DETECTING POPULATION FLUCTUATION OF TUTA ABSOLUTA ON SOME SOLANUM SPP. IN RELATION TO DIFFERENT ENVIRONMENTAL CONDITIONS AND IT'S ECONOMIC EVALUATION IN KAFR EL SHEIKH GOVERNORATE, EGYPT

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Abstract

In the present study the population fluctuation and host preference of the tomato leaf miner *Tuta absoluta* (Meyrick), a dangerous pest attacking Solanaceae in Egypt causing great losses, was investigated using pheromone traps. The study was conducted in Kafr El Sheikh Governorate. The incidence of the pest was studied in two important vegetable crops, *i.e.* tomatoes and eggplants. Pheromone traps were used to capture males of *T. absoluta* in two different locations per crop. Number of moths was recorded through a period of 4 months starting from October 2016 till January 2017. Degree Days Unit was estimated during the period of the research, in addition, temperature, relative humidity and wind velocity effects on the pest population fluctuation was investigated. Moreover, the effect of the pest on the economic indicators of tomato crop was also studied. *T. absoluta* registered 4 peaks in both crops, prefers tomato as primary host plant and is active within the range of 10-20°C. Relative humidity did not affect the pest population either in tomato or in eggplant within the period and location of the experiment whereas wind velocity showed a direct effect. Males' captures increased when wind velocity ranged between 40-58 Km/hr. Results indicated that the loss in production of tomatoes in Kafr El Sheikh Governorate reached 17.2 thousand tons, while on the country level it reached about 571.8 thousand tons, which equivalent to 26.7 and 880.6 thousand pounds on both levels, *i.e.* Kafr El Sheikh and country, respectively. The economic evaluation analysis indicated that on the 4th and 5th weeks of tomato transplanting; control measures intensity should be condensed to decrease the rate of pest infestation in tomato fields.

INTRODUCTION

Egypt is considered one of the most important tomato producers in the world (WPTC, 2011). The area under cultivation spread from the extreme north to the extreme south and approximately 531.1 thousand feddans ((1 feddan = 0.42 ha) produce about 9 million tons annually (Bekheit and Latif, 2015). This ranked Egypt as the fifth tomato producer in the world (Mahmoud *et al.*, 2015). The majority of this area is concentrated in Delta region.

On the other hand, eggplant is an important vegetable crop that is widely cultivated in the tropical and subtropical areas. Globally, the top three eggplant producers are China, India, and Egypt (Del Prado-Lu JL. 2015).

The tomato leaf miner *Tuta absoluta* (Meyrick) is considered as a serious pest to the Solanaceous crops. It is a poly-phagous leaf miner that can develop on hosts such as tomato and eggplant (Desneux *et al.* 2010 and 2011). It invaded Egypt through the Libyan borders in 2009 and by the year 2011 it was well established in all Egyptian governorates (GAFFAR, 2012). *T. absoluta* attacks the plant in all its developmental stages from seedlings to mature but it prefers the fruits. At high densities this destructive pest can cause severe yield losses (Hristina *et al.,* 2016). In Kafr el Sheikh Governorate a percentage of 100% infestation occurred in tomato fields as stated by Moussa *et al.,* (2013). They added that high infestation led to an increase in tomato prices, bans on the trade of tomato including seedlings, in addition to the increase in synthetic insecticide applications and in the cost of crop protection. It was also documented attacking eggplant in Matroh Governorate by Soliman and Imam (2013).

Furthermore, Lepidoptera pheromones have been successfully used for insect monitoring and mating disruption of insects. Virgin female of *T. absoluta* releases a sex pheromone that strongly attracts males. By monitoring *T. absoluta* males using pheromone traps, it may be possible to determine the correct timing for insecticide applications leading to a reduction and rational use of pesticides (Abolmaaty *et al.,* 2010).

Nevertheless, the environmental conditions such as temperature and relative humidity are factors that influence insect physiology and behavior and thus its infestation rate and plant destruction causing substantial losses in yield (Abolmaaty *et al.,* 2010).

Unfortunately, there are neither enough records on the population fluctuation of this pest in Egypt nor its economic evaluation. Therefore, the objectives of this study are to monitor *T. absoluta* in tomato and eggplant fields in Kafr el Sheikh Governorate using pheromone traps and investigate the relationship between the pest population on both crops and some environmental factors, *i.e.* temperature, relative humidity and wind velocity. In addition, an economic evaluation estimating the loss in productivity, area, production, costs and net return was conducted.

MATERIALS AND METHODS

The present study was implemented in Kafr El Sheikh Governorate- Egypt. The investigation extended from the first week of October 2016 till the last week of January 2017. An area of one feddan (4200 m^2= 0.4 hectare) was divided into 4 plots *i.e.* two for tomato and two for eggplant.

1- TOMATO PLOTS:

In the second week of September an area of 2450 m^2 was cultivated with tomato seedlings (20-25 days old- Carmen variety) that were transplanted in the permanent field in rows with spacing of 60 cm between rows and 50 cm distance between each two successive plants (The Central Administration for Agricultural Extension and Environment, 2016).

2- EGGPLANT PLOTS:

An area of 1750 m^2 was cultivated with eggplant seedlings of 15cm height in the second week of September (variety black beauty). Spaces between seedlings were 50-60cm. (The Central Administration for Agricultural Extension and Environment, 2016).

3- EXPERIMENTAL DESIGN:

a- PHEROMONE TRAP:

Delta traps were used to study the population fluctuation of *T. absoluta*. Traps consisted of a triangular-shaped body (Manufactured of carton paper obtained from the Plant Protection Research Institute of the Agricultural Research Center-Egypt) measured 16 x 9.5 x 9.5 cm. Figure (1) represents the traps structure where A is the pheromone dispenser, B is the paper body and C represents the sticky surface. Traps are opened at both ends; the sticky insert placed inside it on the base of the triangle is a removable one.

Traps were hanged 1 m above the ground in the wind direction to facilitate the spreading of the pheromone. Traps were investigated once a week for moth counts and captured moths were removed. Every 4 weeks pheromone lures including the sticky inserts were replaced on a regular schedule.

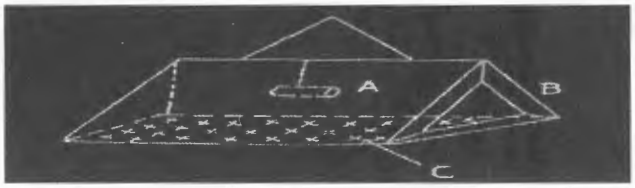


Fig. 1. The Delta Trap Structure

b- Relative number of captured moths:

Relative number of captured moths was calculated according to the equation: (No. of captured moths ÷total No. of captured moths) x 100, (Khider *et al.,* 2012).

c- WEATHER CONDITION:

Maximum and minimum temperature, wind velocity and relative humidity were daily recorded throughout the experimental period.

d- DEGREE-DAYS UNIT ESTIMATION:

Degree day's unit (DDU) was estimated and *T. absoluta* thermal units were calculated using the equation applied by Barrientos *et al.,* (1998). Degree day's unit

calculations were made to estimate the number of possible generations of *T. absoluta* in the field.

e- STATISTICAL ANALYSIS:

The data was subjected to analysis of variance (ANOVA) and the means were compered by L.S.D test at $P< 0.01$ levels, using SAS program. In addition, when a significant value was found averages were compered by Duncan Test. It was used to compare the number of captured males to weeks and identify weeks where high infestation occurs.

RESULTS AND DISCUSSION

To improve monitoring programs and to design effective management strategies of the tomato leafminer *T. absoluta* populations in Egypt, it was important to strengthen our knowledge on the dynamics of invasion, pest population fluctuation and environmental conditions suitable for this pest in addition to its economic evaluation at the level of the country and also in Kafr el Sheikh Governorate, one of the Egyptian regions where tomato and eggplant are cultivated.

I. INCIDENCE OF *T. ABSOLUTA* IN TOMATO FIELDS IN BOTH LOCATIONS:

Males of *Tuta absoluta* were attracted to the pheromone traps and relative differences were observed in their mean numbers. Data collection in tomato first plot started on the 10th of October 2016 where the mean number of male captures reached 21.50± 5.95, then, number of males increased gradually till it reached 34.50±11.9 by the end of October (Table 1). Male's number in the pheromone traps continued to increase where on the first week of November (7th of November) it reached 49±6.45 and this was the highest number registered during the whole season. However, starting from the second week of November number of moths fluctuated between 14.17±2.06, 19.50±4.57 and reached 20.17±2.75 by the end of the month. In the first week of December the mean number of captures was (19.50±2.66), yet, it decreased dramatically till it reached 0.83±0.83 on the 26th of December. A slight increase in the number of male moths occurred in the first week of January (1.33±1.15), followed by another increase in the second week (4.67±1.67), while in the following two weeks reduction continued to occur until numbers of *T. absoluta* males reached 0.83±0.54 by the end of January as shown in table (1).

On the other hand, in tomato's second plot number of captures was relatively close during the month of October (*i.e.* 24.67±2.56, 19.17±3.06, 23.83±7.65 and 24.33±3.38). These records were the highest during the whole season in this plot as shown in table (1). While during the next 2 months captures were fluctuated in their number. The least record registered was on the 23rd of January *i.e.* 2.50±1.31.

Males of *T. absoluta* population had relatively the same pattern in the two tomato locations where no big differences in the total male's number in both locations were noticed in the pheromone traps (1668 and 1722, respectively).

II. INCIDENCE OF *T. ABSOLUTA* IN EGGPLANT FIELDS IN BOTH LOCATIONS:

It was clearly noticed that there is a dramatic reduction in the number of males' captures in the two eggplant plots when compared to tomato plots. This was attributed to the host preference of *T. absoluta* where it attacks tomatoes as the most preferred host in family Solanaceae. Several authors had reached the same conclusion, *i.e.* Salama *et al.,* 2015, Caparros, *et al.* (2014) and Garica and Espul (1982) where they confirmed that *T. absoluta* showed more preference to tomato followed by black nightshade, eggplant, potato and pepper. Total number of moths captured in tomato fields in the two locations was 1668 and 1722, respectively, while in eggplant fields numbers decreased in the two locations where they registered 192 and 233, respectively. These findings support previous studies carried out by Pereyra and Sánchez (2006) and Miranda *et al.* (1998).

Maximum registered number of male's captures occurred in the 3rd week of November *i.e.* 10.75±2.72, then, numbers of males fluctuated as shown in table (1) till it dropped to 1±0.41in the last week of December. No captures were recorded in the first week of January, yet, a very slight increase occurred in the second week of January where male records registered 0.5±0.29 in average. During the last two weeks of January no moths were caught in the pheromone traps.

Mean numbers of captures in the second location registered its maximum in the first week of December where it reached 7.5±2.25. Otherwise, number of males fluctuated through the period of the experiment registering its minimum capture during the three latest weeks of January where no moths were collected at all (Table 1).

III. Relative number of captured moths:

Results in table (2) and Figure (2) show that there are 4 peaks that occurred in the first tomato plot on the inspection dates of October 17th, November 7th and 28th and finally in January 9th where the relative number of captured moths were 10.5,17.6, 7.2 and 1.67, respectively.

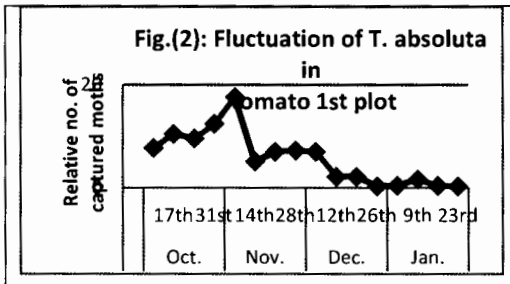
Moreover, *T. absoluta* registered 4 peaks also in the second tomato plot with differences in dates and number of captures when compared to the first plot as seen in Figure (3). Peaks dates were on the 7th and 21st of November, 5th and 19th of December were relative number of captured moths were 8.5, 8, 7.2, and 7.2, respectively. On the other hand, captures of *T. absoluta* registered the same number of peaks in eggplant plots where four peaks were registered in the first plot as showed in table (2) and illustrated in Figure (4). These 4 peaks occurred on the 17th of October, 7th and 28th of November and finally 12th of December (relative number of captures were 9.3, 11.4, 22.3 and 10.4, respectively). Similarly, the second plot witnessed 4 peaks as illustrated in Figure (5), *i.e.* on the 24th of October, 7th and 21st of November, and finally the 5th of December (9, 11.6, 8.5, and 12.9, respectively). These results were found also by Mahmoud *et al.* (2015) where they found that *T. absoulta* has 4 peaks during both the winter and summer plantations.

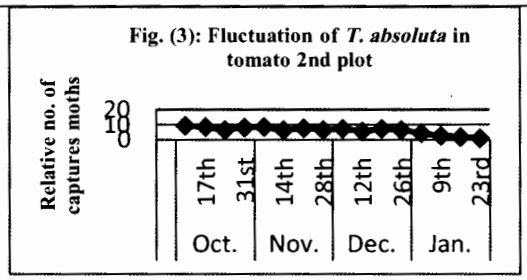
Table 1. Population Fluctuation of *Tuta absoluta* Males Captured by Pheromone Traps on Tomato and Eggplant Plantations (Oct. 2016 –Jan. 2017) in Kafr El Sheikh Governorate.

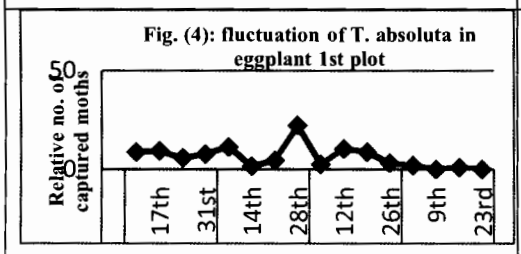
Months	Inspection Date	Tomato plantation				Eggplant plantation				DDU	AV. Temp.	Av. R.H. %	Wind velocity Km/hr.
		Location 1		Location 2		Location 1		Location 2					
		Mean No. of males	SE	Mean No. of males	SE	Mean No. of males	SE	Mean No. of males	SE				
October	10th	21.50 B-E	5.95	**24.67A-B**	2.56	4.25AB	2.17	6.25A	3.17	14.1	**20.6**	71.65	**58.2**
	17th	29.33A-C	6.52	19.17A-C	3.06	4.50AB	1.55	5.00A	1.47	13.2	21.5	74.45	77.7
	24th	26.83A-D	3.59	23.83A-C	7.65	2.75B	1.38	5.25A	2.21	15.3	16	71.35	60.7
	31st	34.50 A-B	11.9	24.33 A-B	3.38	3.75B	1.31	4.75A-B	1.11	9.1	16.15	78.3	60
November	7th	**49.00 A**	6.45	18.50A-D	3.03	5.50AB	1.55	6.75A	1.38	11.2	**18.35**	72.8	**41.4**
	14th	14.17 B-E	2.06	22.83A-C	3.05	0.75B	0.48	4.00AB	2.16	10.8	15.585	72.05	56
	21st	19.50 B-E	4.57	19.00A-D	3.91	2.25B	0.63	5.00A	1.41	9.7	15.25	71.25	42
	28th	20.17B-E	2.75	20.67A-D	4.03	**10.75A**	2.72	4.75AB	2.17	6.5	**13.95**	79.2	**43.5**
December	5th	19.50 B-E	2.66	16.67A-D	3.13	1.25B	0.75	**7.50A**	2.25	8.9	**10.85**	75.75	**49**
	12th	6.17C-E	3.27	19.00A-D	4.17	5.00AB	0.82	3.25BC	1.03	5.8	11.05	75.85	85.4
	19th	6.17 C-E	3.62	19.33A-D	2.44	4.25AB	2.02	2.75BC	1.03	5.9	13.1	79.4	46.8
	26th	0.83 E	0.83	12.33A-D	4.30	1.50B	0.96	2.75BC	2.14	4.9	14.6	71.9	52.4
January	2nd	1.33 E	1.15	8.17B-D	2.99	1.00B	0.41	0.00C	0.00	6.3	15.35	73	55.2
	9th	4.67 D-E	1.67	5.67 CD	1.96	0.00B	0.00	0.25C	0.25	5.0	11.35	72.5	106
	16th	1.17 E	0.48	3.00 D	1.79	0.50B	0.29	0.00C	0.00	7.1	11.55	75.75	78.7
	23rd	0.83 E	0.54	2.50 D	1.31	0.00B	0.00	0.00C	0.00	9.3	14.75	75.55	56

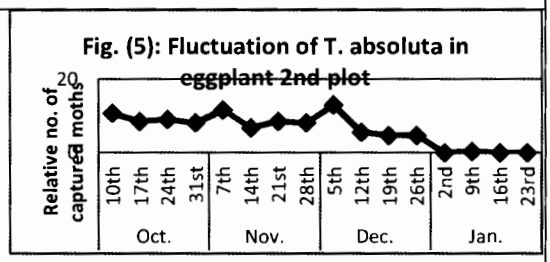
Table 2. Relative Number of Captured Moths of *T. absoluta* in Tomato and Eggplant Plots in Kafr el Sheikh Governorate.

Months	Inspection Date	Relative Number of Captured Moths			
		Tomato plot 1	Tomato plot 2	Eggplant plot 1	Eggplant plot 2
Oct.	10th	7.7	9.6	8.85	10.7
	17th	10.5	8.6	9.3	8.5
	24th	9.6	6.7	5.7	9
	31st	12.4	8.3	7.8	8.1
Nov.	7th	17.6	8.5	11.4	11.6
	14th	5.1	6.5	1.5	6.8
	21st	7	8	4.6	8.5
	28th	7.2	6.6	22.3	8.1
Dec.	5th	7	7.2	2.6	12.9
	12th	2.22	5.8	10.4	5.6
	19th	2.22	7.2	8.8	4.7
	26th	0.29	6.7	3.1	4.7
Jan.	2nd	0.47	4.3	2.1	0
	9th	1.67	2.8	0	0.4
	16th	0.41	1.9	1	0
	23rd	0.30	1	0	0









Differences between Weeks and Locations in Tomato Fields:

The analysis of variance indicated that significant differences were noticed between the weeks in tomato fields, male's number and weeks and the interactive effect between the locations and weeks as well, yet, no significant differences were noticed for male's number between the locations (Table 3). When using Duncan test number of males showed significant differences on the 5th week other than the rest of weeks followed by 2nd, 4th, 13th and 15th weeks (Table3).

Table 3. Analysis of Variance for the Interactive Effect of *T. absoluta* in Relation to Weeks in the Two Tomato's Locations.

Source	Type III Sum of Squares	DF	Mean Square	F value	Sig.
Corrected Model	22760.078[a]	31	734.196	6.907	**
Weeks	17908.995	15	1193.933	11.232	**
places	155.880	1	155.880	1.466	.228
Locations*weeks	4695.203	15	313.014	2.945	**
Error	17008.167	160	106.301		
Total	94477.000	192			
Corrected Total	39768.245	191			

** Highly significant at 0.01

Table 4. Results of Duncan Test of *T. absoluta* Males/Weeks for Tomato

Weeks	Average	Homogenous subsets								
		1st	2nd	3rd	4th	5th	6th	7th	8th	9th
5th	36.6									
4th	29.2									
2nd	27.0									
1st	24.4									
3rd	23.0									
7th	21.1									
9th	20.0									
8th	19.5									
6th	16.3									
11th	12.5									
10th	11.4									
12th	10.0									
14th	8.5									
13th	4.7									
15th	3.4									
16th	1.9									

The shaded cells refer to the significant difference of the week compared to the other un-shaded weeks between the homogenous subsets.

Differences between Weeks and Locations in Eggplant Fields:

Table (5) shows that significant differences were noticed between weeks and between weeks and number of males captured, however, no significant differences were noticed in male's number in the different locations. Duncan test showed significant differences in the 8th week followed by the 5th, 1st and 2nd weeks as shown in (Table 6).

Table 5. Analysis of Variance for the Interactive Effect of *T. absoluta* in Relation to Weeks in the Two Eggplant's Locations.

Source	Type III Sum of Squares	DF	Mean Square	F value	Sig.
Corrected Model	848.117[a]	31	27.359	3.076	**
Weeks	619.242	15	41.283	4.642	**
places	13.133	1	13.133	1.477	.227
Places*weeks	215.742	15	14.383	1.617	.083
Error	853.750	96	8.893		
Total	3113.000	128			
Corrected Total	1701.867	127			

** Highly significant at 0.01

Table 6. Results of Duncan Test of *T. absoluta* Males/Weeks for Eggplant.

Weeks	Average	1st	2nd	3rd	4th	5th	6th
8th	7.8						
5th	6.13						
1st	5.25						
2nd	4.75						
9th	4.38						
4th	4.25						
10th	4.13						
3rd	4.0						
7th	3.63						
11th	3.50						
6th	2.38						
12th	2.13						
13th	0.50						
15th	0.25						
14th	0.13						
16th	0.0						

The shaded cells refers to the significant difference of the week compared to the other un-shaded weeks between the groups

These findings indicate that *T. absoluta* control programs in tomato should be intensified in the weeks pointed out previously according to the average of pest numbers. The weeks of severe infestation and the rate of control that should be implemented are highlighted in table (7).

Table 7. Severity of Infestation with *T. absoluta* in Tomato and Intensity of Control

Weeks of Infestation	intensity of Control
5th and 4th	Very high
2nd and 1st	High
3rd, 7th and 9th	Moderate
8th and 6th	Moderate to some extent
11th and 10th	Satisfied
12th and 14th	Normal
13th ,15th and 16th	Normal

On the other hand, in eggplant fields control programs should be concentrated in the period of the shaded weeks highlighted in table (6) and the next table shows the descending order of weeks according to the infestation and the intensity of control.

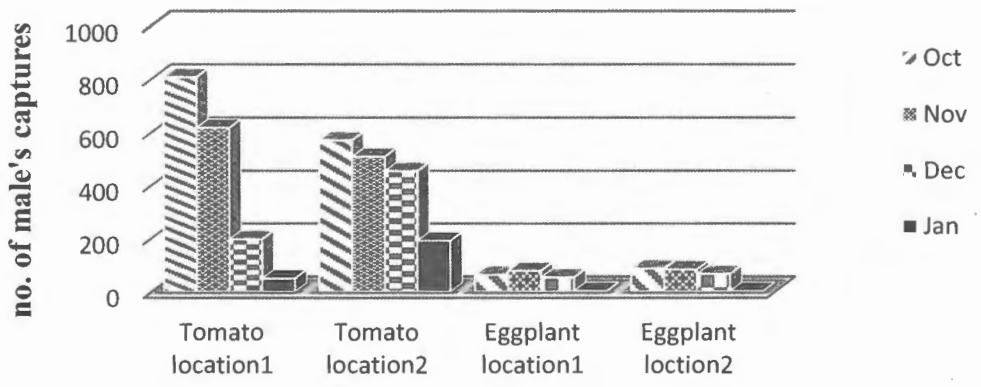
Table 8. Severity of Infestation with *T. absoluta* in Eggplant and Intensity of control

Weeks of Infestation	Intensity of Control
8th	Very high
5th , 1st and 2nd	High
9th, 4th and 10th	Moderate
3rd, 7th and 11th	Moderate to some extent
6th and 12th	Satisfied
13th ,15th , 14th and 16th	Normal

Total Months' Captures in Tomato and Eggplant Fields:

Monthly calculation of *T. absoluta* moths in the pheromone traps in both crops was also registered. As shown in Figure (6) in tomato plots the highest number of captures in both locations were recorded during the month of October, *i.e.* (807 and 570 moths, respectively), while in eggplant plots the highest captures of moths were registered during the months of November and October were they recorded (77 and 85 moths, respectively). This indicates that in autumn plantation the months of October and November witness the highest number of *T. absoluta*. On the other hand, the least registered number of moths either in tomato or in eggplant plots occurred during the month of January as shown in Figure (6).

Fig. (6): Total Number of *T. absoluta* in Tomato and Eggplant Crops



Relationship between the Different Weather Conditions and Number of *T. absoluta* Males:

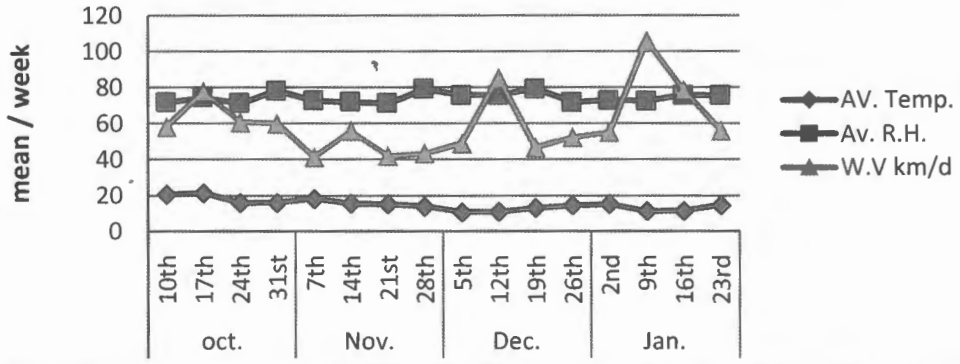
Considering its high biotic potential, *T. absoluta* has the ability to adapt to various climatic conditions as stated by Zlof and Suffert, (2012). The relationship between environmental conditions (temperature, relative humidity and wind velocity) and the population of *T. absoluta* males' captures is an important part of this study.

It was noticed that during the period of the experiment temperature ranged between 10 and 21◦C (Figure 7). Although this is not the range said to be the most suitable for this pest, still, results proved that *T. absoluta* can attack tomato crop within this temperature's range. In tomato plots higher temperature resulted in more moths captures as stated in table (1).

Relative humidity percentage, on the other hand, seemed to have no effect on moths captures during the experimental period (October- January, 2016-2017) where it ranged between 71%-79% (Figure 7). Whereas, results showed that wind velocity

had a direct relationship with the number of moths captured in the pheromone traps. The higher number of male moths in tomato 1st and 2nd plots, *i.e.* 49 and 24.67, were captured when the wind velocity was 41.4 and 58.2 km/hr. Higher wind velocity resulted in less moths captures. Same results were noticed in eggplant plots where lower wind velocity caused higher captures as shown in table (1).

Fig. (7): Weather conditions during the research period



Economic Evaluation of *T. absoluta* Impact on Tomato Crop in Egypt:

According to the previous results and as mentioned before, *T. absoluta* preferred tomato as its main host plant and the degree of infestation was higher than that on eggplant. Therefore, the economic evaluation of the pest was carried out only on tomato crop rather than eggplant. The relative importance of the loss due to pest infestation and its relation to the economic indicators of tomato are discussed.

1- Current Situation of the Economic Indicators of Tomato Crop in Egypt:

Table (9) shows that the cultivated area of tomato crop in Egypt during the period 2011-2015 witnessed some fluctuation. The maximum cultivated area was 515.2 thousand feddans with a record of 101.9 in 2012, while the minimum cultivated area was 497.6 thousand feddans.

On the other hand, during the period of 2011-2015, tomato productivity registered its maximum yield on the year 2013, where it reached 16.92 tons /feddan. While the minimum productivity occurred in 2011 (15.92 tons/feddan) followed by 2014 (16.22 tons/ feddan) with an average productivity reached 16.43 tons/ feddan as shown in table (9).

Moreover, the total production of tomatoes witnessed, as well, a fluctuation during the same period where it reached 8.05 million tons in 2011 compared to the year 2015 where it was 7.73 million tons. Total average of tomato production was

8.18 million tons. The cost per feddan increased from LE 4312 in 2011 up to LE 5743 in 2015, whereas, the net return per feddan decreased from LE 19793 in 2012 to LE 17118 in 2014 and increased slightly up to 17317 in 2015, as shown in table (9).

Table 9. Economic Indicators of Tomato Crop and the Records in Egypt (2011-2015).

year	Area 1000/f	Record	Productivity Ton/f	Record	Production 1000 ton	Record	Cost average LE/f	Record	Net return LE/f	Record
2011	505.8	100	15.92	100	8053.7	100	4312.0	100	19714.33	100
2012	515.2	101.9	16.64	104.5	8571.1	106.4	4550.7	105.5	17793.33	90.3
2013	488.8	96.6	16.92	106.3	8269.2	102.7	4886.7	113.3	17564.67	89.1
2014	509.6	100.8	16.22	101.9	8264.5	102.6	5296.7	122.8	17118.33	86.8
2015	468.5	92.6	16.49	103.6	7727.2	95.9	5743.0	133.2	17317.67	87.8
Average	497.6	-	16.43	-	8177.2	-	4957.8	-	17901.67	-

Source: the Ministry of Agriculture and Land Reclamation- Economic Affairs Sector- Agriculture Statistics Bulletin- different issues

2- The Loss and Its Relation to the Economic Indicators for Tomato in Egypt:

T. absoluta causes great losses in tomato productivity that influences the economic indicators related to this crop. In a study carried out by FAO (2016) it was mentioned that the productivity of tomato decreased by about 7.4% as a result of the infestation by *T. absoluta*. Yet, there are no enough economic studies concerning the losses caused by this pest on tomatoes, therefore, the following section of this study depends mainly on the results we got during our investigation as guiding data to calculate the economic impact of *T. absoluta* and its effect on the economic indicators of tomato in Kafr El Sheikh and also on the country level.

From table (10) it is clear that the losses in cultivation area due to infestation with *T. absoluta* did not exceed 0.99 thousand feddan in Kafr el Sheikh Governorate and 34.7 thousand feddan at the country level. While the losses in productivity on both levels reached 1.28 and 1.22 tons/ feddan, respectively. Due to losses in both productivity and area, the loss in production on the level of Kafr El Sheikh reached 17.2 thousand tons, while on the country level it reached about 571.8 thousand tons. When calculating these losses and expressing them in money it reached 26.7 and 880.6 thousand pounds on Kafr El Sheikh and country level, respectively.

The losses in the costs of production per feddan reached about LE 416.2 and 424.9 on both levels, respectively. Whereas the total cost losses for the total area at the level of Kafr El Sheikh and the whole country reached about 5.6 and 199 million pounds, respectively. In addition, table (10) also clarify that the loss in net return per feddan reached 1564 in Kafr El Sheikh and 1281.5 on Egypt level.

Table 10. The Economic Losses Caused by *T. absoluta* on the Economic Indicators Related to Tomato Crop at Kafr El Sheikh and Country Levels.

Level	Loss %	Area 1000 f.	Productivity Ton/f.	Production (1000 tons)	Costs LE/f.	Farm price LE/ton	Net return LE/f.	Loss in area 1000 f.
	1	2	3	4	5	6	7	8=1*2
Kafr el Sheikh	7.4	13.5	17.25	232.88	5609	1550	21135	0.99
Country		468.5	16.49	7727.2	5743	1540	17318	34.67
	Loss in productivity /f. 9=1*3	Loss in production (1000 tons) 10= 1*4 Or 2*9	Total loss value in production (1000 LE) 11=6*10	Loss value in costs/f. 12=(5/3)*9	Total loss in costs (1000LE)	Loss value x net return LE/F. 14=1*7	Total loss value x net return 15=2*14	
Kafr el Sheikh	1.28	17.23	26706.5	416.2	5618.7	1564	21114	
country	1.22	571.81	880587.4	424.9	199065.7	1281	600397	

Source:

- The Ministry of Agriculture and Land Reclamation- Economic Affairs Sector- Agriculture Statistics Bulletin- different issues.
- Market evaluation of chain value of tomatoes and grabs in Egypt- FAO- Near East Regional Office- in Egypt- August, 2016.
- Table (5).

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الكشف عن تذبذب تعداد *Tuta absoluta* علي بعض انواع الباذنجانيات وعلاقة ذلك بالعوامل البيئية المختلفة وتقييمها اقتصاديا في محافظة كفر الشيخ مصر

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١. *المعمل المركزى للزراعة العضوية – مركز البحوث الزراعية – مصر .*
٢. *معهد بحوث وقاية النباتات – مركز البحوث الزراعية – مصر .*
٣. *معهد بحوث الاقتصاد الزراعى – مركز البحوث الزراعية – مصر .*

تم دراسة تذبذب تعداد ناخرة أوراق الطماطم *T. absoluta* ، تلك الآفة الخطيرة التي تهاجم العائلة الباذنجانية في مصر مسببة خسائر فادحة، باستخدام المصائد الفيرمونية. اجريت الدراسة في محافظة كفر الشيخ. وقد تم تسجيل تواجد الآفة علي محصولين هامين من محاصيل الخضر وهما الطماطم والباذنجان. واستخدمت المصائد الفيرومونية لصيد ذكور *T. absoluta* في موقعين مختلفين لكل محصول. سجل عدد الفراشات خلال ٤ شهور بدأ من اكتوبر ٢٠١٦ وحتي يناير ٢٠١٧. كما تم تقدير وحدة الدرجات الحرارية للأيام DDU خلال فترة البحث، هذا بالإضافة إلي دراسة تأثير كل من درجة الحرارة والرطوبة النسبية وسرعة الريح علي تذبذب تعداد الافة ودراسة تأثير الأفة علي المؤشرات الاقتصادية لمحصول الطماطم. سجلت *T. absoluta* أربعة ارتفاعات (قمم) في المحصولين، مفضلة الطماطم كعائل اولي، كما انها كانت نشيطة خلال المدي الحراري من ١٢-٢٠ درجة مئوية. لم تؤثر الرطوبة النسبية علي تعداد الآفة سواء في الطماطم او الباذنجان خلال مدة ومكان التجربة في حين اظهرت سرعة الرياح تأثيرا مباشرا حيث ارتفعت نسبة الذكور المصادة عندما تراوحت سرعة الرياح بين ٤٠-٥٨كم/ساعة. واشارت النتائج إلي ان الخسائر في انتاج الطماطم في محافظة كفر الشيخ وصلت إلي ١٧,٢ ألف طن، في حين وصلت إلي ٥٧١,٨ ألف طن علي مستوي الجمهورية والتي تعادل ٢٦,٧ و ٨٨٠,٦ ألف جنيه مصري علي مستوي كل من كفر الشيخ والجمهورية علي التوالي. وقد اشارت نتائج تحليل التقييم الاقتصادي إلي انه يجب تكثيف المكافحة في الاسبوعين الرابع والخامس من شتل الطماطم وذلك لتقليل معدل الاصابة في حقول الطماطم.