OCCURRENCE OF TOMATO LEAF MINER *TUTA ABSOLUTA* MEYRICK(LEPIDOPTERA:GELECHIIDAE) IN DUHOK REGION (A)

Lazgeen Haji Assaf [1], Feyroz Ramadan Hassan [2], Halgurd Ismael Rasheed [2], Mohammad Abdulrahman Sadiq [1], Rezgar M. Ismael [1], Mohammad Sh. Ahmed [1], Salah Adel Saeed [1] and Farhad Mohammed Taher Salih [1]

[1] General Directorate of Agriculture-Duhok, Kurdistan Region – Iraq.
[2] Dept. of Plant Protection, School of Plant Production, Faculty of Agriculture and Forestry, University of Duhok, Kurdistan Region – Iraq.

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Abstract:

The aim of this work is to investigate the population density and infestation percentage of *Tuta absoluta* on tomato crop *Lycopersicum esculentum*Mill under field conditions in three locations at Duhok province/ Kurdistan region/ northern of Iraq in 2012. The average number of mines/ leaflet, larvae/ leaf and larvae/ fruit during the study season were 2.33, 0.34 and 0.61 respectively. The results showed a significant differences in infestation percentage and number of male per trap among the three locations. The highest percentage of infestation was recorded in September as 74.00, 72.00 and 60.00 for Summel, Shekhan and Zawita respectively. The maximum number of males/ trap/ week was 1205.40 recorded on 26/8/2012 in Summel. Concerning the use of pheromone trap for pest monitoring, linear regression analysis results was significant between trap catches and the number of mines per leaf and the infestation rate of leaves.

Keywords: *Tuta absoluta*, population dynamics, Pheromone traps, Tomato.

1- Introduction

Tomato (Lycopersicon esculentum) is one of the economic important crops of Iraq. It is consumed as fresh table tomato and as an essential raw material for a variety of food processing industries. According to Food and Agriculture Organization 2010, tomato was planted in highland in the world reached to 1.2 million hectare and in Iraq the planted area reached to 842.296 hectare. In Duhok province, more than 12000 hectare of land was planted with tomato in 2012. Tomato production faces many problems from several causes such as seasonal weather, temperature, humidity, diseases and insect pests as thrips, whitefly, tomato fruitworm, leaf miner, leafhopper, aphid and mites.

The tomato borer,*Tuta absoluta* (Meyrik) (Lepidoptera:Gelechiidae) is one of the most destructive pest of tomato crops in South America (Epp,2010).After its first detection in eastern Spain in 2006,its rapidly invaded various other European countries and spread through the Mediterranean basin (Desneux *et al*.2010).In Iraq,tomato borer *T. absoluta*was first detected in Autumn 2010 from sex pheromonetraps installed in Rabia region, Nineveh province (AbdulRazzak *et. al*.2010). Since that time,this pest spread quickly in all tomato growing areas,destroying entire open and protected fields.Ramireze *et. al*.(2010) reported that the damage by *T.absoluta* can reach to 100% in unprotect crops andwas considered in its region distribution area as asignificant tomato insect pest(Leite *et.al.* 2010),due not only to the intensity of its attack but also to its occurrence during all crop cycle (Oliveira *et. al.* 2008).It can develop on other Solanaceous plants, like potato (Pereyra and Sanchez,2006),eggplant and wild species (Garacia and Espul, 1982). Abbes and Chermiti, 2011 reported that the trap catches can be correlated with larval damage. In this way, the minimal amount of spraying required to control the pest population.

The aim of this work is to study the occurrence and infestation level of *T. absoluta* on tomato crops *Lycopersicum esculentum* Mill underopen field conditionsin three sites as Summel, Zawita and Shekhan at Duhok governorate during 2011- 2012 crop season .

2- Material and methods

2-1: Study area

For general observations , initial survey was done before starting the project in order to put the hand on the predominant areas in which the tomato planted and settled in Duhok provinces.To carry out this work, threecommercial fieldslocated in three sites within Duhok governorate (36° 54' N, 43° 8' E) were choose as Shekhan (483 m a.s.l and 34 km far form Duhok centre), Zawita (855m a.s.l. and 16 km far from Duhok centre)and Summel (473 m a.s.l and 16km far from Duhok centre). The average degree of temperature and relative humidity was obtained from Metrological Station of Duhok Governorate .

2-2: Experiment procedure

To determine the tomato infestation by the tomato leaf miner, two methods were followed as:

1- leaves sampling for recording larvae and mines of *T. absolutae* :

To calculate the larvae and mines number of *T.absoluta*, fields were divided to five subarea approximately 0.2 ha. Each subarea with asimilar number of plants to ensure that all the area represented in the samplings. Weekly sampling from May to September were carryout and in each field 25plants were randomly selectedbeing five in each subarea. At each selected plants five leaflets were collected and singly packed in labelled plastic boxesthen transported to the laboratory.

At the laboratory,with aid of Binocular, each leaflet was examined and the number of mines and larvae per leaflet was registered (Leite *et.al.* 2001). Also the number of larvae / fruit was recorded during this study.

2- Trapping methods for adult males harvesting :

This experiment was conducted in two fields, Summel and Shekhan site. Theadults of *T.absoluta* were monitored by using pheromonelure TUA-500 and the TUTASAN® trap (TUTASAN® is a water trap specifically conceived to early detect and catch the tomato leaf miner males, each trap contains of one plate and one pheromone container (green basket with a lid)).The pheromone lure was put in the green basket, closed up with the lid and fixed at the top of the plate. The plate was filled with water till reaching the maximum level. The male insects are attracted by the sex pheromone lure from the top of the trap, and fall down into water. In each field six traps were well positioned and installed 0.5 m above ground level. Four traps at the tops of tomato plants (one in each direction) and two within the field centre. Sex pheromone lure were renewed every four weeks and the number of captured individuals was recorded every week during study period from May to September 2011-2012.

Note: Pest management strategies were applied by farmers and based largely on chemical applications (Insecticide) which targeted to controlling *T. absoluta* and other lepidopteran pests (Noctuidae: Heliothinae).

Data were statistically analysed as Factorial experiment using Randomize Complete Block Design (RCBD) with five replications and SAS program was used. The means were compared using Duncan's multiple range test (DMRT)at $P \leq 0.05$. Also the relation between trap catches, the infestation rate and the number of mines per leaf was performed by a linear regression analysis.

3-Results and Discussion

3-1: Leaves sampling for recording larvae and mines of *T. absoluta*

The data represented in table (1) showed that the general mean number of *T. absoluta* mines/leaflet was 3.37, 2.46 and 1.2 for Shekhan, Summel and Zawita, respectively.

T. absoluta mines resorted to concentrate on leaves on the middle and upper levels. According to fig. (1), the number of leaf mines was initially low in May and June and increasing during August and September to reach a maximum of24.33 on 26/8/2012.Allache and Demnati (2012) mentioned that in Biskra (Algeria), during the first phonologic stages of the crop, tomato plants are free from attack of *T. absoluta* .

Table1: Mean mines, larvae number and the infestation percentage of leaves during study season.

Sample sites	Average No. of mines/ leaflet	Average No. of larvae/leaflet	Average No. of larvae /fruit	Leaves Infestation Percentage %				
				May	June	July	August	September
Shekhan	3.37 a	0.36 b	0.54 c	0	10.67 B	67.20 a	69.00 A	72.00 a
Summel	2.46 b	0.46 a	0.68 a	0	34.00 A	68.00 a	73.33 A	74.00 a
Zawita	1.20 c	0.20 c	0.61 b	0	14.00 b	29.60 b	58.00 B	60.00 b
Average	2.33	0.34	0.61	0	19.56	54.93	66.78	65.33

Means followed by a common letter within the same Column are not significantly different at the 5% level by Duncan's Multiple Range Test (DMRT).

The maximum number of leaf mines was closely related to the density of *T. absoluta* larvae, that the damage caused by larvae on tomato leaves in three locations led to high density of mines rising up to an average of 7.20 mine/ leaf starting from the beginning of July (fig.1).

Harizanova *et.al*.(2009) pointed that the leaves were the most heavily damaged plant parts with an average of 9.42 and 8.75 mines per leaflet on the middle and upper layer of the canopy respectively, followed by the fruits. Increase of the larvae number on leaves caused a high infestation rate reached to 73.33%, 69% and 58% in August for Summel, Shekhan and Zawita.The maximum number of mines/ leaf recorded in September which was 31.4, 28.6 and 14.6 (fig. 2) in Shekhan, Summel and Zawita, respectively.

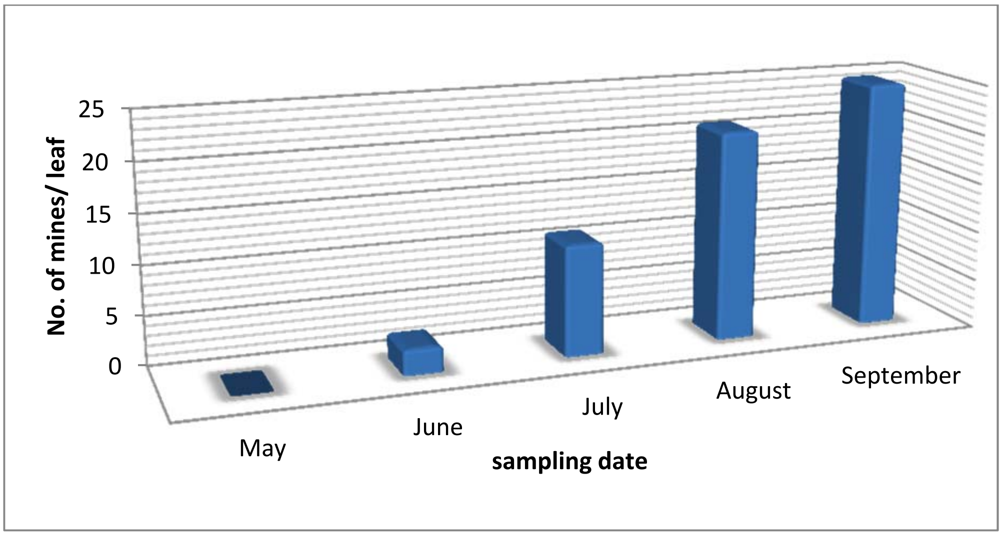

Fig.1: Average number of *T. absoluta*mines / leaf on tomato leaves in three regions in 2012.

Statistical analysis showed a significantdifferences in leaf mines caused by *T. absoluta* larvae amongthe three locations. It could be concluded that in Zawita the mean number of mines (fig. 2), the infestation rate and the number of larvae per mine(tab. 1) was the lowest because it was located in mountainous location which was characterized by (855 m) above sea level and the low temperature degree.

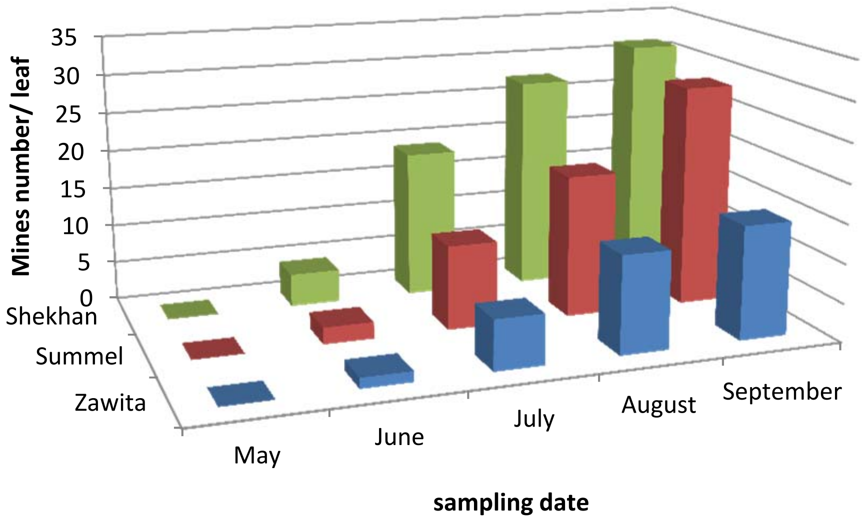

Fig.2: Evolution of the number of*T. absoluta*mines/ month/location on tomatoleaves inthree sites in 2012.

Lacordaire and Feuvrier (2010) reported that the number of*T. absoluta* was influenced perhaps by abiotic factors like temperature, insecticide application and by biotic factors i.e absence of natural enemies.

The average number of larvae/ leaflet (tab. 1) was 0.46, 0.36 and 0.20 for Summel, Shekhan and Zawita , respectively. It was frequent according to Lacordaire and Feuvrier (2010) that the larvae of *T. absoluta* left their galleries and reinstalled in another leaflet or leaf as suggested by Torres *et.al*. (2001),which also added that this low number might be due to insecticide applications which limited the development of the larvae.

3-2 Trapping methods for adult males harvesting :

According to fig. 3, the average number of adults male captured by pheromone traps was variable during study period in the two sites. *T. absoluta* was present from May until September in Summel, while in Shekhan it was noted from June to September (fig. 4). For the two sites, the adults captured increased towards the end of plant cycle. It was relatively low in June with an average of 10.9 adults/ trap/week and their number became relatively high, as their attack became intense towards the end of crop cycle that reached to a maximum of 1055.40 adults/trap/week on 3/9/2012 (fig.3). An increase in temperature was detected at this time in the year. These results agreed with Nannini et.al. (2010), who mentioned that in Southern Sardinia (Italy), the highest number of moths caught in traps were in September-October. These results also matched with those found by Miranda et.al. (1998) and Lacordaire and Feuvrier (2010), who underlined the occurrence and increase in leaf miner captures during the crop season. During this gradual increase, each renewal of the capsules was often followed by an increase in the number of trapped adults.

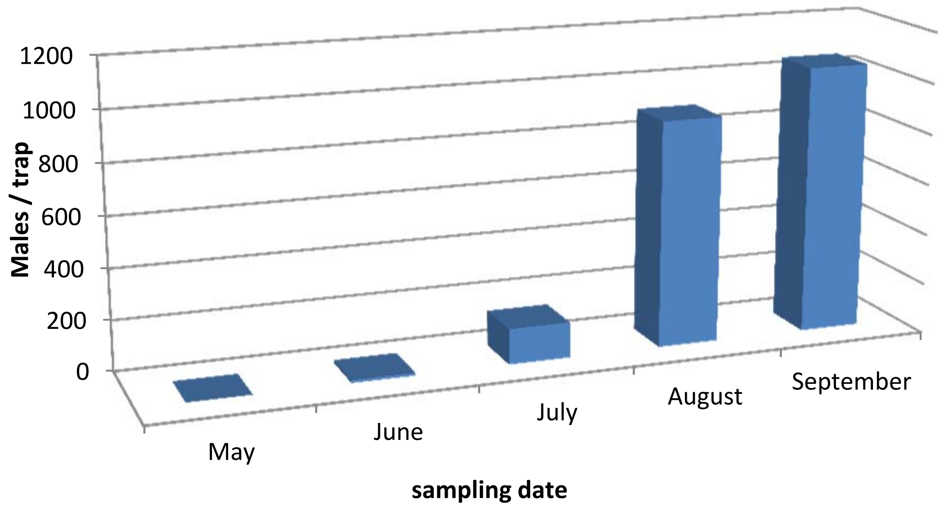

Fig.3: Average number of *T. absoluta*trapped males of two regions

The average number of captured males/week was respectively about 378.73 and 337.23 in Summel and Shekhan. Although the number of adults captured in Summel was more abundant than that in Shekhan and there was a significant differences between these two population, the figure of the evaluation of mass trapping in Summel field shows a similar shape of that in Shekhan (fig. 4). Indeed after 16.80 males caught on 19/6/2012, the number of trapped males continued to increase speedily to exceed 1205.40 0n 26/8/2012.

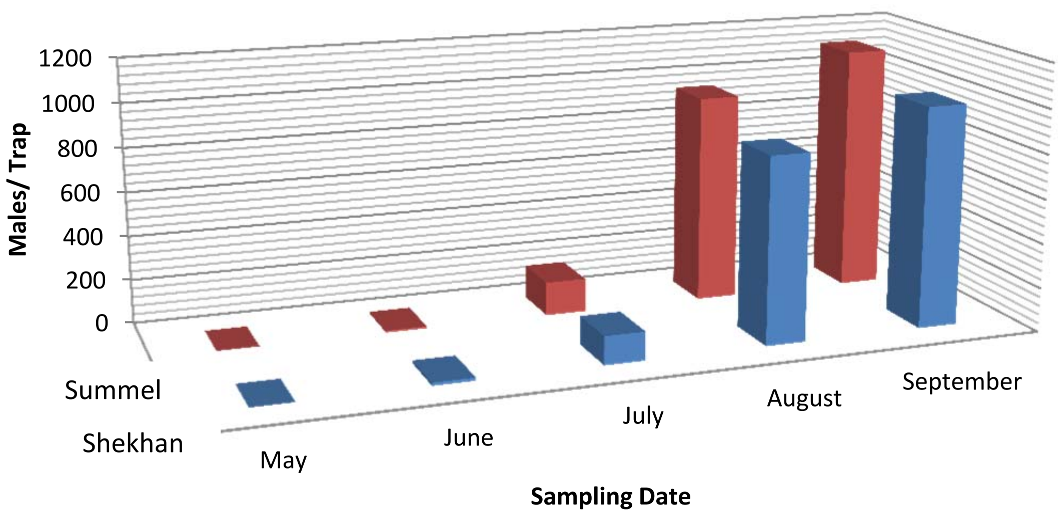

Fig.4: Average number of trapped males/ month/ site of *T. absoluta* for two regions

To investigate that the sex pheromone trap reflects the real level of damage in tomato crops and the infestation rate of plants depending on the number of trapped males of *T. absoluta*, the relation between trap catches, the infestation rate and the number of mines per leaf was performed by a linear regression analysis .

Analysis showed a significant relationship between the number of mines /leaf and the number of trapped males in both Summel and Shekhan(fig. 5 A, B). However, linear regression between infestation rate and the number of catches in sex phermone traps was also significant in two regions (fig. 6 A, B). These results agreed with Abbes and Chermiti (2011) who reported that the number of leaves and leaflets were differentially affected by the densities of *T. absoluta*infestation (p≤0.05)

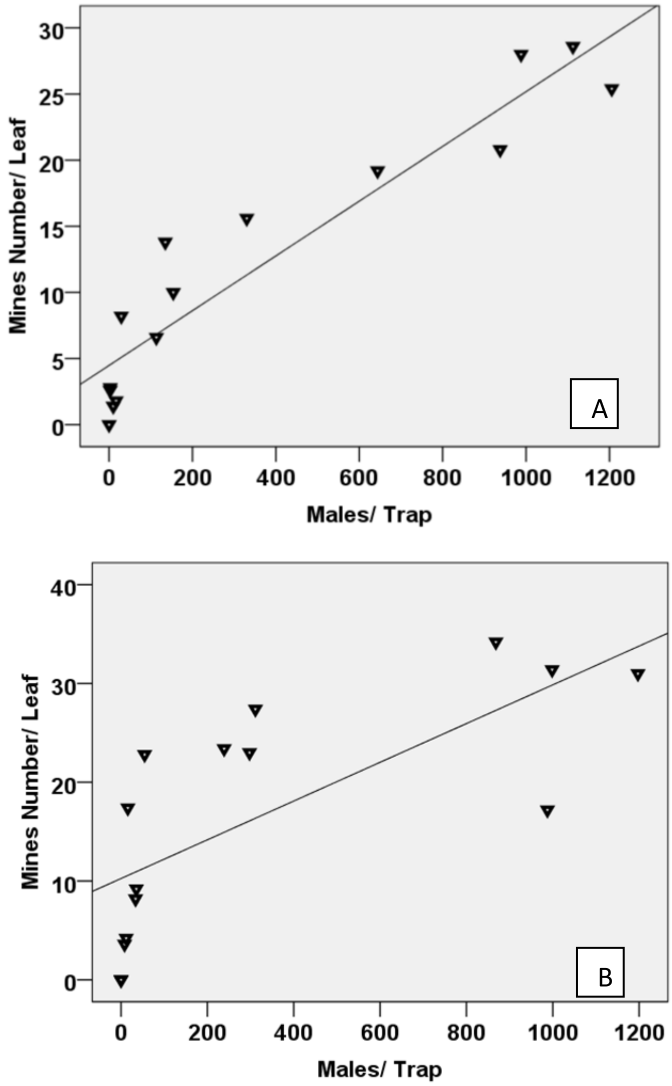

Fig. 5: Linear regression between the number of caught males of *Tuta absoluta* and the number of mines per leaf in Summel (A) (R^2= 0.88) and Shekhan (B) (R^2= 0.53) in 2012.

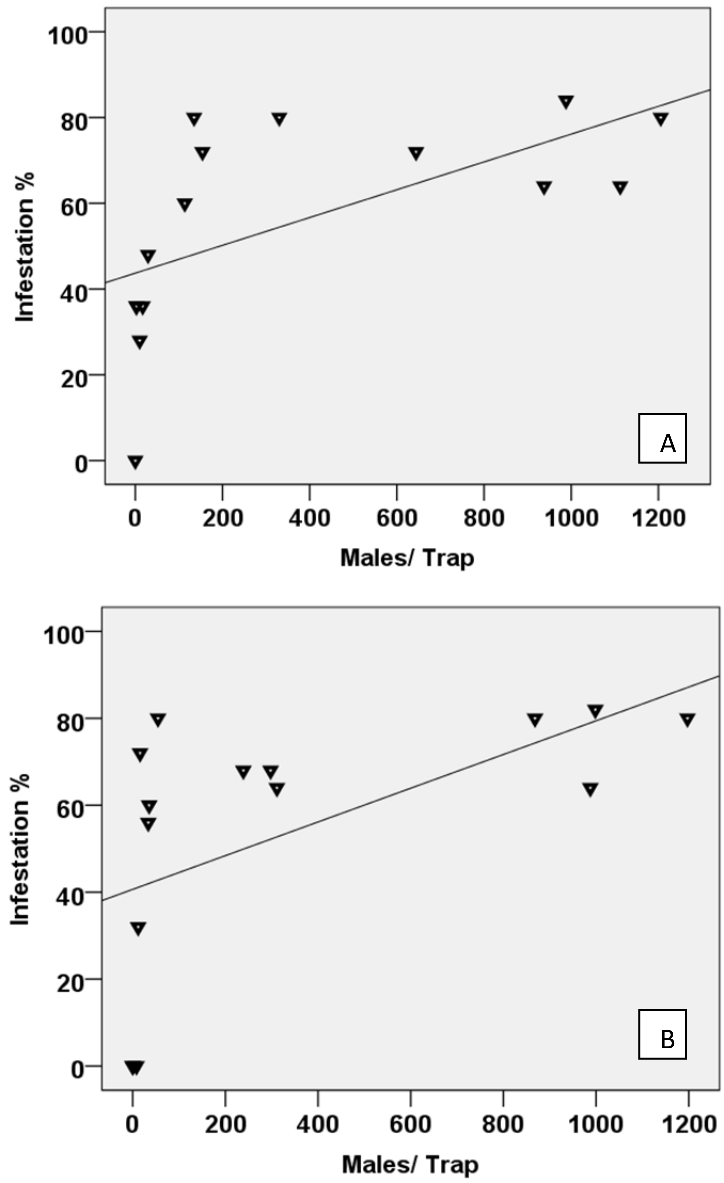

Fig. 6: Linear regression between the number of caught males of *Tuta absoluta* and the infestation rate of leaves in Summel (A) (R^2= 0.37) and Shekhan (B) (R^2= 0.31) in 2012.

Results of linear regression betweenthe number of trapped males and theinfestation level suggest the utilization ofthe sex pheromone traps as good indicators of the infestation rate of thecrop. Some authors recommend 30trapped males per trap per week tostart chemical curative measures.Monitoring is very important in IPMprograms; it allows the detection of theearly infestations. Using of chemicalsbased on data from pheromones traps areusually more effective in controlling firstattacks and avoiding the rapidcolonization of the crop. This cansignificantly reduce the number ofsprayed insecticides, and preserve naturalenemies of the pest.

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هەبوونا مورا *Tutaabsoluta*Meyrick(Lepidoptera:Gelechiidae) ل دەڤەرا دهوکێ

پوختە :

ئەڤ ڤەکولینە هاتە ئەنجامدان ژ بۆ زانینا چریا ژمارەیی و ڕێژەیا تووشبوونێ ب مورا ***Tutaabsoluta*** ل سەر دەرامەتێ باجان سورکێ ل ژێر کاودانێین زەڤیا ڤەکری ل سێ دەڤەرێن سەرەب پارێزگەها دهوکێ (سێمێل، شێخان و زاویتە) ل هەرێما کوردستانا عیراقێ ل سالا ٢٠١٢ . بەرئەنجامێ ژمارا تونێلا/ بەلگ و ژمارا گرما/ بەلگ و ژمارا گرما/ فێقی گەهشتنە ٢,٣٣ ، ٠,٣٤ و ٠.٦١ ل دویف ئێك دا. ئەنجامان هەبونا جیاوازیێن بەرجاڤ د رویژەیێن تووشبوونێ و ژمارا نێرا بو هەر خەفکەکێ د ناڤبەرا هەرسێ دەڤەرا دیارکر. بلندترێن رێژەیا تووشبونێ د هەیڤا ئیلونێ هاتە تومارکرن ددەمێ گەهشتیە ٧٤، ٧٢ و ٦٠ ٪ ل سیمێلێ ، شێخان و ل زاویتە ل دویف ئێك دا. مەزنترین ژمارا نێرا/ خەفك/ حەفتی هاتەتومارکرن ل سێمێلی ل ٢٠١٢/٨/٢٦ ددەمێ گەهشتیە ١٢٠٥,٤ نێر. ئەنجامێن شلوڤەکرنا تێژبوونا هێلی هەبوونا پەیوەندیێ د ناڤبەرا ژمارا نێرێن هاتینەگرتن دخەفکاندا و ژمارا تونێلا /بەلگ و هەروەسا دگەل رێژەیا تووشبونونا دیارکر.

تواجد حشرة حفار اوراق الطماطة *Tutaabsoluta*Meyrick(Lepidoptera:Gelechiidae) في منطقة دهوك

الخلاصة:

اجريت هذه الدراسة لتحديد الكثافة العددية و نسبة الاصابة بحشرة حفار اوراق الطماطة *Tuta absoluta*على محصول الطماطة تحت ظروف الحقل المكشوف في ثلاث مناطق تابعة لمحافظة دهوك (سميل، شيخان و زاويتة)/ اقليم كوردستان العراق ٢٠١٢. كان معدل عدد الانفاق/ وريقة، عدد اليرقات/ ورقة و عدد اليرقات/ ثمرة ٢,٣٣، ٠,٣٤ و ٠,٦١ على التوالي. أظهرت النتائج اختلافات معنوية في نسب الاصابة و عدد الذكور لكل مصيدة بين المناطق الثلاثة. اعلى نسبة اصابة سجلت في ايلول حيث وصلت الى ٧٤، ٧٢ و ٦٠٪ في سميل، شيخان و زاويته على التوالي. سجل اعلى عدد للذكور/ مصيدة/ اسبوع في سميل بتاريخ ٢٠١٢/٨/٢٦ حيث وصل الى ١٢٠٥,٤٠ ذكر. نتائج تحليل الانحدار الخطي اظهرت وجود علاقة بين عدد الذكور الممسوكة في المصائد و عدد الانفاق/ ورقة و ايضا مع نسبة اصابة الاوراق.