Population Fluctuation of Certain Insects Infesting Vegetable Crops and their Predators Caught by Using Light Traps and Effect of some Weather Factors on those Insects

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ABSTRACT

Investigation was carried out to survey the main insects attacking the vegetable crops caught by using light traps and the population fluctuations; flight activity of four nuctuids insect species and the effect of weather factors on the population fluctuations of these species during the two years (2016 and 2017) at Mansoura district. Results obtained revealed that there were nine species belonging to Family: Noctuidae (Order Lepidoptera), one species of the Family: Gelechiidae and one species of Family:Pyralidae. One species of Family: Gryllotalpidae (Order Orthoptera) were recorded. Meanwhile, one species of Family: Pentatomidae (Order Heteroptera) and one species of Family: Scarabaeidae (Order: Coleoptera) were found. Data obtained showed that the population fluctuation of *Spodoptera littoralis* (Boisd.) had seven peaks were found all the year round. The results cleared that *Spodoptera exigua* (Hubner) was recorded five peaks in vegetable crops. These peaks were occurred in the 3rd week of March, last week of April, 2nd week of June, 1st week of Aug. and 3rd week of September, during the first year of study, In the second years, the peaks were during the 1st week of Febr, 2nd week of May, last week of June, 3rd week of Aug. and 1st week of Oct. The population fluctuation of *Agrotis ipsilon* (Hufn.) revealed that this insect had six peaks in vegetable crops. The obtained data cleared that population fulctuation of *Heliothes armigera* Hbn This insect had four peaks in vegetable crops. These peaks were occurred in the 2nd week of May, 2nd week of June, 3rd week of July and 2nd week of Sept. during the first year of study. In the second year, the peaks were during the 3rd week of March, last week of June, 1st week of Aug. and 1st week of Sept. Results indicated that the values of correlation coefficient of the relationship between the average temperature, relative humidity and the population fluctuation of these four insect species during the two seasons of study, assuted that the average temperature and relative humidity parameters exerted varied effect with a value ranged from slight to highly significant correlation during the two seasons of the investigation.

INTRODUCTION

Insects are the most species- rich taxon with about one million species described worldwide, corresponding to more than half of all known species (Groombridge, 1992;Gullan and Cranston, 2010). Due to their high ecological diversification and short generation times, insects are useful indicators of environmental change (Thomas, 2005 and Schowater, 2011). Lepidoptera (butterflies and moths) is one of the largest insect orders with 160.000 described species, of which 95% are moths (New, 2004 and Kristensen, *et al* 2007).

The most widely applied method to survey moths is to use light traps, which exploit their attraction to artificial light (Franzen and Johannesson 2007; Merckx *et al.*, 2009 and Groenendijk and Ellis, 2011).

However, many entomologists suggested the use of light traps for recording new species and for determining the relative abundance of major insect pests throughout the year. Such information may enable them to predict the possible out- breaks of certain insect species (El- Deeb *et al.* 1968, Ghanim 1977, Fayle *et al.* 2007 and Leraut 2009). Inaddition, this information makes it easier to predict the population fluctuations of such species and facilitates and lessens the amount of the used insecticides or other integrated control methods. There are many lepidopterous insect species attacking vegetable crops through the year. Many investigators studied the population fluctuations of the important insect species (El- Mezayyen *et al.,* 1997; El-Zanan and El- Hawary, 1999; Sharma *et al.*, 2010 and Pehlevan and Kovanci, 2013)and Wang, *et al*; (2014) , .

Weather factors, such as temperature and rainfall, relative humidity and the moon light in the open during new moon week and full moon week was found to show a significant negative lunar periodicity of macrolepidoptera catches (Hosny, 1955).

Many entomologists announced the importance of light traps as successful method of testing the relationships of weather factors and the activity of vegetable crops insect species (Hendricks *et al.,* 1975; Ghanim, 1977 and Mark, 2014).

Therefore, this study aimed to survey the main insect species attacking the vegetable crops and their predators at Mansoura district and the population fluctuations and flight activity of four noctuids insect species infesting vegetable crops and the effect of some weather factors on the population fluctuations of these species.

MATERIALS AND METHODS

1-Survey and population fluctuation of main insect pestes attacking vegetable crops and their predatory insects:

For studying the abundance and population fluctuation of main insect species infesting vegetable crops and their predators at Mansoura, district, samples were taken daily during two years from 26th December 2016 till 25th December 2018, by using two Robison light traps (Robinson and Robinson 1950). The traps were placed in the farm of farm of faculty of Agriculture, Mansoura University at a height of 7 meters. The two light traps were baited with mercury vapour lamps (250 walt) as a source of light.

The trap consists of an inverted metal cone, 24 inches in diameter, and contains six radial vanes projecting two inches above the upper aperture. These vanes obstruct the flight of insects circling or heading for the light and thus reduce their flight speed causing them to stall and fall into the sloping cone and then into the receptacle .At the lower aperture of the cone and in the center of the vanes, a 250 watt clear mercury vapour lamp is fixed in a socket and so adjusted that its light is unobstructed above the upper structure is fitted tightly on a barrel –like 24 inches deep receptacle which forms the base of the apparatus. Sodium cyanide, put in a glass jar, is used as a killing agent inside the trap. The light trap was set off daily for a period of 12 hours from sunset to sunrise.

The traps were emptied every morning and the traps catches were singly placed in polyethylene sac, then the catch was brought to the laboratory for identification.

The daily catch was separated, identified, counted and recorded at the same day. The daily catch was a accumulated biweekly for the two years of study.

Daily records of temperature and relative humidity of Mansoura district were obtained from meterological organization, Ministry of Defence. These records have been calculated as mean of biweekly degrees related to the accumulated biweekly catch of the insect species.

2-Effects of some weather factors on the population fluctuation of four insect species attacking vegetable crops and their predators

The correlation coefficients between the mean biweekly numbers of the four insect species attacking vegetable crops and their predators and the mean biweekly temperature degrees and the relative humidity were statistically calculated.

3-Statistical analysis:

For the purpose of statistical analysis, data were analyzed by using two way analiysis of variance (ANOVA),correlation coefficaticient and multiple regression equation using computer advanced statistical program (Costat 1990).

RESULTS AND DISCUSSION

1: Effectiveness of light traps in monitoring certain insect pests infesting vegetable crops.

Surveying insect species infesting vegetable crops by using light trap at Mansoura district :

The total numbers and percentages of insect species infesting vegetable crops during the two years 2016 and 2017 at Mansoura district by using light traps. It counted every biweekly to indicate the abundance and population fluctuation of these insect pests were given in Table (1). From this table, it can be seen that, there were nine species belonging to Family: Noctuidae (Order Lepidoptera), one species of the Family: Gelechiidae and one species of Family:Pyralidae. One species of Family: Gryllotalpidae (Order Orthoptera) was recorded. One species of Family: Pentatomidae (Order Heteroptera) and one species of Family: Scarabaeidae (Order: Coleoptera) were found. The noctuid insects were: *Spodoptera littoralis* (Boisd.), *Spodoptera exigua* (Hubner), *Agrotis ipsilon* (Hufn.), *Autographa gamma* L., *Autographa chalcytes* L., *Autographa ni* L. , *Heliothes armigera* Hbn, *Phthorimaea operculella* (Zeller) and *Cryptoblabes gnidiella* (Mill).

The Gryllotalpidae, Pentatomidae and Scarabaeidae insects were *Gryllus domesticus* L., *Nezara viridula* (Linnaneus) and *Pentodon algerinum dispar* Baudi. It can be stated from this Table that the most dominant species was *Agrotis ipsilon* which represented 22.80% of the total catch in 2016 and *S. littoralis* and *H. armigera* which represented 20.26% of the total catch in 2017 .

2 - Surveying some predators associated with these insect by using light trap at Mansoura district:

The total number and percentages of predators during 2016 and 2017 year at Mansoura district by using light traps were counted biweekly to indicated that the abundance and population fluctuation of these predatory insects are given in Table (2) From this table it can be seen that, there were two species belonging to Family: Chrysopidae order Neuroptera and Family: Anthocoridae. These species were *Chrysoperla carnea* and *Orius albidipennis*.

El- Mezyyen *et al.* (1997), in Egypt mentioned that twenty two insect species were recorded by using light traps and *S. littoralis* constituted 53.34% of the total catch.

II. Population fluctuation of four insect species infesting vegetable crops by using light traps at Mansoura district:

1- *Spodoptera littoralis*:

Data represented in Figure (1) showed that the population fluctuation of *S. littoralis* during the two years of study. The biweekly catch revealed that this insect had seven peaks was found all the year round. These peaks were occurred in the 3rd week of Feb., 3rd week of April, 2nd week of June and 2nd week of July., the third week of August., 1st week of October and in the 2nd week of November during the first year of study. In the second years, these peaks were recorded in the 3rd week of March, last week of June, 1st week of Augast, 1st week of Sept. and 3rd week of October at Mansoura district the results were similar as indicated by Hassanein (1956) the moths of *S.littoralis* were captured in all months of the year at Shebin El-kom and the maximum abundance was during June and July. Ghanim (1977) found that *S. littoralis* had seven generation at Mansoura district. These generations beginning at the second week of April, last week of May, last week of June, last week of July, last week of August first, first week of October and last week of November. Ye Shu Guang *et al.* (2000) in China who stated that most dominant insect species was *S. littoralis* followed by *A. ipsilon* then *S. exigua*. Nandihulli *et al.* (1990) in India assured that the light traps was more effective at capturing individual of *S. littoralis* and *H. armigera* . Ye Shu Guang *et al,* (2000) in china who stated that most domenant insect species was *Spodoptera litura* followed by *Agrotis ipsilon* then *Spodoptera exigua* . Wandihulli *et al,* (1990) in India assured that the light traps was more effective at capturing individua of *s.littoralis* and *H.armiger*.

Table 1. Total Numbers and percentages of insect species infesting vegetable crops caught by light trap at Mansoura district during 2016 and 2017.

years	2016		2017	
Orders and insects species	**Total individuals**	**%**	**Total individuals**	**%**
Order: Lepidoptera				
1-Fam: Noctuidae				
Spodoptera littoralis	2303	14.3	3368	20.26
Spodoptera exigua	1795	11.1	2584	15.54
Agrotis ipsilon	3667	22.80	2174	13.07
Autographa gamma	825	5.11	667	4.01
Autographa chalcytes	625	3.88	534	3.22
Autographa ni	1068	6.64	770	4.63
Heliothes armigera	1541	9.58	3368	20.26
2-Fam.:Gelechiidae				
Phthorimaea operculella	1439	8.94	1148	6.94
3-Fam.:Pyralidae				
Cryptoblabes gnidiella	437	2.00	232	1.39
Order:Orthoptera				
Fam.:Gryllotalpidae				
Gryllus domesticus	1209	7.5	918	5.52
Order:Heteroptera				
Fam.:Pentatomidae				
Nezara viridula	1151	7.15	832	5.00
Order: Coleoptera				
Fam.:Searabaeidae				
Pentodon dispar	20	1.00	27	0.16
Grand total numbers	16080	100	16622	100

B. Effect of temperature and relative humidity on the population fluctuation of *Spodoptera littoralis*. The values of correlation coefficient which describe the relation between temperature and the relative humidity parameters cleared highly significant positive or negative correlation during 2016

and 2017 years The combined effect of temperature and relative humidity exerted highly positive significant correlation in the two years of investigation. The obtain results assured that the temperature parameters was the main weather factors which affected greatly on the population size of *Spodoptera littoralis* which cought by light traps. During the two years 2016 and 2017 the values of proportional effect (explained variance) of temperature and the relative humidity parameters tested were ranged from 83% to 14% (Table 3)

Table 2. Total numbers of some predatory insects and their percentages to the total catch related to their orders caught by using light traps inhabiting vegetable crops.

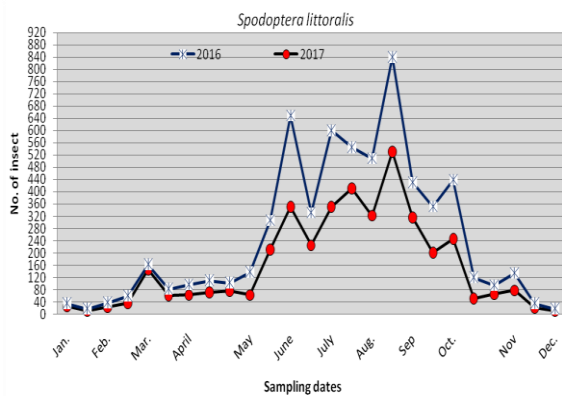| Years	2016		2017	
Predatory species	Total numbers	%	Total numbers	%
Neuroptera: Family: chrysopidae *Chrysoperla carnea*	336	37.92	96	16.61
Heteroptera: Family: Anthocoridae *Orius albidipennis*	550	62.08	482	83.39
Total numbers	886	100	578	100

Figure 1. Population fluctuation of *Spodoptera littoralis* caught by using light trap during 2016 and 2017 at Mansoura district.

Table. 3. Correlation coefficient and regression between the population density of *S. littoralis*, the temperature and relative humidity components during 2016 and 2017 at Mansoura district.

	Simple correlation coefficient (r)		Regression (R2)	
year	Average Temperature	Average R.H.	Average Temperature	Average R.H.
2016	0.67± 0.15***	0.238± 0.19 ns	0.83± 2.158	0.14± 1.176
2017	0.703± 0.142***	-0.133± 0.198 ns	0.17± 3.542	-0.2122± 3.151

ns= non significant * = significant with varied degree where r = correlation coefficient p = probability s = significant sign.

Results obtained in Table (3) indicated that the values of correlation coefficient of the relationship between the average temperature, relative humidity and the population density of *S. littoralis* during the two years of study. The average temperature and relative humidity parameters exerted varied effect with a value ranged from non-significant to highly significant correlation during the two years of the investigation.

2-*Spodoptera exigua*:

Data illustrated in Figure (2) revealed that the population density of *S. exigua* during the two years of study. The biweekly catch revealed that this insect had five peaks in vegetable crops. These peaks were occurred in the 3rd week of March, last week of April, 2nd week of June, 1st week of

Aug. and 3rd week of Sep. during the first year of study. In the second years, the peaks were during the 1st week of Febr, 2nd week of May, last week of June, 3rd week of Aug. and 1st week of Oct. at Mansoura district.

B. Effect of temperature and relative humidity on the population fluctuation of *Spodoptera exigua*. The values of correlation coefficient which describe the relation between temperature and the relative humidity parameters cleared highly significant positive or negative correlation during 2016 and 2017 years The combined effect of temperature and relative humidity exerted highly positive significant correlation in the two years of investigation. The obtain results assured that the temperature parameters was the main weather factors which affected greatly on the population size of *Spodoptera exigua* which cought by light traps. During the two years 2016 and 2017 the values of proportional effect (explained variance) of temperature and the relative humidity parameters tested were ranged from 84% to 11% (Table 4)
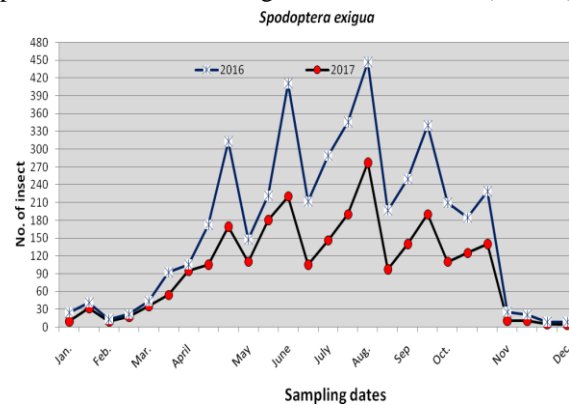

Figure 2. Population fluctuation of *Spodoptera exigua* caught by using light traps during 2016 and 2017 at Mansoura district.

Table 4. Simple correlation coefficient and regression between the population fulcuation of *S. exigua*, the temperature and relative humidity components during 2016 and 2017 at Mansoura district.

	Simple correlation coefficient (r)		Regression (R2)	
years	average Temperature	average R.H.	average Temperature	Average R.H.
2016	0.742± 0.134***	0.276± 0.192 ns	0.72± 1.314	0.11± 0.785
2017	0.815± 0.115 ***	0.077± 0.199 ns	0.84± 1.204	0.52± 1.352

ns = in significant   * = significant with varied degree where
r = correlation coefficient   p = probability   s = significant sign.

Results obtained in Table (4) indicated that the values of correlation coefficient of the relationship between the average temperature, relative humidity and the population density of *S. exigua* during the two years of study. The average temperature and relative humidity parameters exerted varied effect with a value ranged from non significant to highly significant correlation during the two years of the investigation. Wang Kaiyuan *et al*. (1995) in China recorded 4-5 generations annually on vegetables crops by using light traps. Ming *et al*. (2006) mentioned that three light traps were evaluated for monitoring beet armyworm (*S. exigua* and *S. littoralis*). It possessed higher reliability and efficiency and lower cost and therefore is practical to be applied for forecasting and controlling of *S. exigua* and *S. littoralis*.

3-*Agrotis ipsilon*:

Data represented in Figure (3) cleared that the population fluctuation of *A. ipsilon* during the two years of

study. The biweekly catch showed that this insect had six peaks in vegetable crops. These peaks were occurred in the 1st week of March, 3rd week of April, last week of May, 1st week of Aug, 3rd week of Oct and 2nd week of Nov. during the first year of study. In the second year, the peaks were during the 3rd week of April, last week of May, 3rd week of Aug. and 2nd week of Nov. at Mansoura district. B. Effect of temperature and relative humidity on the population fluctuation of *A. ipsilon* . The values of correlation coefficient which describe the relation between temperature and the relative humidity parameters cleared highly significant positive or negative correlation during 2016 and 2017 years The combined effect of temperature and relative humidity exerted highly positive significant correlation in the two years of investigation. The obtain results assured that the temperature parameters was the main weather factors which affected greatly on the population size of *A.ipsilon* which cought by light traps. During the two years 2016 and 2017 the values of proportional effect (explained variance) of temperature and the relative humidity parameters tested were ranged from 84% to 13% (Table 5)
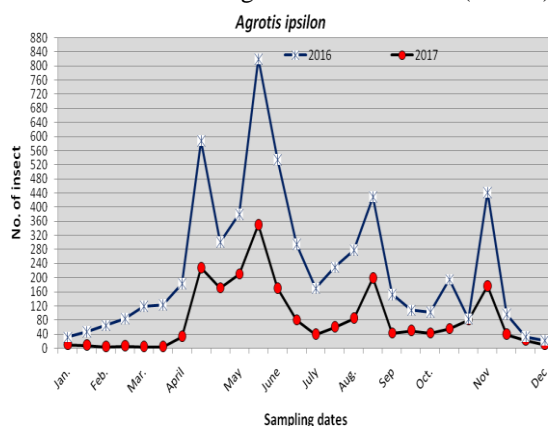

Figure 3. Population fluctuation of *A. ipsilon* caught by using light trap during 2016 and 2017 at Mansoura district.

Results obtained in Table (5) indicated that the values of correlation coefficient of the relationship between the average temperature, relative humidity and the population density of *A. ipsilon* during the two years of study. The average temperature and relative humidity parameters exerted varied effect with a value ranged from slight to negative significant correlation during the two years of the investigation. Meshram *et al*. (1990) in India stated that there were ten insect species attacking vegetables crops were recorded, the dominant species of them, *A. ipsilon* and *H. armeigra.*

Table 5. Simple correlation coefficient and regression between the population fulcutaion of *A.ipsilon,* the temperature and relative humidity components during 2016 and 2017 at Mansoura district.

years	Simple correlation coefficient (r)		Regression (R2)	
	average Temperature	average R.H.	average Temperature	average R.H.
2016	0.444± 0.179*	0.177± 0.196 ns	0. 83± 3.350	0.13± 1.533
2017	0.425± 0.181*	-0.308± 0.190 ns	0.84± 3.589	0.39± 2.407

ns = in significant   * = significant with varied degree where
r = correlation coefficient
p = probability   s = significant sign

Jakubowska and Bocianowski (2013) observed a local, growing population of cutworm in agricultural fields

with various plants such as vegetables, horticultural, and ornamental plants has been observed. The scope of study covered the observation of two species of cutworms: *Agrotis segetum* (Schiff.). The overall results can be used for adjusting the currently used monitoring methods for short-term and long-term forecasting of cutworm flights, and for optimizing chemical control of the cutworm.

4-*Heliothis armigera*:

Data illustrated in Figure (4) recorded the population fluctuation of *H. armigera* during the two years of study. The biweekly catch revealed that this insect had four peaks in vegetable crops. These peaks were occurred in the 2nd week of May, 2nd week of June, 3rd week of July and 2nd week of Sept. during the first year of study. In the second year, the peaks were during the 3rd week of March, last week of June, 1st week of Aug. and 1st week of Sept. at Mansoura district. B. Effect of temperature and relative humidity on the population fluctuation of *H.armigera*. The values of correlation coefficient which describe the relation between temperature and the relative humidity parameters cleared highly significant positive or negative correlation during 2016 and 2017 years The combined effect of temperature and relative humidity exerted highly positive significant correlation in the two years of investigation. The obtain results assured that the temperature parameters was the main weather factors which affected greatly on the population size of *H.armigera* which cought by light traps. During the two years 2016 and 2017 the values of proportional effect (explained variance) of temperature and the relative humidity parameters tested were ranged from 82% to 10% (Table 6)
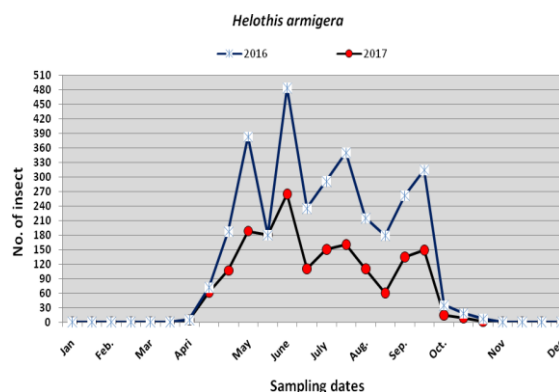

Figure 4. Population fluctuation of *Heliothis armigera* caught by using light traps during 2016 and 2017 at Mansoura district.

Table 6. Simple correlation coefficient and regression between the population density of *H. armigera*, the temperature and relative humidity components during 2016 and 2017 at Mansoura district.

years	Simple correlation coefficient (r)		Regression (R2)	
	Average Temperature	Average R.H.	average Temperature	average R.H.
2016	-0.04367± 0.199 ns	0.0052± 0.0049 ns	-0.1000± 0.457	0.10± 0.190
2017	0.648± 0.152***	-0.136± 0.198 ns	0.82± 1.934	-0.11± 1.606

ns = non significant   * = significant with varied degree where
r = correlation coefficient
p = probability   s = significant sign.

Results obtained in Table (6) indicated that the values of correlation coefficient of the relationship between the average temperature, relative humidity and the population

density of *H. armigera* during the two years of study. The average temperature and relative humidity parameters exerted varied effect with a value ranged from non significant to highly significant correlation during the two years of the investigation. Deepa *et al.* (2009) in India recorded mentoring and relationship between light raps catches of *H. armigera* showed that traps catches and positively correlated with temperature and negatively correlated with relative humidity.

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التنبذبات العددية لبعض أنواع الحشرات التى تصيب محاصيل الخضر و مفترساتها الحشرية و التى جمعت بواسطة المصائد الضوئية و تأثير بعض العوامل الجوية على هذه الحشرات

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اجريت دراسة لحصر أنواع الحشرات التى تهاجم بعض محاصيل الخضر بمنطقة المنصورة والتنبذبات العددية ونشاط الطيران لأربعة أنواع من عائله Noctuidae التى تصيب محاصيل الخضر و تأثير بعض العوامل الجوية على التنبذبات العددية لهذه الأنواع خلال عامى 2016 و 2017 , حيث تم حصر تسعة أنواع من الحشرات التابعة لعائلة Noctuidaeعائله (Order: Lepidoptera) و نوع تابع لعائلة Gelechiidae و نوع يتبع عائلة Crambidae. و نوع يتبع عائلة Gryllotalpidae (Order: Orthoptera) و نوع يتبع عائلة Pentatomidae (Order: Heteroptera) و نوع يتبع عائل(Scarabaeidae: Order: Coleoptera) التعداد الكلى و النسبة المئوية لهذه الانواع التى تصيب محاصيل الخضر جمعت بواسطة المصائد الضوئية , و أظهرت النتائج أن لدودة ورق القطن سبعة ذروات خلال عامى الدراسة , وأوضحت النتائج أن لدودة ورق القطن الصغرى أن لها خمسة ذروات أثناء عامى الدراسة حيث تم تسجيل الذروات فى الاسبوع الثالث من مارس و الاسبوع الاخير من أبريل و الاسبوع الثانى من يونيه و الاسبوع الاول من أغسطس و الاسبوع الثالث من سبتمبر , خلال العام الاول من الدراسة وفى العام الثانى كانت هذه الذروات الاسبوع الاول من فبراير و الاسبوع الثانى من مايو و الاسبوع الاخير من يونيه و الاسبوع الثالث من أغسطس و الاسبوع الاول من اكتوبر , وأظهرت النتائج التنبذبات العددية للدودة القارضة السوداء أن لها ست ذروات . وعرضت النتائج التنبذبات العددية لدودة اللوز الامريكية وجد أن لها أربعة ذروات كانت فى الاسبوع الثانى من مايو و الاسبوع التانى من يوليه و الاسبوع التانى من سبتمبر خلال عامى الدراسة أوضحت النتائج أن قيمة الارتباط بين متوسط درجات الحرارة و الرطوبة النسبية و التنبذبات العددية للحشرات الاربعة خلال موسمى الدراسة تراوحت تأثيرها بين المعنوية البسيطة الى المعنوية الموجة العالية .