Population Fluctuations of *Thrips tabaci* Lind. (Thysanoptera: Thripidae) on Strawberry Plants in Relation to Certain Ecological Factors at Qalyoubia Governorate, Egypt

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ABSTRACT

Population fluctuations of *Thrips tabaci* was studied during the two successive seasons, 2017/2018 and 2018/2019 on two varieties of strawberry plants; Festival and Fortuna, at Shebin El-Qanater, Qalyoubia Governorate, Egypt. *Thrips tabaci* Lindeman (Thysanoptera: Thripidae) is a serious insect pests affecting strawberries in all stages of growth. The seasonal abundance of this species was higher during the second season than the first one (the total numbers of 5631 and 6086 individuals respectively). The population of *Thrips tabaci* showed two peaks, the higher one was recorded in the 1st week of December during the two seasons of study, while the lower one was recorded in the 3th week of march during the two seasons of study. Statistical analysis indicated that there was a highly significant relation between the insect numbers and the age of the plant, while this relation was insignificant for each of temperature, relative humidity and wind velocity. The combined effects of temperature, relative humidity, wind velocity and plant ages on thrips activity were (81.2 %) and (92.7 %) during the first and second seasons, respectively.

Key words: Strawberry plants, *Thrips tabaci*, population fluctuation, temperature, plant age.

Introduction

Strawberry (*Fragaria x ananassa* Duch.) is one of the most important members of the family Rosaceae. It has become one of the most economic vegetable crops in Egypt and considered the main cash crop for strawberry growers in Qalyubia, Ismailia, Sharkia and Beheira governorates. It is one of the most favorite and delicious fruits of where its demand has been increased in Egypt for local consumption and for exportation. The fruits are rich in vitamin C and are commonly eaten fresh as a dessert fruit, it also used as a pastry or pie filling. Cultivation of strawberries is an important economic activity for small- and medium sized farms in different producing regions (Ferla *et al.* 2007 and Gamila *et al.* 2019).

Egypt ranked as the fifth country in the world in strawberry production after China, USA, Mexico, and Turkey (FAO, 2019).

Under Egyptian conditions, strawberry is liable to be attacked by several pests which are responsible for considerable quantitative and qualitative losses in the fruit yield. It is appropriate that attention be given to the more important insect and other pests which attack strawberry plants. These pests can cause serious economic loss by markedly reducing crop yields and quality (Rings and Neiswander, 1966).

Thrips tabaci Lindeman (Thysanoptera: Thripidae) is one of the mainly significant insect pests affecting strawberries in all stages of growth (Shakya *et al*., 2010). It generated significant yield loss globally (Lewis, 1997).

This work aimed to study the population fluctuations of Thrips, *T. tabaci* on strawberry plants and also to evaluate the combined effects of certain ecological factors on the population of tested pest. The obtained data can help producers to implement an integrated pest management (IPM) program for the pest and define the best time to employ control measures (Miller and Foottit) (2009); Henz (2010).

MATERIALS AND METHODS

Experimental design:

The population fluctuations of Thrips on strawberry plants were studied at Shebin El-Qanater, Qalyoubia Governorate, Egypt from the 3rd week of October, 2017 to the 4th week of April, 2019. An experimental area of about 1/8 feddan was divided into four replicates (each replicate about 130m2). This experimental area was planted by fresh strawberry seedlings of two cultivars; festival and Fortuna. Sowing dates were in Sept. 20th in early planting and for the late planting Oct.10th, during 2017 and 2018. The weekly sampling started after four weeks of cultivation date and continued until the end of the season (the fourth week of April) in both seasons of the study. These samples were taken weekly. Yellow sticky cards measuring 20×10 Cm steady fixed on

stalks were distributed at a rate of 4 traps / (1/8) feddan and were put in the center of the cultivated area. Traps were located just or slightly above the top of the plants. Then the traps (yellow cards) replaced weekly and transferred to the laboratory for insects' identification.

Study of the influence of ecological factors on the population fluctuations of *T. tabaci*:

This part of the study aimed to obtain information about the effect of certain ecological factors such as temperature (°C), R.H. (%), wind velocity and plant age on the activity of the pest. Records of these meteorological factors were obtained from weather underground program and its location on the internet https://www.wunderground.com.

Statistical analysis:

In order to determine the effect of each of the previous ecological factors separately on the variability within the insect populations, the partial regression term "C" multipliers was the best statistical method for evaluating the previous relation exactly using Proc. Reg. and Anova in SAS (SAS Institute, 1988), (EL.Saadany 1969 and Fisher, 1950).

RESULTS AND DISCUSSION

Population fluctuations of insect *Thrips tabaci* on strawberry plants:

The First Season 2017/2018:

Data presented in Table (1) and illustrated in Fig. (1) show that the first appearance of ***T. tabaci*** on both Festival and Fortuna varieties was at the 1stweek of November in early planting. The weekly numbers of insects were 33 and 46, respectively. The insect population increased gradually to give the highest peak in 1st week of December with weekly numbers of 420 and 430 individuals on Festival and Fortuna respectively. The insect population decreased gradually, but a moderate peak was noticed in the 4th week of December on Festival v. (54 insects), and in the 4th week of December also on Fortuna (48 insects). The insect population decreased gradually week by week until the end of the season on both varieties.

While in case of late planting, the first infestation with *T. tabaci* was noticed during the 3rd week of November by 132 and 141 individuals on Festival and Fortuna respectively. The insect population raised gradually to reach the highest weekly number by the beginning of December on both varieties, the insect numbers were 310 and 520 individuals respectively. A moderate peak was observed (32 individuals) on Festival in the 4th week of December and (46 individuals) on Fortuna during the 4th week of December, also. From the beginning of January, the pest population tended to decline until the end of the season.

The Second Season 2018/2019:

Data presented in Table (1) and illustrated in Fig. (1) show that the first appearance of *T. tabaci* on both Festival and Fortuna varieties was at the 4th week of October in early planting. The weekly numbers of insects were 32 and 30, respectively. The insect population increased gradually to give the highest peak in 1fr week of December with weekly numbers of 330 and 372 individuals on Festival and Fortuna respectively. The insect population decreased gradually, but a moderate peak was noticed in the 4th week of December on Festival v. (62 insects), and in the 4th week of December also on Fortuna (82 insects). From the beginning of January, the pest population tended to decline and increase; ups and down until the end of season.

While in case of late planting, the first infestation with *T. tabaci* was noticed during the 1st week of November by 121 and 132 individuals on Festival and Fortuna respectively. The insect population raised gradually to reach the highest weekly number in 3rd of November on both varieties, the insect numbers were 322 and 354 individuals respectively. A moderate peak was observed (43 individuals) on Festival during the 3rd week of December and (55 individuals) on Fortuna during the 3rd week of December, also. From the beginning of January, the pest population tended to decline and increase; ups and down until the end of season.

These results greatly correspond with the findings of Shivanna *et al.* (2011), who revealed that Thrips population was found throughout the year except in July and August months. In contrary, Seham (2016) stated that the highest numbers of Thrips species was recorded in August plantations for *T.tabaci*. While Abd El-Salam *et al.* (2019) stated that this pest is a serious insect pest affecting strawberries in all stages of growth. It is clear that the insect pest which has a wide range of host plants so, may be found during the most of the year.

The effect of ecological factors on the population fluctuation of *Thrips tabaci*:

Statistical analysis of results obtained in the 1st season indicated that simple correlation between the mean numbers of *T. tabaci* and each of plant age1, plant age2 and plant age3 were negative and nonsignificant (r= -0.416 & -0.375 & -0.317 respectively). While the correlations between the insect numbers and each of daily mean maximum temperature, daily mean minimum temperature, and the daily mean relative humidity were positive correlation but they were nonsignificant. On the other hand, the daily mean wind gave a negative correlation and nonsignificant with the insect numbers in 2017/2018 season (Table 2).

In the 2nd season (2018/2019), data in Table (2), show that simple correlation between mean numbers of *T. tabaci* and plant age1, plant age2 , plant age3 were negative and significant (r= -0.494 & -0.559 & -0.583 respectively). Daily mean maximum temperature, daily mean minimum temperature recorded significant negative correlation. While, the daily mean relative humidity recorded negative correlation but it was nonsignificant (r= 0.309). On the other hand, the daily mean wind velocity, gave insignificant positive correlation in 2018/2019 season.

The partial regression analysis gave negative and significant effect for Plant age1 & Plant age3 on mean numbers of *T. tabaci* (b= -1513.49 and -2.134) during 2017/2018 season. But it was positive and significant for plant age2. Moreover, daily mean minimum temperature and the R.H. % had negative and nonsignificant regression. The daily mean maximum temperatures, and wind speed had positive and nonsignificant regression during this season. The partial regression analysis of 2018/2019 season gave positive and significant effect between Plant age1 & Plant age3 and mean numbers of *T. tabaci* (b= 177.87 and 0.268). But it was negative and significant correlation for plant age2. Daily mean minimum temperature and the R.H. % were negative and nonsignificant correlation. The daily mean maximum temperatures, and wind speed had a positive and nonsignificant regression during this season.

As shown in Table (2) the combined effect of studied ecological factors was highly significant on mean numbers of *T. tabaci* during the first season (2017/2018). The explained variance (E.V. %) was 81.2 % during 2017/2018 season could be attributed to the combined effect of such considered factors on *T. tabaci* population. The remaining percentage is due to other factors not included in this study.

The same trend was observed during the second season (2018/2019), Table (2). The combined effect of the three weather factors and all plant ages was highly significant on mean numbers of *T. tabaci* during the tested season (2018/2019). The explained variance (E.V.%) was 92.7% could be attributed to the combined effect of studied different factors on mean numbers of *T. tabaci*, the remainder precent is due to other factors not included in this study, besides of course to the experimental error.

Obtained data proved that plant age and temperature significantly affected the population of *T.tabaci*, particularly in the second season. Whereas, Palomo *et al.* (2015) stated that the main suppressive effect of weather on thrips populations was caused by rainfall. In another study, El-Sappagh (2018) showed that the weather factors as maximum temperatures and maximum & minimum relative humidity did not give significant correlation. On the contrary, minimum temperature give significant correlation in the 1st season. On the other hand, the author stated that all weather factors were positively correlated with insignificant except the minimum R.H. during the 2nd season. In addition, plant age resulted in strong and significant correlation and regression which correspond with our results.

CONCLUSION

The population of *T.tabaci* on strawberry plants showed two peaks during growing season. The highest one was recorded in the first week of December during the two seasons of study. There was a highly significant relation between the insect numbers and the plant age, this relation was insignificant in respect to each of temperature, relative humidity and wind velocity.

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Table 1: Weekly numbers of *Thrips tabaci* on strawberry plants at Shebin El-Qanater, Qalyoubia, Governorate during 2018/2019 and 2018/2019 seasons.

2017 - 2018					2018 - 2019				
" Date of inspection"	Early 20/9/2017		Late 10/10/2017		" Date of inspection"	Early 20/9/2018		Late 10/10/2018	
	Festival	Fortuna	Festival	Fortuna		Festival	Fortuna	Festival	Fortuna
29-Oct	0	0	0	0	28-Oct	32	30	0	0
05-Nov	33	46	0	0	04-Nov	50	53	121	132
12-Nov	45	85	0	0	11-Nov	57	76	172	193
19-Nov	75	140	132	141	18-Nov	116	135	322	354
26-Nov	330	360	250	270	25-Nov	211	237	216	257
03-Dec	420	430	310	520	02-Dec	330	972	118	133
10-Dec	135	148	78	65	09-Dec	182	211	98	111
17-Dec	76	85	34	38	16-Dec	97	162	43	55
24-Dec	54	48	32	46	23-Dec	62	82	22	18
31-Dec	14	12	9	7	30-Dec	22	27	15	11
07-Jan	15	12	13	14	06-Jan	14	13	19	21
14-Jan	28	16	14	18	13-Jan	11	15	13	12
21-Jan	9	14	8	11	20-Jan	7	8	7	6
28-Jan	18	7	16	21	27-Jan	8	11	9	11
04-Feb	10	11	9	13	03-Feb	13	9	13	15
11-Feb	25	13	20	12	10-Feb	17	14	11	8
18-Feb	12	10	13	6	17-Feb	16	21	18	21
25-Feb	27	18	22	15	24-Feb	23	28	22	28
04-Mar	33	26	31	22	03-Mar	42	35	26	32
11-Mar	38	32	41	48	10-Mar	54	61	30	32
18-Mar	54	48	62	57	17-Mar	51	57	54	59
25-Mar	33	31	42	48	24-Mar	35	22	32	37
01-Apr	0	0	25	22	31-Mar	0	0	13	17
08-Apr	0	0	0	0	07-Apr	0	0	0	0
Total	1484	1592	1161	1394	Total	1450	1679	1394	1563
mean	61.83a	66.33a	48.37a	58.08a	mean	60.41a	69.95a	58.08a	65.12a

Table 2: Simple correlation coefficient and partial regression values of different factors with their significant levels and percentages of explained variance on the population of *Thrips tabaci* during seasons 2017-2018 and 2018-2019 on strawberry at Shebin El-Qanater, Qalyoubia Governorate.

Years	Factors	Simple correlation		Partial Regression		F. value	P.	E.V.%
		r.	P.	b.	P.			
2017-2018	Plant age1	-0.4164	0.0539	-1513.49	0.0097	5.56	0.0103	81.2
	Plant age2	-0.3751	0.0854	100.52	0.0189			
	Plant age3	-0.3178	0.1495	-2.134	0.0309			
	Temp. Max.	0.013	0.9542	22.74	0.6587			
	Temp. Min.	0.1467	0.5146	-27.07	0.5814			
	R.h.%	0.2168	0.3324	-3.057	0.8479			
	Wind v.	-0.3713	0.0888	25.79	0.6408			
2018-2019	Plant age1	-0.4941	0.0268	177.871	0.0019	18.18	0.0001	92.7
	Plant age2	-0.5592	0.0104	-12.599	0.0012			
	Plant age3	-0.583	0.007	0.268	0.0011			
	Temp. Max.	-0.7291	0.0003	3.24	0.6387			
	Temp. Min.	-0.7251	0.0003	-7.15	0.1923			
	R.h.%	-0.3095	0.1842	-1.009	0.3838			
	Wind v.	0.3645	0.114	8.137	0.1209			

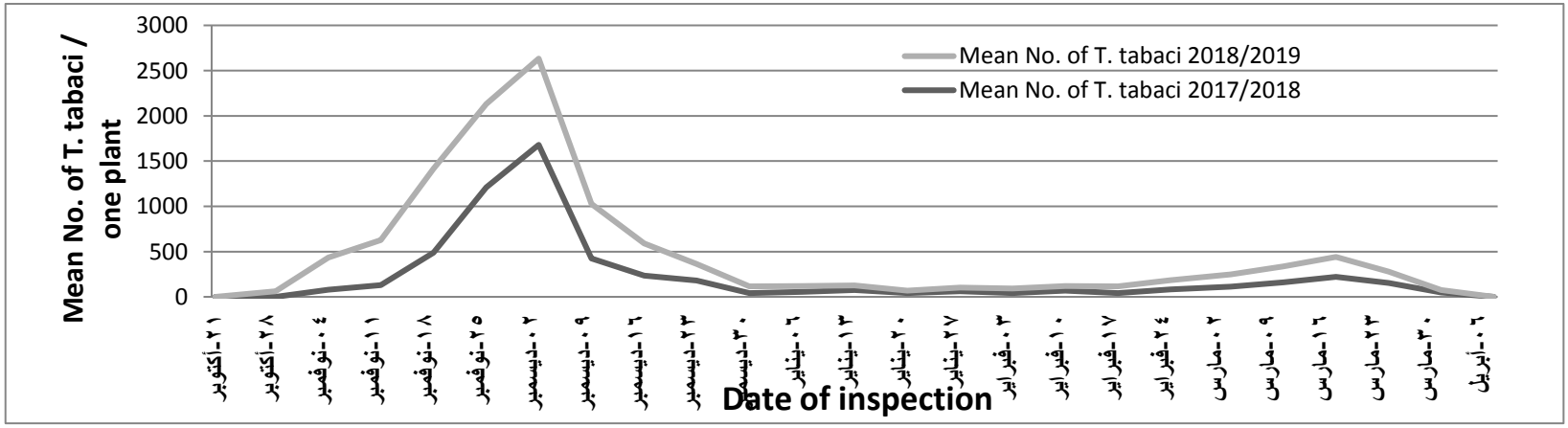

Figure 1. Population density of *T. tabaci* Lind. on onion plantations during the two seasons.

التذبذبات العددية لحشرة *Thrips tabaci* Lind. (Thysanoptera: Thripidae) على نباتات الفراولة وعلاقتها ببعض العوامل البيئية في محافظة القليوبية ، مصر.

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الملخص العربى

أجريت هذه الدراسة بغرض دراسة التذبذبات العددية لحشرة *Thrips tabaci* Lind. علي نباتات الفراولة علي مدي موسمين (2018/2017 – 2019/2018) في منطقة شبين القناطر بمحافظة القليوبية. كما استهدفت الدراسة بيان تأثير بعض العوامل البيئية علي نشاط هذة الحشرة (الحرارة والرطوبة وسرعة الرياح وعمر النبات). أوضحت النتائج المتحصل عليها أن الوفرة الموسمية للحشرة في الموسم الثاني (6086 حشرة) أعلى منها في الموسم الأول (5631 حشرة) وكان للحشرة فترتان واضحتان للنشاط في الموسم الأول (2018/2017)، فترة النشاط الأولي والتي تحتوي علي أكبر عدد للحشرة كانت في أول ديسمبر في كلا ميعادي الزراعة (المبكرة والمتأخرة)، بينما كانت فترة النشاط الثانية في منتصف شهر مارس من العام التالي. كما أشارت بيانات الموسم الثاني (2019/2018) أن للحشرة فترتين للنشاط أيضا، فترة النشاط الأولي والتي تحتوي علي أكبر عدد للحشرة كانت في أول ديسمبر بالنسبة لميعاد الزراعة المبكر، بينما كانت في أواخر شهر نوفمبر بالنسبة لميعاد الزراعة المتأخر، بينما كانت فترة النشاط الثانية للحشرة في منتصف شهر مارس من العام التالي في كلا ميعادي الزراعة. وأوضح التحليل الإحصائي وجود إرتباط قوي بين أعداد الحشرة وعمر النبات وضعف هذا الإرتباط مع الحرارة والرطوبة وسرعة الرياح. بلغ التأثير المجمع لدرجات الحرارة والرطوبة النسبية وسرعة الرياح وأعمار النبات على نشاط التربس (81.2٪) و (92.7٪) خلال الموسم الأول والثاني على التوالي.

الكلمات الاسترشادية: نباتات الفراولة, التربس, التذبذبات العددية, درجة الحرارة, عمر النبات.