International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2015): 6.391

Population Fluctuations of Tomato Leaf Miner *Tuta absoluta* and its Associated Predator True Spiders in Egyptian Tomato Fields

Hemmat E. AL-Sawy[1], Aliaa A. Gazzy[2], Ahmed. E. Abada[3], Samir. A. Kassem[4]

[1, 4]Vegetables Pests Research Department, Plant Protection Research Institute, Agricultural Research Center, Kafrelsheikh, Egypt

[2, 3]Department of Zoology, Faculty of Science, Kafrelsheikh University, Kafrelsheikh, Egypt

Abstract: ***Tomato is one of the most important Egyptian vegetable crops. Its infestation by Leaf miner Tutaabsoluta (Meyrik) results in a considerable economic loss. Therefore, the current study aims to monitor the population fluctuations of Tutaabsolutalarvae as well as true spiders as possible predators. Tuta-lure 0.5mg/capsule pheromone efficiency for monitoring the male insect was tested during two subsequent tomato seasons 2014 and, 2015. Direct examination of tomato leaves revealed a consistent fluctuation pattern of both the insect larvae and the true spiders in the two seasons. Insect larvae peaked on the mid of June having (65 larvae/10 plants) while the true spiders peaked one week later having (5 spiders/10 plants) in both seasons, respectively. The observed insect larvae population reduction accompanied with an increase in true spiders population during the midseason may reveal a possible predation relationship between them. The afterward detected declining of both populations, may be attributed to the initiations of plant dryness prior to the end of the season. The current study strongly emphasises the importance of phermone traps as an effectitve and powerful predicting method for early pests warning.***

Keywords: *Tutaabsoluta*, population dynamics, tomato, phermone trap

1. Introduction

Tomato (*Lycopersiconesculentum*) is the most important vegetable crop throughout the world, and one of the economic crops in Egypt. It is consumed fresh as well as an essential raw material for a variety of food processing industries. Tomato production faces many problems such as dramatic changes in weather, diseases and insect pests. This plant is highly sensitive to most of insect pests as thrips, aphid, white fly, mite and leaf miners. Fortunately, predators as lady beetles and true spiders feed upon many pests that reproduce on tomatoes. One of the latest invasive species that arrived in the Western Palaearctic region; the tomato leafminer, *Tutaabsoluta* (Meyrick) (Lepidoptera: Gelechiidae). This moth is a Neotropical species and is considered a key pest of the tomato in South America**(M et al., 2012**)

After its initial detection in eastern Spain in 2006, it rapidly invaded various other European countries and spread through the Mediterranean basin(Desneux, 2010). The larva feeds voraciously on tomato plants producing large galleries in leaves, *T. absoluta* was found for the first time in Egypt in July 2009 at Nubaria, Beheira Governorate, Egypt. Later, it was recorded at several Egyptian regions(Bekheit and M impiglia, 2011) Many studies have documented *T. absoluta* biology (Caparros megido et al., 2012; Tropea gariza et al., 2012.)susceptibility and resistance to pesticides(**Tomé et al., 2012**)(**Gontijo et al., 2013**)Predators are widly used as biocontrol agents for regulating populations of pestsas well as an important alternative to chemical**(Lu Y et al., 2012)** as well as an important alternative to chemical insecticides**(Desneux, 2010**). The importance of arachnid such as phytoseiidae and lycosiidaeas being beneficial biocontrol agents for *T.absoluta*has been highlighted by.(**Ghoneim, 2014**)

Among integrated pest management(IPM) strategies, the use of sex pheromone traps is one of the most recognized tactics against the tomato pest that become extensively used worled wide. Early monitoring of invasive pests and notifying farmers and growers to recognize the associated risks will limit the damage and losses caused by the pest**(Witzgall et al., 2010)**

The study suggested that once *T. absoluta* appears in pheromone traps, preventive measures should be initiated and could even be integrated with predator and/or parasitoid releases**(Desneux, 2010**). The biotechnological tools for *T. absoluta* control include mass trapping**(Cagnotti et al., 2012)(Cocco et al., 2015)**, which is a control method widely used by farmers against *T. absoluta* infestation**,(Chermiti et al., 2009)**

The aim of the current study was first to study *T. absoluta*population fluctuation and true spiders as associated predators in the open field in two subsequent seasons. Second to establish an early infestation warning protocol using the commercial brand of *T. absoluta*pheromone lure (0.5 mg/capsule).

2. Materials and Methods

The present study was conducted during 2014 and 2015 seasons at tomato orchards, to monitor the population fluctuation of tomato borer, *Tutaabsoluta* (Meyrick) and true spiders as its associated predators. Temperature, relative humidity and wind velocity was obtained from metrological Research station of SakhaKafr-Elsheikh governorate. The study was carried out at two locations as follows:

Tutaabsoluta **and true spiders population fluctuations:** The study was conducted at the Experimental Farm of Sakha

Orchard Research Station during 2014 and 2015 seasons. An area of 300 m^2, cultivated with tomato, *Lycopersiconesculentum* Mill. was divided into three equal parts to act as three replicates.

Inspection of tomato plants for monitoring *T. absoluta* level population density started 30 days after tomato transplanting and continued weekly till the end of the season. At each sampling date, tomato plants were inspected and numbers of *T. absoluta* larvae, and true spiders (adults and spider lings) were recorded in the field.

Pheromone application: This experiment was carried out at El-Riad region, Kafr El-Sheikh governorate, in an area of two feddans cultivated with tomato. The experimental area was divided into eight equal plots. One water pheromone trap was fixed at each plot at height of 50 cm above the ground. Catch of the pheromone lure (Tuta lure 0.5 mg/capsula) was recorded 30 days after transplanting, and continued at 7 day intervals, the sex pheromone capsule was renewed every four weeks and dirty water in the traps was replaced with clean water when necessary.

3. Results

1. Population fluctuation of *Tutaabsoluta* larvae

Tutaabsoluta infestation was moderate (21 larvae/10 plants) by the beginning of June **(2014**) and increased gradually (27 larvae/10 plants) at the secon week of June Table (1) and Fig. (1). *T. absoluta* larvae peaked (65 larvae/10 plants) by mid-June. By late June larval population decreased to moderately numbers and up to the end of July, the larval population density was remarkably low.

Similarly, almost the same trend was obtained in the second season **(2015).***Tutaabsoluta* larval population density peaked by the mid of June (44 larvae/10 plants). Furthermore, gradual reduction in the larval population density was apparent towards the end of the experimental period.

The average *T. absoluta* population density was relatively constant in both seasons being (22) and (20) individuals in 2014 and 2015, respectively Table 1.

Population density of true spiders (adults and spiderlings) was obviously lower than that of *T. absoluta* with average values 5 and 3 individuals /10 plants in the first and second seasons, respectively. True spiders peaked one week after *Tutaabsoluta* maximum abundance having (26, 15 spiders/10 plants) in both seasons respectively.

Table 1: Population fluctuations of *Tutaabsoluta* larvae and true spiders associated predators on summer tomato plantation.

Sampling date		Mean no. of *T. absoluta* larvae/10 plants	Mean no. of True spiders /10 plants
Season 2014	02/06/2014	21.4	3.4
	09/06/2014	27.00	4.4
	16/06/2014	65.3	0.00
	23/06/2014	26.6	26.4
	05/07/2014	3.4	1.6
	12/07/2014	4.3	0.0
	20/07/2014	9.00	2.0
Average ± SE		22±2.85	5±1.21
Season 2015	02/06/2015	24.2	2.3
	09/06/2015	34.3	4.0
	16/06/2015	44.4	2.3
	23/06/2015	20.4	15.2
	05/07/2015	3.00	1.0
	12/07/2015	6.00	0.0
	20/07/2015	8.3	0.0
Average ± SE		20±2.03	3±0.67

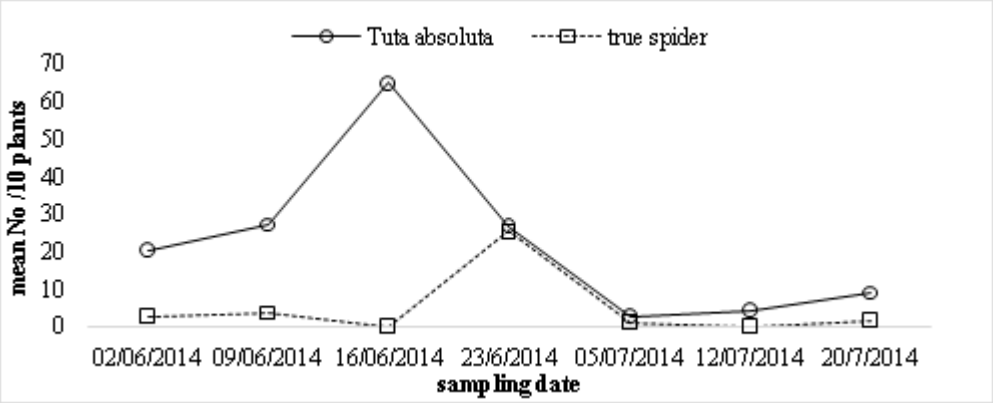

Figure 1: Population fluctuations *of Tutaabsoluta* and true spiders during 2014 season

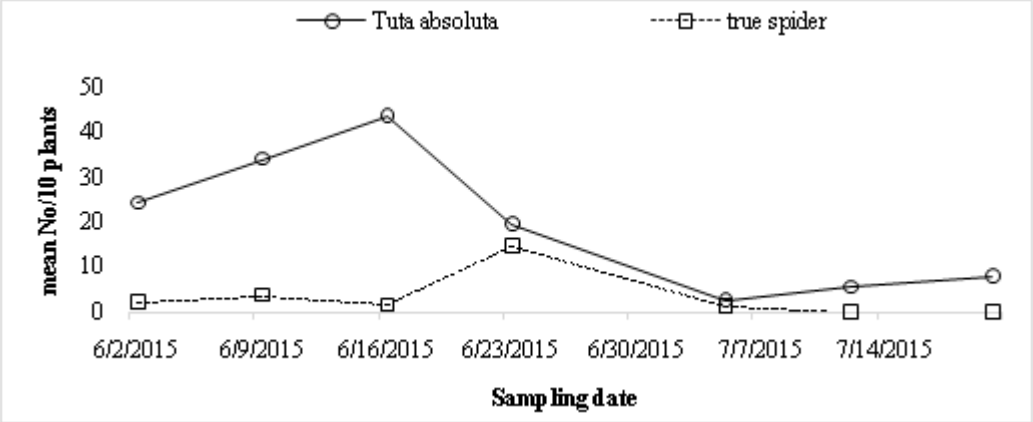

Figure 2: population fluctuations *of Tutaabsoluta* and true spiders during 2015 season

2. Population fluctuation of *Tutaabsoluta* males as monitored by phermone traps:

Based on the data obtained from the control treatment, the pheromone (*Tuta*-Lure50gm/capsula) efficiently attracted the insect males.

Male *Tutaabsoluta* population had relatively the same pattern in the two seasons having two peaks. The first peak was recorded by the beginning of June. The second peak was reported within the period of end of June(2014) and the beginning of July(2015) Fig 2 & Table. 2

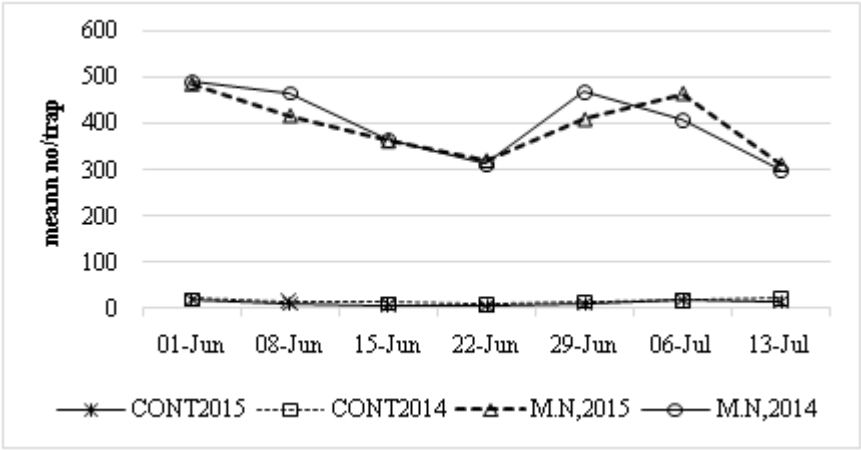

Figure 3: Number of *Tutaabsoluta* males captured by pheromone traps comparing to the control on tomato plantation during 2014&2015 seasons

Table 2: Population fluctuation of *Tutaabsoluta* males captured by pheromone trap on summer tomato plantation during 2014 and 2015 seasons

Date	nmbers of captured males	± S.E.	Control	± S.E.	Weather factors		
					Av. Temp.	Av. R.H.%	Wind velocity km/day
Season 2014							
1/6/2014	491	1.55	19	5	25.47	99.9	81.85
8/6/2014	467	51.3	10	0.01	26.48	70.1	73.71
15/06/2014	365	2.38	8	1	25.59	69.4	101.22
22/06/2014	312	0.89	7	0.02	24.24	70.4	81.14
29/06/2014	469	1.7	12	2	27.79	69.8	84.7
6/7/2014	409	1.89	19	2	20.22	69.85	99.71
13/07/2014	299	0.84	15	4	29.2	68.97	103.71
Average	402		13				
Season 2015							
1/6/2015	485	0.129	21	1	24.97	65	88
8/6/2015	417	0.69	14	1	23.04	66.42	110
15/06/2015	363	0.93	11	1	23.84	62.92	116
22/06/2015	320	0.67	8.5	0.5	27.52	65.35	117.85
29/06/2015	409	1.05	15.5	1.5	23.53	65.43	124
6/7/2015	465	0.71	17.3	1.8	22.5	58.5	124.28
13/07/2015	311	0.61	23.5	1.5	27.82	73.14	89.28
Average	395		16				

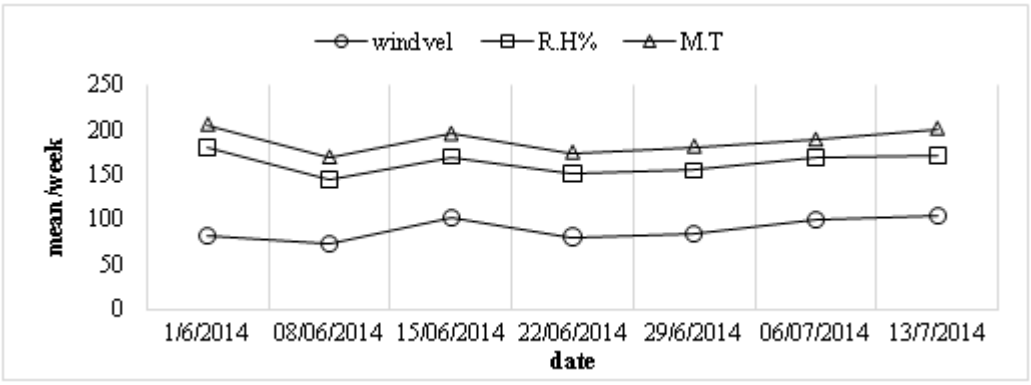

Figure 4: Weather factors (Temperature, Relative humidity and wind velociety km/day during, 2014 season

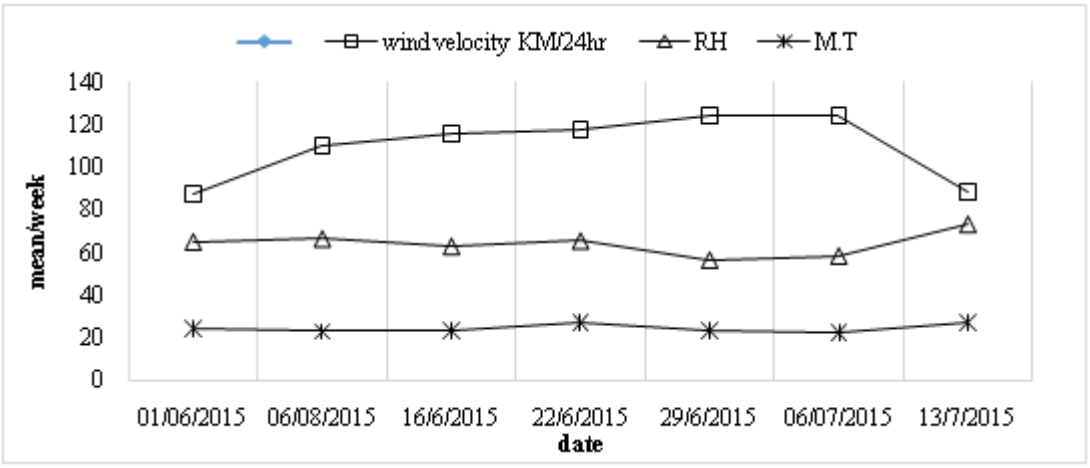

Figure 5: Weather factors (Temperature, relative humidity and wind velociety km/day during2014seas

4. Discussion

The monitoring of population fluctuation of *T.absoluta* larvae can be emphasized by finding the relationship between the population density and number of larvae /10plants.The evolution of *T.absoluta* on tomato young leaves during 2014&2015 seasons can be divided into three phases from transplantation to the end of crop cycle (growing season).the first phase from transplantation till the end of May,this stage of tomato crops are free from attacking of *T.absouluta* as mentioned in Biskra(Algeria) (Meena et al., 2013). The second phase started from the appearance of larvae population in 2nd June where larvae population growing occure and peaked by mid June

These results was in line with the report which has peaks of *Tabsoluta* by mid-June or mid-July(Mohammed, 2012b). *T. absouluta* larval population density appeared in relatively low numbers during the third week of May, and began to increase from the fourth week of May and beginning of June(Mohammed, 2012a)It was frequent that the larvae of *T .absoluta* left their galleries ,they reinstalled in another leaflet or leaf **(A. and Feuvrier, 2010)** during this period larvae are very active and their abundance were relatively high,this may due to temperature rising (25^0) or no insectcide application and the third phase by late of June and up to end of July (2014&2015) the larvae population density was remarkably low,this may due to activity of larvae which caused ageneral drying of leaves, the destruction of young foliage,preferential sites for oviposition lead to decline of *T.absoluta* population .The leaves were the most heaviy damaged plant parts with an average 9.42 and 8.75 minesper leaflet on the middle and upper layer of the canopy respectively followed by the fruits**(Harizanova et al., 2009)**. The leaves were attractive to female after egg hatching ,the larvae penetrate tomato leaves forming irregular leaf mines that get longer**(Torres et al., 2001)**. The nutritional quality of tomato leaves had appositive effect on *T.absouluta* larvae development duration**(Leite et al., 1999)**. True spider was the most dominant predators on tomato plants during the inspection period of surveying *T.absoluta*. The present study reveals the synchronous reduction in larvae population (mid season) with increasing true spiders population may revealed apossible predation relationship between them . this can be emphasized the finding which recorded some wolf spiders predation on *T. absoluta**(Probst K, 1999)*Similarly , the observation which reported that the predation of *Tanimlanmamissp* (Aranea: Lycosidae) on it in Turkey**(Öztemiz, 2013)**The study which was conducted on two different agro ecosystem of tomato crops ,convential and organic systems that revealed a higher diversity of pests and higher abundance with diversity of predaceous arthropods, *T .absoluta* was the commonest pest species, coinciding with the population peak of it, the most abundant predators were true spiders uniformly distributed in both systems**(Medeiros et al., 2009)**. Eight phytoseiid species(true spiders) were tested to evaluate their potential as predators of *T.absoluta* eggs as an alternative/ natural food source under laboratory conditions**(Momen et al., 2013)**.

Population fluctuation of *Tutaabsoluta*males as monitored by pheromone traps:

The adult captures by use of pheromone lure showed that population s of *T.absoluta* have a relatively uncontrolled expontial growth throughout the study period and continuously reached to high counts from the first till the end of growing season.. This could be ascribed to the continuous availability of tomato plants in the field as a source of food for the pest, which would promote its reproduction and multiplication. This finding concordant with the report of that with the availability of host plants, the adult moths continue In ovipositing (**Pereyra and Sánchez, 2006**)previous studies revealed that . *T. absoluta* was present from early June to September**(lazgeen H.Assaf, 2013).** Continuous monitoring of the insect pest by pheromones in integrated pest programs was documented in a series of publications(Patricia, 2009)**(lazgeen H.Assaf, 2013(Cherif et al., 2013)(Y.A.Mahmoud et al., 2014**),

The current study strongly emphasizes the importance of pheromone traps as an effective

5. Acknowledgement

First of all thanks to Alla for his gifts .The authors would like to thank the plant protection Research Institute, Sakh, Kafrelsheikh, Egypt for a technical assistance

References

[1] A., L., and Feuvrier, E. (2010). Tomate, traquer Tuta absoluta. *Phytom* **632**, 40-44.
[2] Bekheit, H. K., and M impiglia, A. (2011). tuta absoluta(tomato borer)out break and control measures in egypt. *EPPO/IOBC/FAO joint Inter national symposium on management of tut absoluta (tomato borer)*, 2.
[3] Cagnotti, C. L., Viscarret, M. M., Riquelme, M. B., Botto, E. N., Carabajal, L. Z., Segura, D. F., and López, S. N. (2012). Effects of X-rays on Tuta absoluta for use in inherited sterility programmes. *Journal of Pest Science***85**, 413-421.
[4] Caparros megido, R., Haurug, E., and Verheggenf.J (2012). First evidence of deuterotokous parthenogenesis in the tomato leafminer, Tuta absoluta (Meyrick) (Lepidoptera : Gelechiidae). *J. Pest Sci***i85**, 3.
[5] Cherif, A., Mansour, R., and Grissa-Lebdi, K. (2013). Biological aspects of tomato leafminer Tuta absoluta (Lepidoptera: Gelechiidae) in conditions of Northeastern Tunisia: possible implications for pest management. *Environ. Exper. Biol***11**, 179-184.
[6] Chermiti, B., Abbes, K., Aoun, M., Ben Othmane, S., Ouhibi, M., Gamoon, W., and Kacem, S. (2009). First estimate of the damage of Tuta absoluta (Povolny)(Lepidoptera: Gelecheiidae) and evaluation of the efficiency of sex pheromone traps in greenhouses of tomato crops in the Bekalta region, Tunisia. *African Journal of Plant Science and Biotechnology***3**, 49-52.
[7] Cocco, A., Deliperi, S., Lentini, A., Mannu, R., and Delrio, G. (2015). Seasonal phenology of Tuta absoluta (Lepidoptera: Gelechiidae) in protected and open-field crops under Mediterranean climatic conditions. *Phytoparasitica***43**, 713-724.
[8] Desneux, N. (2010). Bilogical invasion of European crops by Tuta absoluta:ecolgy,geographic expansion and prospects for biological control. *J.pest Science***83**, 19.
[9] Ghoneim, K. (2014). Predatory insects and arachnids as potential biological control agents against the invasive tomato leafminer, Tuta absoluta Meyrick (Lepidoptera: Gelechiidae), in perspective and prospective. *J Entomol Zool Stud***2**, 52-71.
[10] Gontijo, P., Picanço, M., Pereira, E., Martins, J., Chediak, M., and Guedes, R. (2013). Spatial and temporal variation in the control failure likelihood of the tomato leaf miner, Tuta absoluta. *Annals of Applied Biology***162**, 50-59.
[11] Harizanova, V., Stoeva, A., and Mohamedova, M. (2009). Tomato leaf miner, Tuta absoluta (Povolny)(Lepidoptera: Gelechiidae)–first record in Bulgaria. *Agricultural science and technology***1**, 95-98.
[12] lazgeen H.Assaf, F. H. I., SalahA.Saeed (2013). population density of Tomato leaf miner Tuta absouluta Meyrick(Lepidopter:Gelechiidae) under plastic houses conditions(b). *IOSR Journal of Agriculture and Veterinary Science(IOSR-JAVS)***5**, 4.
[13] Leite, G., Picanço, M., Della Lucia, T., and Moreira, M. (1999). Role of canopy height in the resistance of Lycopersicon hirsutum f. glabratum to Tuta absoluta (Lep., Gelechiidae). *Journal of Applied Entomology***123**, 459-463.
[14] Lu Y, W. K., , J. Y., Guo Y, and N, D. (2012). Widespread adoption of Bt cotton and insecticide decrease promotes biocontrol services. *nature***487**.
[15] M, L., Sanchez NE, PC, P., E, N., Savino V, Luft E, Virla E, and S, S. (2012). Biological control of *Tuta absolut*a inArgentina and Italy: evaluation of indigenous insects as natural enemies. *EPPO Bull***42**, 260-267.
[16] Medeiros, M. A., Sujii, E. R., and Morais, H. C. (2009). Effect of plant diversification on abundance of South American tomato pinworm and predators in two cropping systems. *Horticultura Brasileira***27**, 300-306.
[17] Meena, R., Ameta, O., and Meena, B. (2013). Population dynamics of sucking pests and their correlation with weather parameters in chilli, Capsicum annum L. crop. *The Bioscan***8**, 177-180.
[18] Mohammed, A. S. (2012a). The south American tomato leaf miner, Tuta absoluta(Meyrick) (Lepidoptra: Gelechiidae) infesting tomatoes in Kafer El - SHeikh,pest status and its parasitoids. *j.Agric Res.Kafer El-sheikh Univ***38**.
[19] Mohammed, A. s. (2012b). The south American tomato leaf miner,Tuta absoluta(Myrick)(Lepidoptra:gele chidea)infesting tomatoes in Kafr Elsheikh,pest status and its parasitoids. *j.Agric.Res.Kar ElsheikhUniv.***38)**, 15.
[20] Momen, F., Metwally, A., Nasr, A., Ebadah, I., and Saleh, K. (2013). First report on suitability of the tomato borer Tuta absoluta eggs (Lepidoptera: Gelechiidae) for eight predatory phytoseiid mites (Acari: Phytoseiidae) under laboratory conditions. *Acta Phytopathologica et Entomologica Hungarica***48**, 321-331.
[21] Öztemiz, S. (2013). Population of Tuta absoluta and natural enemies after releasing on tomato grown

greenhouse in Turkey. *African Journal of Biotechnology***12**.

[22] Patricia, L. S., Michel,K.Julio,G.Fernando andV.Cluadia (2009). Effect of phermone trap density on mass trapping of male potato tuber moth,phthorimaea operculella(zeller)(lepidoptra:Glechiidae) and level of damage on potato tuber. *chilean J.Agric.***(2)**, 5.

[23] Pereyra, P. C., and Sánchez, N. E. (2006). Effect of two solanaceous plants on developmental and population parameters of the tomato leaf miner, Tuta absoluta (Meyrick)(Lepidoptera: Gelechiidae). *Neotropical Entomology***35**, 671-676.

[24] Probst K, P. L., Sauerborn J, Zebitz CPW. (1999). Influencia de varios regimenes de uso de plaguicidas sobre la entomofauna de tomate en las tierras altas de Ecuado.

[25] *Manejo Integrado de Plagas CATIE Costa Rica (In Spanish***54**, 53-62.

[26] Torres, J., Faria, C., Evangelista Jr, W., and Pratissoli, D. (2001). Within-plant distribution of the leaf miner Tuta absoluta (Meyrick) immatures in processing tomatoes, with notes on plant phenology.

[27] Tropea gariza, G., SIscaro, G., , B., A, and Zappala (2012.). Tuta absoluta, an exotic invasive pest from South America now in the EPPO region: biology, distribution and damage. . *Bull OEpp.***42**, 5.

[28] Witzgall, P., Kirsch, P., and Cork, A. (2010). Sex pheromones and their impacts on pest management. *Journal of Chemical Ecology***36**, 80-100.

[29] Y.A.Mahmoud, , I. M. A. E., , A. S. A.-E., T.E.Abd-Elwahab, and S.H.Deif (2014). Efficiency of diffrent colored traps baited with phermone incapturing tomato adult moth,tuta absoluta(Meyrick)(lepidoptra:Glelechiidae) during sumer plantation. *worled applied sciences Journal* **(4)**, 7.