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Sticky Traps as Monitoring Tools for the Flight Activity and Population Density of Onion Thrips (Thysanoptera: Thripidae) in Assiut Governorate

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ABSTRACT

The experiments were carried out at the experimental farm of Assiut Agricultural Station (Arab-Elawamer) - Abnoub province - during two successive growing seasons 2013 and 2014. The aim is the evaluation of the population trends of onion thrips, *Thrips tabaci* Lind. (Thysanoptera: Thripidae) and its relation to plant age and certain abiotic factors (temperatures and relative humidity %) that have been evaluated by the direct count on onion plants. Also, flight height activity of this insect pest and it's relation to plant height has been evaluated by sticky traps methodology. By the using of plants direct count three peaks during first January, mid-February and late March in both seasons were recorded. The obtained results revealed that the third peak is equal 1.71 and 1.16 fold of the first and the second peaks, respectively. Thrips peaks were coincided with the optimum (max. and min.) temperatures °C with positive correlation coefficient (r) with the pest populations. However, the relative humidity % (max. and min.) showed a negative (r) with the pest populations during the two studied seasons. Plant age showed positive (r) with the pest populations and appeared as the third factor responsible for *T. tabaci* population fluctuations. By using both yellow and white sticky traps the pest exhibited two peaks. The first peak showed quietly high numbers at February, 6 while the second peak showed the pest greatest numbers at March, 27 in both seasons. Data revealed that yellow and white sticky traps hanged at 30 cm height, captured the highest numbers at the first peak. However, those hanged at 60 cm height captured the greatest numbers at the second peak. Traps hanged at 90 cm height captured the least numbers at both peaks. Data reported that there were a positive (r) between plant height and thrips populations. It is important to note that the two peaks of *T. tabaci* recorded by sticky traps were appeared one week before the 2nd and 3rd peaks recorded by direct count method. So, sticky traps can be consistently detected thrips earlier than direct count and could be used instead of plant counts to monitor onion thrips populations.

Keywords: *Thrips tabaci* Lind., population density, sticky traps, abiotic factors.

INTRODUCTION

Onion (*Allium cepa* L.) is since ancient Egypt times a valuable vegetable crop for people all over the world. On the list of worldwide cultivated vegetable crops, onions rank second only preceded by tomatoes. Onion thrips, *Thrips tabaci* Lind. (Thisanoptera: Thripidae) is a well known onion pest worldwide. Onion thrips cause both direct and indirect damage to onion by feeding and ovipositing on leaves that may cause green onion (scallions) to be unmarketable and dry bulb onion size to be reduced (Gill *et al.*, 2015). Onion plantations are often subject to considerable insect's infestation which affected in the crop quality and quantity. Onion plants usually subject to infestation by different insect pests during their different stages of growth (Ciocioal *et al.,* 2002 ; Shahnawaz and Goud , 2005; Szwejda 2005; Mahmoud 2008; Amro *et al*., 2009; Mahaffey and Cranshaw, 2010; Abd El-Hameed *et al*., 2011; Awadalla *et al.,* 2011, Temerak *et al*., 2015 and Pobozniak *et al.,* 2016). Determination of the population fluctuations of *T. tabaci* was previously evaluated abroad by Lorini and Junior (1990) and by Sato and Nakano (1990). In Upper Egypt, studies on thrips population fluctuations and control were initiated by several authors e.g. Salman (2000); Abou-Elhagag and Ezzel-Din (2002); Sallam and Hosseny (2003); Amro *et al.*, (2009) and Temerak *et al*., (2015). Sticky traps of different colors, materials, and shapes have been used for sampling and monitoring, estimating populations and controlling *T. tabaci* under field conditions (Szenasi *et al.*, 2001). However, scarce information has been obtained about thrips flight heights. In USA MacIntyre-Allen (2004) and MacIntyre-Allen *et al.*, (2005) used direct count and sticky traps to monitor thrips fauna in onion fields to gain insight about thrips flight heights. The aim of this research was to gain better understanding about onion thrips activity and flight heights. To achieve this target, two aspects of onion thrips field activities were studied: 1- Determine the population fluctuation of *T. tabaci* on onion plants and its correlation with certain abiotic and/or weather parameters, 2- Determination of the flight height activity of adult thrips by using yellow and white sticky traps and relation to plant heights.

MATERIALS AND METHODS

This work was conducted at the experimental farm of Assiut Agricultural Station (Arab-Elawamer) Abnoub province Assiut Governorate during the two successive growing seasons of 2012/13 and 2013/14. The experiment was conducted in an area of about 1/2 feddan, cultivated by the onion cultivar Giza 20, with replicates 3×3.5 m (1/400 feddan). Regular conventional practices were performed. The experimental area divided into two equal areas (1/4 feddan/each). The first area was used to evaluate the population trends of thrips populations and its relation to certain abiotic factors (temperatures and relative humidity %). The second one was used to measure thrips populations in different heights by using yellow and white sticky traps and its relation to plant heights. The insecticides were completely prevented.

1. Population fluctuations of *Thrips tabaci* and its relation to certain abiotic factors

Fluctuations of *T. tabaci* population infested onion was determined by picking up five separated plants from four replicates and transferred to the laboratory in muslin bags. Plants were dissected and examined under stereomicroscope to count thrips nymphs and adults inhabiting each plant. Samples were taken weekly early in the morning from the beginning

of January till harvesting. Plant age was determined. The relations and correlations between the populations of *T. tabaci* and some abiotic factors were determined. Temperature °C (max. and min.) and relative humidity % (max. and min.) were obtained from the meteorological station located at Assiut Agricultural Station (Arab-Elawamer).

2- Seasonal flight activity monitoring sticky traps and its relation to plant heights

The size of trap was 9 × 14 cm painted with glossy white paint was used to monitor the seasonal flight activity of adult onion thrips. The yellow sticky traps (YST) and white sticky traps (WST) were used as described by Mac Intyre-Allen *et al.,* (2005). Monitoring the captured adults was used to determine flight height of onion thrips. Three yellow in addition to three white sticky traps (4 replicates) were installed weekly on one meter stick at three heights (30, 60 and 90 cm). Sticky traps were transferred to the laboratory. Adult thrips were counted by using a stereomicroscope. Plant heights were measured weekly. Data were statistically analyzed by using F test; means were compared according to Duncan's multiple range tests by SAS software (SAS Institute 2002). Correlation coefficient (r) between the tested abiotic factors and/or plant age with thrips mean numbers was calculated. Also, (r) between plant heights and thrips mean numbers on three heights of yellow and white sticky traps was estimated.

RESULTS AND DISCUSSION

1. Population fluctuations of *Thrips tabaci* and its relation to certain abiotic factors

Fluctuations of *T. tabaci* population on onion and its relation to certain abiotic factors were determined in Tables (1&2). During the first season of study (2012/2013), four weeks after transplanted onion plants, population of *T. tabaci* appeared on onion fields at moderately high numbers with an average of52.50 individuals/ plant at the first of January, 2 and plant age of 23 days after transplantation (first peak) (Table.1). Except of this low peak the insect pest showed two peaks on the onion fields. The second peak recorded 77.50 individuals' plant at February, 13 and 65 days after transplantation. The third peak recorded89.85 individuals/ plant, at March, 27 and 107 days after transplantation. It is important to note that, the third peak is equal 1.71 and 1.16 fold of the first and second peaks, respectively. Variations between inspection dates or (plant age) showed highly significant F value (12.94**). Similar results were recorded during 2013/2014 season (Table 2). Determination the population trends and the time required for thrips peaks appearance could be enabling the entomologists to choose the appropriate time for controlling this insect pest. Correlation coefficient (r) between thrips populations and the tested abiotic factors were also showed in Tables (1&2). During the study period 2013 and 2014 growing seasons, thrips peaks were coincided with the optimum (max. and min.) temperature °C with positive (r) with the pest populations. However, the relative humidity % (max. and min.) showed a negative (r) with the pest populations during the tow studied seasons. The obtained results agree with that finding by Patel and Patel (2015) in India that indicated the population of thrips had significant positive correlation with maximum temperature (0.57823**) and mean temperature (0.49487*). However mean relative humidity (−0.87602**) had a significant negative correlation with the population of thrips. Plant age showed relatively high (r) values with the pest populations and appeared as the third factor responsible for *T. tabaci* population fluctuations. In this approach, Quartey (1982) studied the population dynamics of *T. tabaci* on onion in USA. Abd El-Hameed *et al.,* 2011 recorded that the dynamics of the nymphal stage showed increase steadily after half of February until end of March. In Assiut Governorate, Temerak *et al.,* (2015) recorded three peaks of the *T. tabaci* by using onion plants direct count. They determined the relation between *T. tabaci* populations and air temperature in addition to the relative humidity. They reported that *T. tabaci* peaks were coincided with the lowest temperature and relative humidity.

Table 1. Mean numbers of *Thrips tabaci*/plant on onion plants and its relation to temperature and relative humidity during 2012/2013 growing season at Abnoub province.

Sampling date	Plant age (days)	Mean no. individuals/ plant	Temperature (C)		RH (%)	
			Max.	Min.	Max.	Min.
Jan. 2	23	52.50 cd	24.00	11.00	80.00	23.00
Jan. 9	30	13.15 ef	21.14	7.29	67.71	13.43
16	37	10.25 ef	21.29	7.57	68.29	14.14
23	44	29.75 de	25.00	6.00	70.29	7.00
30	51	41.55 cd	25.00	7.43	69.57	9.86
Feb. 6	58	51.35 cd	24.14	8.71	69.43	12.71
13	65	77.50 ab	25.29	7.14	74.29	11.57
20	72	73.05 ab	26.29	8.43	72.71	9.43
27	79	55.30 bc	26.86	10.57	71.14	8.86
Mar. 6	86	40.55 cd	28.14	12.00	62.86	7.71
13	93	46.45 cd	25.29	10.43	66.29	8.43
20	100	59.25 bc	26.43	10.43	71.43	10.57
27	107	89.85 a	30.00	10.86	70.57	4.14
Apr. 3	114	82.95 a	29.86	12.86	66.43	3.86
10	121	29.75 de	31.00	12.86	65.14	2.86
17	128	17.05 ef	35.00	15.29	64.43	4.29
24	135	4.48 f	36.00	15.43	65.71	7.43
Mean		41.96				
(r)	0.375	F= 12.94 **	0.133	0.002	-0.175	-0.214

Means followed by the same letter are not significantly different at 0.05 level of probability by Duncan's multiple range tests.

Table 2. Mean numbers of *Thrips tabaci*/plant on onion plants and its relation to temperature and relative humidity during 2013/2014 growing season at Abnoub province.

Sampling date	Plant age (days)	Mean no. individuals/ plant	Temperature (C)		RH (%)	
			Max.	Min.	Max.	Min.
Jan. 2	23	43.15 cd	18.00	7.35	57.00	4.50
9	30	14.00 def	15.66	4.70	64.70	20.33
16	37	10.25 ef	23.00	7.00	75.50	12.00
23	44	19.00 def	24.50	6.33	74.50	12.00
30	51	24.85 def	26.57	7.50	66.00	12.00
Feb. 6	58	57.55 bc	27.25	10.80	72.50	13.50
13	65	64.00 ab	22.00	6.50	70.00	10.00
20	72	60.25 ab	22.25	7.40	72.67	12.75
27	79	56.30 bc	19.33	7.00	72.66	16.00
Mar. 6	86	48.40 bc	23.50	9.00	77.50	8.80
13	93	49.45 bc	29.00	11.60	73.75	8.50
20	100	69.10 ab	26.00	9.50	69.60	11.00
27	107	75.05 a	27.67	13.00	71.67	7.25
Apr. 3	114	63.20 ab	30.33	10.80	66.50	9.50
10	121	27.80 cde	32.66	12.67	57.33	10.00
17	128	15.75 def	33.33	15.00	64.33	11.00
24	135	5.56 f	35.00	16.40	64.50	11.75
Mean		40.99				
(r)	0.242	F=11.39**	0.154	0.061	-0.102	-0.143

Means followed by the same letter are not significantly different at 0.05 level of probability by Duncan's multiple range tests.

2. Seasonal flight activity monitoring sticky traps and its relation to plant heights

Data presented in Tables (3&4) expressed about the mean numbers of *T. tabaci* captured by both yellow and white sticky traps during both seasons. The pest exhibited two peaks by using both trap types. The first peak recorded quietly high numbers at February, 6 and plant age of 58 days post transplantation. However, the second peak showed the pest greatest numbers at March, 20 and plant age of 100 days post transplantation. Data in Table (3) indicated obviously that adult numbers captured by (YST) during the second peak in 2012/2013 growing season is equal (11.36, 21.46 and 17.54) fold of that captured during the first peak at 30, 60 and 90 cm heights, respectively. Similar trend was recorded during 2013/2014 season. It is observed that, (YST) hanged at 30 cm height, captured the heights numbers at the first peak. However, (YST) hanged at 60 cm height captured the greatest numbers at the second peak. Traps hanging on 90 cm height captured the least numbers at both peaks. This finding could be attributed to the relation between the plants heights and the pest flight heights. The obtained results presented in Table (4) expressed about the mean numbers of*T. tabaci* captured by (WST). It is important to note that, the pest exhibited its peaks during the same day and/or plant age, as well as, those recorded by (YST). Although, the captured adults by (WST) presented in quietly low numbers at the first peak, they showed higher values during the second peak. By using both types of sticky traps, data revealed positive correlation coefficient (r) between plants heights and thrips populations. Also, data indicated that, the two peaks of *T. tabaci* recorded by sticky traps were appeared one week before those recorded by direct count method. The comparison between sticky traps captures and plant direct count indicated that sticky traps consistently detected thrips earlier than direct count. Therefore, sticky traps could be used instead of plant counts early in the season to monitor thrips populations. In agreement results, Gangloff (1999) in USA and Van de Steene (1999) in Belgium recorded two peaks of *T. tabaci* by using sticky traps. However, MacIntyre-Allen *et al.,* (2005) results revealed that sticky traps detected thrips earlier than plant counts. So, it can be concluded that, the use of sticky traps laid to earlier detection of thrips peaks and laid to the appropriate time to control the *T. tabaci*.

Table 3. Population fluctuation of *Thrips tabaci* captured by yellow sticky traps on onion fields during 2012/2013 and 2013/2014 growing seasons at Abnoub province.

Sampling date	Plant age (days)	Plant height (cm)	Mean numbers of individuals /one yellow sticky trap hanging at 3 hights 2012/2013			2013/2014		
			30 cm	60 cm	90 cm	30 cm	60 cm	90 cm
Jan. 9	30	14.38	2.75	4.25	4.00	4.50	3.25	2.75
16	37	17.94	17.25	6.75	6.25	6.75	5.00	4.00
23	44	18.06	19.75	17.75	12.75	18.75	14.50	7.25
30	51	19.94	27.25	23.50	10.25	29.25	27.50	8.50
Feb. 6	58	23.88	164.75	128.25	84.75	165.75	85.25	58.75
13	65	30.13	147.25	98.50	70.00	140.00	70.25	42.00
20	72	34.88	66.25	33.75	18.25	31.75	23.75	17.25
27	79	44.19	94.75	75.75	47.50	79.50	52.25	31.75
Mar. 6	86	45.88	385.75	280.75	132.50	394.75	310.75	159.25
13	93	54.38	1308.25	1106.25	896.25	1482.75	668.50	467.75
20	100	58.50	1872.25	2752.25	1486.75	1857.25	2193.25	815.50
27	107	60.56	60.25	120.00	91.50	104.75	129.25	103.00
Apr. 3	114	46.81	29.50	45.50	48.25	38.75	52.75	56.25
10	121	45.13	23.25	33.25	32.00	27.50	39.50	37.75
17	128	44.88	21.75	23.50	17.25	52.25	35.75	23.50
24	135	43.69	14.25	17.25	6.75	24.50	23.25	20.75
		(r)	0.523	0.576*	0.655*	0.581*	0.682*	0.597*

Table 4. Population fluctuation of *Thrips tabaci* captured by white sticky traps on onion fields during 2012/2013 and 2013/2014 growing seasons at Abnoub province.

Sampling date	Plant age (days)	Plant height (cm)	Mean numbers of individuals /one white sticky trap hanging at 3 hights 2012/2013			2013/2014		
			30 cm	60 cm	90 cm	30 cm	60 cm	90 cm
Jan. 9	30	14.38	2.75	1.75	1.00	3.50	2.25	2.00
16	37	17.94	3.50	2.25	2.25	7.75	3.50	3.00
23	44	18.06	18.50	10.25	6.75	16.50	8.50	4.50
30	51	19.94	33.25	14.75	10.25	32.25	15.50	10.25
Feb. 6	58	23.88	57.75	41.75	14.50	33.50	22.75	15.75
13	65	30.13	45.75	29.00	17.25	30.00	18.25	10.75
20	72	34.88	49.50	32.75	15.50	37.25	19.25	14.75
27	79	44.19	55.25	33.50	13.50	26.75	23.50	14.50
Mar. 6	86	45.88	555.75	306.50	204.25	374.25	349.75	219.50
13	93	54.38	1289.50	1132.75	967.75	1351.75	1371.50	727.50
20	100	58.50	2836.25	3331.75	1724.75	1772.50	2809.75	1288.75
27	107	60.56	32.75	29.25	32.75	45.00	48.25	37.75
Apr. 3	114	46.81	29.25	33.75	32.00	27.75	39.50	37.75
10	121	45.13	27.75	27.25	24.50	27.50	35.75	23.50
17	128	44.88	26.25	22.50	19.50	23.25	26.25	20.75
24	135	43.69	17.25	16.50	15.25	14.50	17.75	15.50
		(r)	0.581*	0.524	0.589*	0.667*	0.624*	0.653*

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المصايد اللاصقة كوسائل متابعة لنشاط الطيران والكثافة العددية تعداد تربس البصل بمحافظة أسيوط

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أجريت التجارب بالمزرعة البحثية بمحطة البحوث الزراعية بأسيوط بمنطقة عرب العوامر- مركز أبنوب - خلال موسمين متتاليين ٢٠١٣ و٢٠١٤ وذلك لتقدير اتجاه تعداد تربس البصل (*Thrips tabaci*) وعلاقته بالمراحل العمرية للنبات وبعض العوامل الجوية بالفحص المباشر على النباتات. كما تم تقدير نشاط طيران التربس على إرتفاعات مختلفة بإستخدام المصائد اللاصقة وعلاقته بأطوال النباتات. بإستخدام طريقة العد المباشر على النباتات سجل التربس ثلاثة قمم على البصل فى أول يناير ومنتصف فبراير ونهاية مارس خلال موسمى الدراسة. كما أظهرت النتائج أن أعداد التربس فى القمة الثالثة كانت تساوى ١.٧١ و١.١٦ مرة من أعداده فى القمتين الأولى والثانية على التوالى. وقد تزامنت قمم التربس مع درجات الحرارة المثلى (العظمى والصغرى) مع وجود إرتباط معنوى موجب مع مجاميع الأعداد. وقد أظهر عمر النبات إرتباطا موجبا مع تذبذب مجاميع الآفة واحتل المركز الثالث فيما بين العوامل المسؤلة عن تذبذب مجاميع التربس. وبإستخدام المصائد اللاصقة الصفراء والبيضاء أظهر تربس البصل قمتين فقط. ظهرت القمة الأولى بأعداد عالية نسبيا فى ٦ فبراير بينما ظهرت القمة الثانية بأعداد عالية جدا فى ٢٠ مارس فى كلا من موسمى الدراسة. كما أظهرت النتائج أن كلا من المصائد الصفراء والبيضاء المعلقة على إرتفاع ٣٠سم جذبت أكبر الأعداد من الآفة فى القمة الأولى. بينما تلك التى علقت على إرتفاع ٦٠ سم جذبت أكبر الأعداد من الآفة فى القمة الثانية. أما المصائد المعلقة على إرتفاع ٩٠ سم فقد جذبت أقل الأعداد فى كل من القمتين. كما أظهرت النتائج وجود إرتباط موجب بين أطوال النباتات وتعداد التربس المنجذب للمصائد اللاصقة. ومن الأهمية بمكان ملاحظة أن قمم التربس التى سجلت بإستخدام المصائد اللاصقة ظهرت قبل أسبوع من ظهورها عند إستخدام طريقة الفحص المباشر للنباتات. وبالتالى فإنه من الممكن التنبؤ بنشاط تعداد التربس مبكرا بإستخدام المصائد اللاصقة وإستخدامها عوضا عن الفحص المباشر لنباتات البصل لتقدير تذبذب تعداد تربس البصل حتى يمكن التخطيط لعمليات المكافحة.