ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Population Fluctuation and Evaluation The efficacy Of Pheromone-Based Traps with Different Color on Tomato Leafminer Moth, *Tuta absoluta* (Lepidoptera: Gelechiidae) In Egypt.

Nesreen M.Abd El-Ghany[1]*, Edris S. Abdel-Wahab[2], Samah S. Ibrahim[2].

[1]Pests and Plant Protection Dept., Agricultural & Biological Research Div., National Research Centre, 33 El-Behous St., Dokki, Giza, PC:12622, Egypt.
[2]Plant Protection Research Institute, Agricultural Research Center, 7 Nadi El-Seid St., Dokki, Giza, Egypt.

Abstract

The population fluctuation of *Tuta absoluta* (Lepidoptera: Gelechiidae) using mass trapping in Qaha (Qalyoubia governorate, Egypt) during spring-early summer cycle in 2013 and 2014 was investigated. The population fluctuation was recorded depend on the catching number of moths/week during the plantation period. Results of the first season indicated gradually increasing from the 4th week of April until an approximately outbreak on 1st week of May. Subsequently, two peaks recorded in 3rd week of May and 1st week of June. The population decline gradually from the 2nd week of June and approximately reaches the lowest in the 3rdweek of July. However in 2014, *T. absoluta* had five peaks during the plantation period. Two peaks were recorded in April; the first peak occurred in the 2ndweek, and the second peak occurred in the 4th week. Subsequently, the third peak was recorded in the 3rd week of May. Additionally, two peaks were recorded in the 1st and 3rd week of June. Moreover, the effect of trap color (red and yellow) was evaluated by comparing weekly catching number of moths/trap. A glance in data that indicate that, red traps are more attractive than the yellow traps.

Key words: *Tuta absoluta*, population fluctuation, mass trapping, trap color, Egypt.

Corresponding author

ISSN: 0975-8585

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill) (Family: Solanaceae) has become a major world food crop. Today, tomatoes are grown commercially in 159 countries. According to FAOSTAT, in 2012, Egypt ranked as one of the top producers of tomatoes (8,625,219 tons were produced). The cultivated area of tomato in Egypt increased considerably during the last two decades. According to the last estimates from the Egyptian Ministry of Agriculture and Land Reclamation in 2013, the total cultivated area, and productivity of tomato in Egypt, was estimated by 515225feddan, yielding 8571050tons with an average of 16.636 tons/feddan[1]. Tomato plants are subjected to infestation with several insect pests: cutworms, aphids, cabbage loppers, whiteflies, tomato fruit worms, leaf miners, and Mealy bugs [2, 3].

Recently, The tomato borer *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) is a major pest of tomato Plants. It is a neotropical oligophagous pest of solanaceous crops [4] and it is native to South America [5]. The larvae of *T. absoluta* mine the leaves producing large galleries and burrow into the fruit, causing a substantial loss of tomato production in protected and open filed cultivations. It has a high reproductive potential, with up to 12 generations per year depending on environmental conditions [6]. The damage is directly related to the reduction of the photosynthetic capacity and of the production levels, both in protected and open-field tomato crops; in addition, economic loss derives from the unmarketability of the infested fruits. Infestations of *T. absoluta* can result in 60 to 100 percent loss of field-produced tomatoes [6, 7]. So, different chemical sprays have been the main method of control used against *T. absoluta*. However, the efficiency of these insecticides for control *T. absoluta* has been weak because of pest resistance against a number of applied insecticides and also due to the endophytic habit of the larvae, which are protected in the leaf mesophyll or inside fruits [8, 9, 10]. Additionally, these chemical insecticides cause adverse environmental effects including water pollution, eradication of beneficial wildlife and human health problems [4, 11]. So, seeking for efficient, economical alternatives for control insect pests is a demand. In this concern, pheromone traps used as a good alternative method for controlling *T. absoluta* in order to minimize the use of high dose of chemical insecticide. The sex pheromone of *T. absoluta* was identified in the late 1990`s and pheromone blends were subsequently tested aiming their use for field monitoring [12]. It is important to emphasize that pheromone does not leave residues, does not contaminate the environment, does not effect on the natural enemies, or generate resistance issues.

Population growth rates are affected by climactic factors such as temperature and Humidity. Knowing information about the population fluctuation of any insect pest is a critical point can enable the correct timing of application of biological control agents against this pest. The present study aims to investigate the population fluctuation of *T. absoluta* using pheromone traps as a mechanical control for this insect pest in Qaha (Qalyoubia governorate, Egypt) during two seasons of spring-early summer cycle in 2013 and 2014. Moreover, the effect of trap color on catching male *T. absoluta* moths was evaluated.

MATERIALS AND METHODS

The population fluctuation of *T. absoluta* was recorded during spring-early summer plantations cycle (2013-2014) in order to obtain valid information about this insect pest for facilitating its control in Qaha (Qalyoubia governorate, Egypt). The population fluctuation of *T. absoluta* was estimated using pheromone traps. The efficiency of sex pheromone water traps (4 traps/ 800 m^2) was conducted. The traps are rubber septa loaded with 1.0 mg (Pheromone Unit of Plant Protection Research Institute), it replaced every 2 weeks. The distribution of traps with pheromones started from the first week of transplanting, and continued during the entire crop cycle. Moreover, the effect of trap color using two different trap colors (Red and yellow) on capture of *T. absoluta* moths was investigated. The data analyzed to calculate the variance of means and standard deviations using SPSS. Concerning, elevation of the traps were hung 20cm above the ground at the initial period of the planting, and subsequently the height increased (40, 60, 80, and 100 cm) during different growth stages of the plants in order to trapped the highest number of insect adults. The daily temperature records were obtained from Central Laboratory for Agriculture Climate (CLAC) during the season's period from 2013 to 2014 for the experimental location. The average of temperature degree and relative humidity was calculated.

ISSN: 0975-8585

RESULT AND DISCUSSION

Several ways have been proposed to evaluate the infestation level of the tomato leafminer in a tomato crop, such as counting eggs, larvae, leaf mines or adult males (with the help of pheromone traps) [13]. In the present work evaluating the infestation level of the tomato leafminer has been performed by counting adult males catches using pheromone traps. The most common traps used for mass trapping of *T. absoluta,* are water traps baited with pheromone which used to monitor, forecast or control populations of moth pests [14, 15]. The water traps baited with pheromone have a larger trapping capacity and less sensitive to dust than Delta or light traps [16, 17]. Mass-trapping involves placing of high density of pheromone-baited traps placed in strategic positions within a crop in order to catching huge numbers of adult males causing imbalance to the sex ratio which impacts the mating pattern to reduce insect populations [17, 18].Concerning trap location in our experiment, it was distributed along all four edges of the field. Such trap distribution was suggested by Russell IPM and [19] for open field crops. Also, it is advisable to adapt traps height according to the growth stage of the plant. The height of the trap in the crop influences male captures and is related to the height of the vegetation [12, 20]. They suggested deploying monitoring traps in a field at a height of 20 cm before planting and then moving them up to 60 cm high as the plants grow. Additionally, higher proportions of moths are found in the upper parts of the canopy but never beyond 1 m high [21]. So, our experiment designed to change the trap height at 20, 40, 60, 80, and 100 cm according to the growth stage of tomato plant. Result indicates that, increasing the height during the cropping cycle increase in efficiency of trap catches.

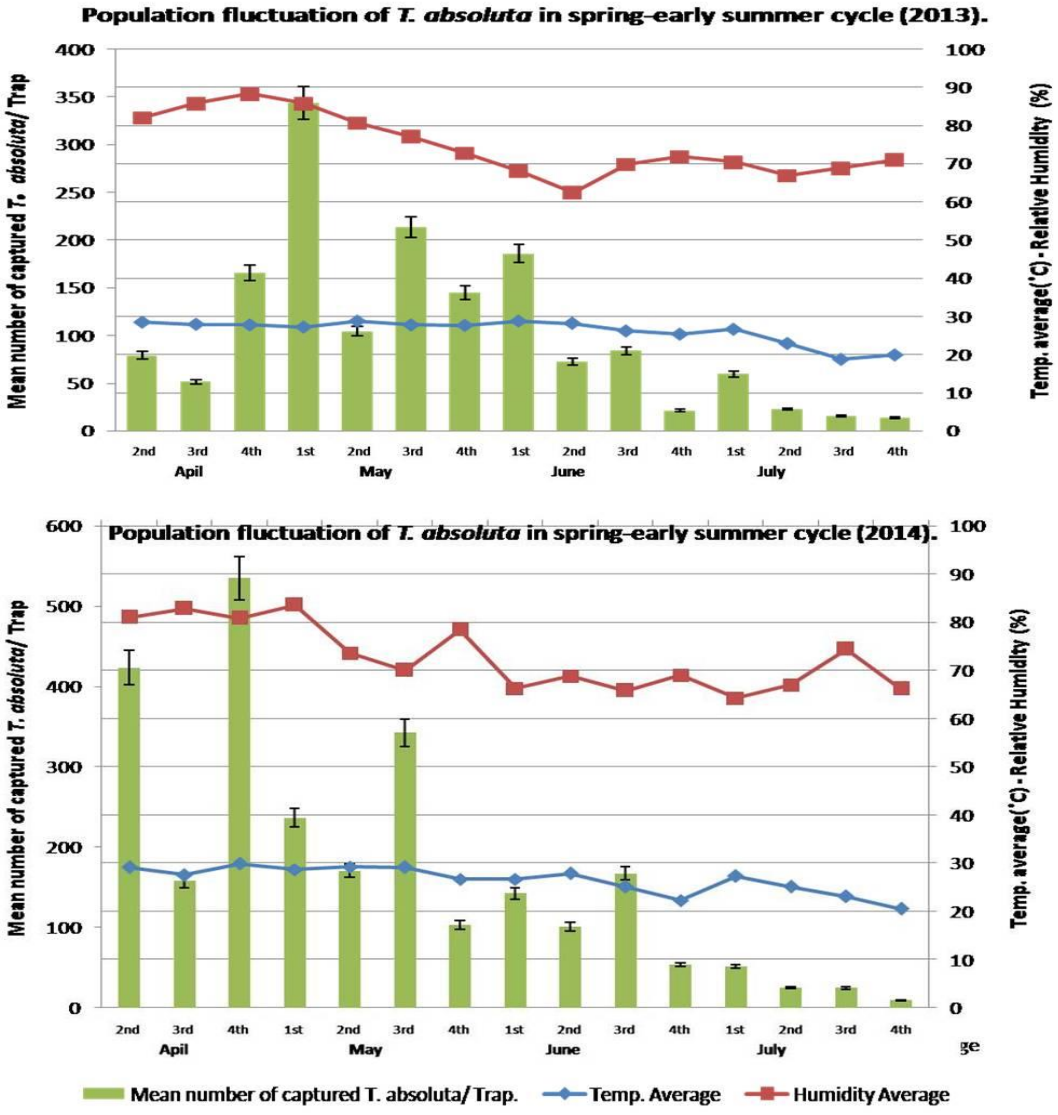

Figure 1

ISSN: 0975-8585

Table 1: The population fluctuation of *T. Absoluta* on tomato plants in Qaha (Qalyoubia governorate, Egypt) during two seasons of spring-early summer cycle (2013 and 2014) using pheromone traps.

Month	Spring-early summer cycle in 2013 season					Spring-early summer cycle in 2014 season			
	Inspection time (Week)	Temp. Average	Humidity Average	Mean number of captured *T. absoluta*/ Trap± SD.	Total number of captured *T. absoluta*/Traps	Temp. Average	Humidity Average	Mean number of captured *T. absoluta*/ Trap± SD.	Total number of captured *T. absoluta*/Traps
April	2nd	19.86	51.14	79±39.46	316	20.57	45.57	423.5±129.99	1694
	3rd	18.71	50.14	51.25±15.56	205	23.14	51.28	157.75±73.49	631
	4th	22.86	44	165.75±85.64	663	25.14	41.85	535±201.68	2140
May	1st	26.57	43.86	343.5±149.97	1374	27.29	37	236.75±33.71	947
	2nd	25.29	46.57	104.5±32.91	418	22.29	46.71	170.75±64.06	683
	3rd	26.14	43.71	213.5±110.07	854	25.14	40.71	342.5±109.17	1370
	4th	28.14	34.29	145±49.37	580	27.86	41	103.25±16.75	413
June	1st	28.71	39.43	185.75±122.28	743	26.71	39.57	142.5±37.67	570
	2nd	27.57	45.14	72.5±29.69	290	26.71	51.71	101±32.18	404
	3rd	27.71	49.43	83.75±19.49	335	29.14	40.86	167.5±60.57	670
	4th	28.71	52	21.25±9.60	85	29.29	44.29	53.75±18.83	215
July	1st	27.14	58.57	59.5±24.46	238	28.71	54.86	51.5±14.63	206
	2nd	27.71	60.57	22.75±29.93	91	29.86	51	25.5±14.26	102
	3rd	27.86	57.86	15.25±5.80	61	27.57	55.29	24.75±5.67	99
	4th	28.43	53.57	13.5±14.36	54	29.14	51.86	9.25±2.59	37

ISSN: 0975-8585

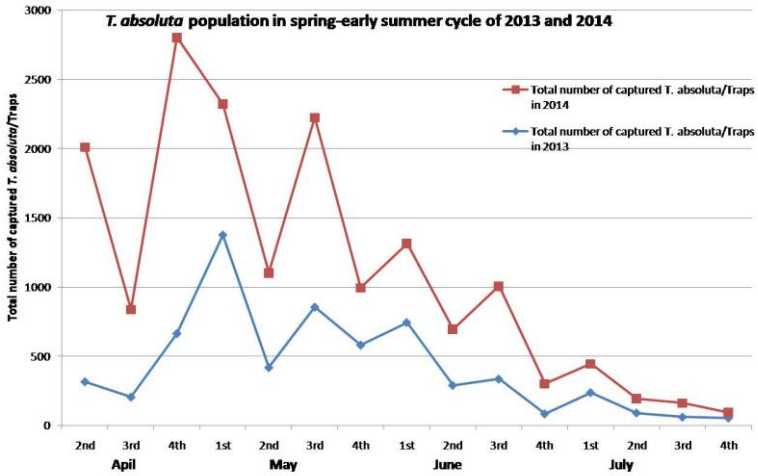

Figure 2

Environmental conditions such as, temperature and relative humidity can affect the population dynamics of any insect pest. Relationship between the *Tuta absoluta* population and the environmental conditions were illustrated in Table (1) and Figure (1). The population fluctuation of *T. absoluta* on tomato plants conducted during spring-early summer cycle for two seasons of 2013 and 2014 at Qaha, Qalyoubia governorate, Egypt. Data shown in Tables (1) recorded weekly counting of male moths using water traps baited with sex pheromone in order to follow the evolution of *T. absoluta* population. The water traps supplied with soap in order to reduce the surface tension and consequently reduce the insect's capacity to escape from the trap. Result indicates that, soapy water traps (1% laundry detergent) baited with 1.0 mg pheromone is very efficient for catching *T. absoluta* moths. For the first season; 2013; low *T. absoluta* population was recorded during 2nd week of April and gradual increasing occurs until an approximately outbreak on 1st week of May (Figure 2). Moreover, two peaks were recorded during 3rd week of May and 1st week of June. Gradual decreasing in *T. absoluta* population occurs on 2nd week and continuously until the last weeks of July which recorded the lowest population. A glance on data, *T. absoluta* population was higher in the second season 2014, than the first season (Figure 2). Results indicate that, *T. absoluta* had five peaks during the plantation period. The population had two peaks during April; the first peak occurred in the 2nd week, and the second peak occurred in the 4th week. Subsequently, the third outbreak typically recorded on 3rd week of May. Finally, the 4th and 5th peaks were recorded in 1st and 3rd week of June, respectively. However, decline of the population was recorded during 4th week of June until the end of July, when occurring in the lowest number. The obtained results of weekly monitoring of *Tuta absoluta* with pheromone traps was agreed with [22]. They divided the population dynamics in Tunisia into three phases: low infestation (from 25th March to 6th May), growing population phase (6th - 27th May), then a decline phase (27th May to 3rd June).

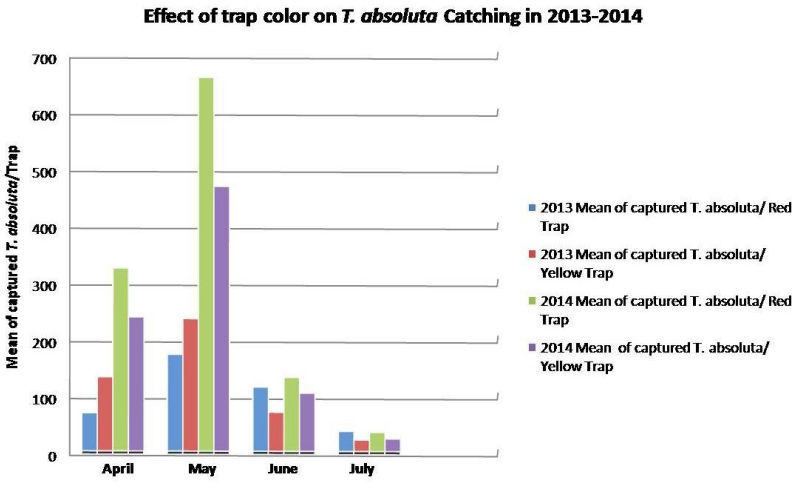

Figure 3

ISSN: 0975-8585

Table 2: Effect of trap color on mass trapping for *T. absoluta* during 2013 and 2014 seasons of spring-early summer cycle.

Month	spring-early summer cycle in 2013 season			spring-early summer cycle in 2014 season	
	Inspection time (Week)	Mean ± SD of captured *T. absoluta*/ Red Trap	Mean± SD of captured *T. absoluta*/Yellow Trap	Mean ± SD of captured *T. absoluta*/Red Trap	Mean ± SD of captured *T. absoluta*/Yellow Trap
April	2nd	42±11	116±16	439.5±130.5	407.5±127.5
	3rd	37.5±2.5	65±10	199±86	116.5±11.5
	4th	121.5±51.5	210±90	650±150	420±180
	Mean	67±20	130.33±38.66	322.12±91.62	236±76.5
May	1st	284.5±53.5	402.5±187.5	258.5±26.5	215±25
	2nd	92.5±27.5	116.5±33.5	220±45	121.5±36.5
	3rd	161±111	266±80	435±65	250±50
	4th	142.5±67.5	147.5±17.5	108.5±13.5	98±18
	Mean	170.12±4.37	233.12±14.12	658.16±98.31	466.13±94
June	1st	246.5±141.5	125±50	160±40	125±25
	2nd	82.5±37.5	62.5±12.5	107.5±32.5	94.5±30.5
	3rd	92.5±22.5	75±10	185±65	150±50
	4th	30±5	12.5±2.5	67.5±17.5	40±5
	Mean	112.87±21.62	68.75±18.75	130±30	102.38±12.63
July	1st	66.5±18.5	52.5±27.5	55±20	48±2
	2nd	36.5±36.5	9±9	39.5±1.5	11.5±3.5
	3rd	19.5±5.5	11±1	28.5±4.5	21±4
	4th	18.5±18.5	8.5±4.5	11±1	8.5±1.5
	Mean	35.25±7.75	20.25±10.5	33.5±5.5	22.25±0.25

Additionally, the effect of colored traps; red and yellow were used to attain which color is favorable to attract *T. absoluta* moths (Figure 3). In Table 2, weekly trap catches were recorded for both trap color (Red and Yellow). The result indicates that, the trap color affect its effectiveness, with dark colors (red) increasing male catches than lighter colors (yellow). These findings agree with results by [20] whose recorded that, The dark colors of the trap (black, red, green and blue) giving higher catches of males than lighter colors (yellow and white). The maximum mean number of captured moths was recorded by red traps during 4th week of April 2014 (650±150 moths/trap) and 2nd week of April (439.5±130.5 moths/trap) followed by 435±65 moths/trap during 3rd week of May 2014, respectively.

REFERENCES

[1] Anonymous 2013. Central Administration of Economic. Ministry of Agriculture, Egypt.

[2] Abd El-Ghany NM. Molecular evaluation of *Bacillus thuringiensis* isolates from the soil and production of transgenic tomato plants harboring Bt gene for controlling lepidopterous insects in Egypt [PhD thesis]. Faculty of Science: Ain Shams Univ., Egypt, 2011, 270 pp.

[3] Ibrahim SS, Moharum FA, Abd El-Ghany NM. J Plant Protec Res 2015;55(1): 48-51.

[4] Lietti MMM, Botto E, Alzogaray RA. Neotrop Entomol 2005; 34(1): 113-119.

[5] Urbaneja A, Monton H, Molla O. J Appl Entomol 2009;133(4): 292-296.

[6] http://www.eppo.org/QUARANTINE/ insects/Tuta_absoluta/DS_Tuta_absoluta.pdf

[7] Cely L, Singer F, Rodrı'guez D, Cure J. Levelsfor Damage caused by different densities of *Tuta absoluta* (Lepido'ptera: Gelechiidae) in tomato greenhouse. Abstracts, SOCOLEN Meeting with Entomologı'ain the coffee. XXXIII Congress Entomologı'a, Manizales, Colombia, 2006; 26-28 July

[8] Silva GA, Picanço MC, Bacci L, Crespo ALB, Rosado JF, Guedes RNC. Pest Manage Sci 2011; 67(8): 913-920.

[9] Reyes M, Rocha K, Alarcón L, Siegwart M, Sauphanor B. Pestic Biochem Physiol 2012; 102(1): 45-50.

[10] Cocco A, Deliperi S, Delrio G. J Appl Entomol 2013; 137(1-2): 16-28.

[11] Salazar E, Araya J. AgricTe´c2001; 61(4): 429–435.

[12] Ferrara FAA, Vilela EF, Jham GN, Eiras AE, Picanco MC, Attygale, AB, Meinwald J. J Chem Ecol 2001; 27(5): 907-917.

[13] Gomide EVA, Vilela EF, Picanço M. Neotrop Entomol 2001; 30(4): 697-705.

[14] Witzgall P, Kirsch P, Cork A. J Chem Ecol 2010; 36(1): 80-100.

[15] Prasad Y, Prabhakar M. Pest monitoring and forecasting. In: Shankar U. & Abrol D.P. eds. Integrated pest management: principles and practice. Oxford shire, UK: Cabi, 2012; 41-57.

[16] Salas J. Rev ColombEntomol2004; 30(1): 75-78.

[17] USDA APHIS 2011. New pest response guidelines: tomato leafminer (*Tuta absoluta*). Washington, DC: United States Department of Agriculture.

[18] http://www.tutaabsoluta.com/insectprofile.php?lang=en)

[19] http://www.russellipm-agriculture.com/uploads/files/recommendationdetectionmonitoring.pdf.

[20] Uchôa-Fernandes MA, Vilela EF. Ann Soc Entomol. Bras 1994; 23: 271-277.

[21] http://www.sardegnaagricoltura.it/documenti/14_43_20100420134239.pdf.

[22] Chermiti B, Abbes K, Aoun M, Ben Othmane S, Ouhibi M, Gamoon W, Kacem S. Afr J Plant Sci Biotech 2009; 3: 49-52.