99.176	100	93.835 (B)
2	Feb., 15	100.00	100.00	48.333	100.00	100	89.667 (C)
3	Jan., 15 + Feb., 15	99.896	100.00	36.625	100.00	100	87.304 (C)
4	Feb., 15 + March, 15	99.653	100.00	73.089	97.882	100	94.125 (B)
5	Jan., 15 + Feb., 15 + March, 15	100.00	100.00	84.674	99.613	100	96.857 (AB)
6	Jan., 15 + Feb., 15 + March, 15 + April, 15	100.00	100.00	98.125	100	100	99.625 (A)
Mean		99.364 (a)	100 (a)	69.035 (b)	99.445 (a)	100 (a)	

* Means followed by the same letter are not significantly different at 0.05 level of probability.

Table (9): Percentage of reduction in *T. tabaci* population on onion crop after 2-week from the date the last pesticide application of each programme during 2000-2001 season, Assiut.

Programme No.	Application time	Reduction (%)					Mean*
		Actellic	Deltanet	Furadan	Mavrik	Pirimor	
1	Jan., 15	100	99.075	46.125	100	100	89.040 (C)
2	Feb., 15	100	100	77.013	99.672	100	95.337 (B)
3	Jan., 15 + Feb., 15	100	100	89.725	100	100	97.945 (AB)
4	Feb., 15 + March, 15	100	100	91.662	100	100	98.332 (AB)
5	Jan., 15 + Feb., 15 + March, 15	100	100	98.112	100	100	99.622 (A)
6	Jan., 15 + Feb., 15 + March, 15 + April, 15	100	100	98.913	100	100	99.783 (A)
Mean		100 (a)	99.846 (a)	83.592 (b)	99.945 (a)	100 (a)	

* Means followed by the same letter are not significantly different at 0.05 level of probability.

(1986) who found that carbofuran was active against banana aphids. The contradiction between the present results and their results may be due to the difference in the kind of the treated pest and in the method of application. Whereas in their study, the compound was injected into the plant pseudostem, while in the present study, the compound was used as granules and put in the ground near the plant roots just before irrigation and the largest amount of the compound would be transferred with the irrigation water.

CONCLUSION

From the present study, it can conclude that migration of *T. tabaci* adults from overwintering sites into onion fields (P_1), occurred during one week from the beginning of December. The population then increased to become 10% (P_2) of the maximum population after 7 weeks, nearly during the last week of January. The maximum population density (P_3) occurred nearly during the second week of March. The population then declined to reach 10% of the maximum level (P_4) nearly during the last week of April. Then, the population vanished from the onion fields (P_5) during the second half of May. The duration from P_1 to P_5 was about 22-23 weeks. The most active period of development of *T. tabaci* population (P_2 to P_4) was about 10 weeks.

The foregoing results of the pest ecology (Tables 3 and 4), showed that the population density of *T. tabaci* increased especially during February and March. So, from the results of

Tables 8 and 9, it could be recommended to use 2-Spray programme (Jan., 15 + Feb., 15) to prevent the population of *T. tabaci* to reach the peak.

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الملخص العربى

العوامل المؤثرة على تعداد التربس على محصول البصل فى مصر العليا مع إشارة خاصة إلى مكافحته الكيميائية

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تمت دراسة تأثير الأعداء الحيوية والعوامل الجوية على تعداد حشرة تربس البصل فى حقول البصل فى جنوب مصر . وقد تم تقسيم نمو المجموع الحشرى لهذه الآفة الى خمسة مراحل من P_1 إلى P_5 . فعندما أخذ فى الاعتبار أول ديسمبر كتاريخ بداية لأخذ العينات فقد وجد أن التربس يبدأ فى الظهور (P_1) بعد ٦ أيام ثم يأخذ المجموع فى الزيادة حتى يصل التعداد الى ١٠% من أعلى كثافة عددية (P_2) بعد ٥١ يوما ثم يصل المجموع بعد ذلك لأقصى تعداد له (P_3) بعد ٩٥ يوما . يتناقص المجموع بعد ذلك تدريجيا حتى يختفى ٩٠% من أقصى كثافة عددية (P_4) بعد ١٢٣ يوما وتختفى حشرات التربس تماما من حقول البصل (P_5) بعد حوالى ١٦٣ يوما. وقد كان معدل الزيادة اليومى (α_1) ومعدل النقصان اليومى (α_2) لحشرات التربس ٠,٢١ و ٠,٣٨ حشرة / يوم على التوالى .

وقد تم أيضا دراسة تذبذبات مجموع المفترسات والذى كان متوفقا مع تعداد التربس.أشارت نتائج التحليل الاحصائى بصفة عامة الى أن المفترسات ودرجة الحرارة العظمى والصغرى فى خلال موسم ١٩٩٩-٢٠٠٠ والأعداء الحيوية والرطوبة النسبية خلال موسم ٢٠٠٠-٢٠٠١ كانت من أهم العوامل التى تدير تعداد الآفة موضع الدراسة . وفيما يخص دراسات المكافحة الكيماوية للتربس فان الدراسة الحالية توصى باستخدام أى من المبيدات المختبرة (اكتيلك - دلتانت- مافريك - بريمور) فيما عدا الكاربوفيوران فى برنامج رش مكون من رشتين خلال (١٥ يناير + ١٥ فبراير) وذلك بغرض تحقيق مكافحة مرضية ضد الآفة .