

**SOME ECOLOGICAL ASPECTS OF THE SHOT-HOLE  
BORER, *STEPHANODERES VULGARIS* CHAUF. (COL.,  
SCOLYTIDAE) IN FIG ORCHARDS IN ALEXANDRIA**

**(Received:5.7.1999)**

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**ABSTRACT**

Ecological studies on the shot-hole borer, *Stephanoderes vulgaris* (Col., Scolytidae) were performed in fig orchards at Alexandria, Egypt, during 1997 and 1998. Results showed that older trees were the most infested, the apical branches harboured the highest number of beetles and no preferred cardinal direction (site) for this insect in the orchard. The adult beetles continued to emerge all the year round. In 1997 and 1998, the maximum mean number of beetles emergence ranged between 201.2-230.3 / cut of fig branch during the period from the 5<sup>th</sup> – 19<sup>th</sup> of Aug. (28.6 - 28.8°C and 70-72% R.H.); while the minimum was 10.2-12.2 / cut of fig branch during the period from the 6<sup>th</sup> of Jan.- the 4<sup>th</sup> of Feb. (11.7-13.3°C and 62-67% R.H.). Five peaks of adult beetles emergence were reached during the 2<sup>nd</sup> or the 3<sup>rd</sup> week of March, the last week of Apr. or the 2<sup>nd</sup> week of May, the 3<sup>rd</sup> week of Jun. or the 1<sup>st</sup> week of Jul., the 1<sup>st</sup> or the 3<sup>rd</sup> week of Aug. and the 2<sup>nd</sup> week of Oct. Beetle emergence was significantly affected by the combined effect of day-maximum temp., day-minimum temp. and daily-mean relative humidity.

*Key words: ecology , fig trees, Stephanoderes vulgaris*

**1. INTRODUCTION**

The bark beetles are the most destructive economic borers on

numerous fruit and wood trees in many countries. In Egypt, fig trees are infested with two main bark beetles, *Hypoborus ficus* and *Stephanoderes vulgaris* (Col., Scolytidae), causing severe damage of the infested branches and stems. Hammad and El-Sherif (1963) recorded *S. vulgaris* on fig trees in the north coastal region of Alexandria. The main biological aspects of this insect were investigated by Shehata (1999). On the other hand, Kinawy (1981), in Egypt, indicated that adults of *Hypoborus ficus* started to appear in fig orchards from the 2<sup>nd</sup> half of February and continued till the end of December, showing four peaks during this period.

The present ecological study on *S. vulgaris* was planned to contribute to the basic information on the population fluctuations, sites of infestation and effect of hygrothermic weather factors on the rate of adult beetles emergence in fig orchards at Alexandria region.

## 2. MATERIALS AND METHODS

Ecological investigations on *S. vulgaris* were executed in fig orchards at Abo-Talat, Alexandria, during the two successive years from the 1<sup>st</sup> week of January 1997 to late December 1998.

### 2.1. Effect of age, site and part of the tree on the infestation level

On January 1997, three fig orchards of about 3-5, 7-11 and 17-20 year old were selected to study the effect of age of fig trees on their susceptibility to infestation with *S. vulgaris*. Percentages of infested trees were based on 200 randomly selected trees in each orchard.

The fig orchard of 17-20 years old was divided into 4 areas according to the cardinal directions (north, south, east and west), each area occupied with 100 random trees. Percentages of infested trees were determined in each direction.

Out of 100 randomly infested trees of the same orchard were chosen to measure the level of infestation on each of the trunk, the main branches and the apical branches.

On January 1998, the same design was repeated on other trees in the same previous selected orchards to prove the results.

## **2.2. Fluctuations of adult beetles population**

Starting from early January 1997 to late December 1998, weekly random samples of 40 cuttings of infested fig branches (15 cm long and 1.3 cm in diameter) were cut out from twenty heavily infested fig trees (17 year old). The cuttings were kept in adequate glass jars covered with cloth (4cuttings/1jar) and taken to the laboratory. Jars were inspected weekly to assess the numbers of adult beetles outside and / or inside fig cuttings. After each count, fig cuttings were removed from all jars and replaced by others.

The previous experimental technique was used to determine the peaks of adult beetles emergence and the effect of day-maximum temperature day-minimum temperature and daily-mean relative humidity on the rate of adults emergence under field conditions.

"C-multipliers formula" described by Fisher (1950) was used to explain the relationship between the effect of hygrothermic weather factors and the rate of adults emergence. "F" test (Snedecor and Cochran, 1961) was calculated to check the relation between the infestation level and each of the age, the site and the infested part of trees.

## **3. RESULTS AND DISCUSSION**

### **3.1. Effect of age, site and part of the tree on the infestation level**

Data presented in Table (1) show the relation between age, site and part of fig tree and percentage of *S. vulgaris* infestation in 1997 and 1998.

Results indicate that the percentage of infested trees fluctuated between 2 to 51% according to the age of fig trees. Trees of 3-5, 7-11 and 17-20 years old were infested by 2-3%, 10-14% and 43-51%, respectively. These differences were found to be highly significant.

Estimation of the infestation level at the different cardinal directions of the inspected area revealed no significant effect of this factor on the degree of infestation. The degrees of infestation were 27 - 43%, 30-39%, 38 - 45% and 35-37% at the north, south, east and west directions, respectively.



Also, the susceptibility to infestation varied in the different wooden parts of the tree [stem (s), main branches (mb) and apical branches (ab)]. Semi-dry and / or dry wooden parts only were infested. Apical branches were the most susceptible ( 25-31% of infested trees ), followed by the main branches (7-9% of infested trees) then the stem (1-2% of infested trees). Calculation of infestation in different combinations of the tree parts showed that 13-19%, 3-5%, 3-4% and 37-41% of trees were infested in the combination parts of (s + mb + ab); (s + mb); (s + ab) and (mb + ab), respectively.

Statistical analysis revealed significant effect of this factor on the infestation rate.

### 3.2. Fluctuations of adult beetles population

The fluctuations of *S. vulgaris* adult beetle population on fig trees were weekly counted under the field conditions throughout the two successive years 1997 and 1998.

Table (1) and Fig. (1) show that the adult beetle emergence fluctuated all the year round.

Numbers of emerged beetles were divided into 4 levels representing low level (less than 50 beetles), moderate level (50-99 beetles), high level (100-150 beetles) and abundant level (more than 150 beetles).

Accordingly, in 1997, the low population ( 10.2-41.5 beetles ) was recorded 11 weeks (at 11.5-26.2°C and 58.0-75.0% R.H.) during 21/1-25/2, 20/5, 8-15/7 and 16-23/12. The moderate level (51.7-96.5 beetles) was recorded 19 weeks (at 13.8-26.8°C and 57.0-74.0% R.H.) during 7-14/1, 4/3, 8-29/4, 27/5-10/6, 22/7-5/8, 16/9-7/10 and 18/11-9/12. The high level (102.7-140.7 beetles) was recorded 11 weeks (at 13.8-26.4°C and 63.0-71.0% R.H.) during 11-25/3, 17-24/5, 12/8, 2-9/9 and 28/10 - 11/11. The abundant level (150.3-201.2 beetles) was recorded 7 weeks (at 19.8-28.6°C and 65.0-73.0% R.H.) during 6-13/5, 1/7, 19-26/8 and 14-21/9.

However, in 1997, five peaks were recorded on the 3<sup>rd</sup> week of Mar. (132.2 beetles) at 13.8°C and 66% R.H., the 2<sup>nd</sup> week of May (160.5 beetles) at 20.9°C and 65% R.H., the 1<sup>st</sup> week of Jul. (150.3 beetles) at 25.2°C and 73% R.H., the 3<sup>rd</sup> week of Aug. (201.2 beetles)

**Table (1): Effect of age, site and part of fig tree on the infestation level.**

Year	Percent of infested trees							F	P	L.S.D.	
	Age of tree / years									0.05	0.01
	3-5	7-11	17-20								
1997	2	14	43				36.12	0.01	0.08	0.12	
1998	3	10	51				56.94	0.01	0.08	0.11	
Mean	2.5	12.0	47.0								
	Site of tree at the cardinal directions of the orchard							F	P	---	---
	North	South	East	West							
	1997	43	39	45	37						
1998	27	30	38	35			0.835	---	---	---	
Mean	35.0	34.5	41.5	36.0							
	Wooden part of tree							F	P	0.08	0.12
	S+Mb+Ab	S+Mb	S+Ab	Mb+Ab	S	Mb	Ab				
	1997	13	5	3	37	2	9				
1998	19	3	4	41	1	7	25	16.96	0.01	0.07	0.10
Mean	16.0	4.0	3.5	39.0	1.5	8.0	28.0				

**Table (2): Weekly mean numbers of stephanoderes vulgaris adult beetles merged from fig trees corresponding with means of temperature and relative humidity at Alexandria district in 1997 and 1998.**

1997						1998						
Date	Mean no. of adult beetles / cut of fig branch	Means of weather factors				R.H. %	Date	Mean no. of adult beetles / cut of fig branch	Means of weather factors			
		Temp., °C			R.H. %				Temp., °C			R.H. %
		Max.	Mean	Min.					Max.	Mean	Min.	
7-1	84.0	20.6	14.5	8.3	60	6-1	12.2	18.7	13.3	7.9	67	
14-1	68.4	21.3	15.3	9.3	57	13-1	15.2	16.6	12.5	8.4	63	
21-1	41.5	17.7	12.9	8.0	63	20-1	26.4	17.1	12.6	8.1	66	
28-1	32.8	18.0	13.2	8.4	60	27-1	31.3	17.2	12.5	7.9	57	
4-2	10.2	15.9	11.7	7.4	62	3-2	60.7	17.1	12.4	7.6	58	
11-2	23.3	15.2	11.5	7.7	58	10-2	54.5	20.1	14.7	9.3	57	
18-2	21.4	19.1	13.4	7.7	60	17-2	73.8	18.6	14.0	9.3	60	
25-2	28.7	15.9	11.8	7.6	58	24-2	112.1	17.0	13.1	9.1	58	
4-3	94.0	19.3	13.8	8.3	61	3-3	150.3	19.4	14.7	10.0	54	
11-3	105.0	19.3	14.2	9.0	68	10-3	171.6	20.7	15.8	10.9	63	
18-3	132.2	18.4	13.8	9.1	66	17-3	142.7	21.4	16.4	11.3	59	
25-3	114.2	18.9	14.4	9.9	63	24-3	95.3	18.3	14.1	9.9	62	
8-4	71.3	20.6	15.6	10.6	70	7-4	85.2	20.7	15.7	10.6	63	
15-4	53.5	20.6	15.6	10.6	66	14-4	63.0	23.1	19.1	15.1	67	
22-4	87.0	26.3	19.3	12.3	68	21-4	74.1	24.6	20.7	16.7	65	
29-4	91.9	25.0	19.0	12.9	66	28-4	172.9	29.6	22.9	16.1	61	
6-5	157.8	24.7	19.8	14.9	66	5-5	148.5	30.4	23.9	17.4	62	
13-5	160.5	27.3	20.9	14.5	65	12-5	102.3	24.3	20.8	17.3	63	
20-5	26.6	27.3	21.0	14.7	69	19-5	123.4	26.6	22.4	18.1	63	
27-5	51.7	27.9	22.6	17.3	68	26-5	82.2	26.7	22.4	18.1	69	
3-6	73.2	26.3	22.0	17.7	70	2-6	86.3	26.4	23.6	20.7	66	
10-6	70.1	28.1	23.2	18.3	67	9-6	97.1	26.4	22.7	18.9	67	
17-6	105.7	28.9	24.1	19.3	71	16-6	169.0	30.6	25.8	21.0	70	
24-6	123.8	30.6	25.8	20.9	70	23-6	158.2	27.6	24.1	20.6	69	

Table (2): Cont'd.

Date	1997				1998				Means of weather factors			R.H. %
	Mean no. of adult beetles / cut of fig branch	Means of weather factors			Date	Mean no. of adult beetles / cut of fig branch	Means of weather factors			Temp., °C	R.H. %	
		Max.	Mean	Min.			Max.	Mean	Min.			
1-7	150.3	29.1	25.2	21.3	73	7-7	100.2	29.4	26.0	22.4	75	
8-7	41.4	30.4	26.2	21.9	75	14-7	109.0	28.6	25.8	23.0	76	
15-7	38.0	29.7	25.8	21.9	75	21-7	111.1	30.4	26.4	22.4	75	
22-7	86.0	30.6	26.8	23.0	74	28-7	86.9	28.3	25.7	23.1	76	
5-8	93.5	29.6	25.9	22.2	71	4-8	230.3	32.9	28.8	24.6	72	
12-8	140.7	30.4	26.4	22.3	71	11-8	128.4	32.4	28.6	24.7	73	
19-8	201.2	35.0	28.6	22.1	70	18-8	130.6	30.6	27.4	24.1	73	
26-8	157.1	29.9	26.2	22.4	70	25-8	125.5	31.1	27.5	23.9	71	
2-9	118.0	29.1	25.4	21.7	70	1-9	138.8	29.9	26.8	23.6	71	
9-9	102.7	29.1	25.6	22.0	70	8-9	125.9	30.0	26.7	23.3	71	
16-9	96.5	28.7	24.9	21.1	69	15-9	120.1	31.7	28.0	24.3	70	
24-9	55.9	28.0	24.8	21.6	71	22-9	93.7	28.6	25.5	22.3	68	
7-10	89.3	27.2	23.4	19.5	70	6-10	167.0	29.3	25.4	21.4	69	
14-10	168.1	28.3	23.7	19.0	69	13-10	185.0	30.3	25.2	20.1	70	
21-10	151.0	25.3	21.5	17.7	71	20-10	115.0	27.7	23.6	19.4	65	
28-10	130.2	26.7	21.9	17.0	65	27-10	127.8	27.3	22.9	18.4	66	
4-11	121.7	24.1	20.3	16.4	63	3-11	103.7	25.7	21.1	16.4	68	
11-11	113.6	24.7	20.8	16.9	66	10-11	114.2	25.3	20.6	15.9	63	
18-11	87.5	24.0	19.4	16.4	64	17-11	90.3	23.3	18.5	13.6	65	
25-11	72.8	23.6	18.3	13.0	63	24-11	81.4	24.9	19.0	13.1	64	
2-12	90.5	22.6	17.6	12.6	70	1-12	65.4	22.0	17.6	13.1	65	
9-12	85.5	20.6	15.4	10.1	69	8-12	67.2	22.7	17.9	13.0	67	
16-12	37.6	20.7	15.1	9.4	69	15-12	41.0	16.1	14.0	11.9	63	
23-12	22.4	17.3	13.0	8.7	68	22-12	23.8	15.7	13.3	10.9	60	

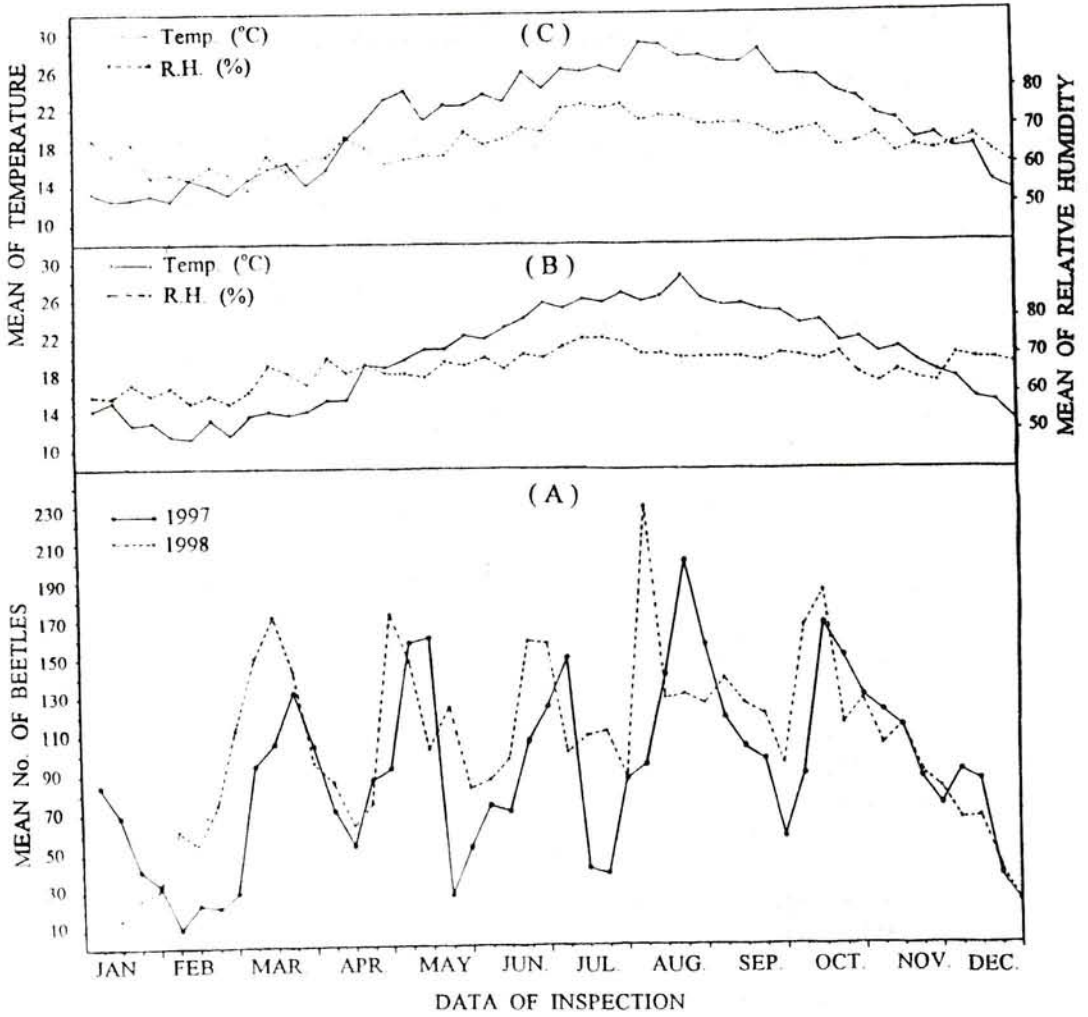


Fig. 1 : (A) : Fluctuation in population of *S. vulgaris* beetles in fig orchards, Alexandria, during 1997 and 1998.  
(B) : Corresponding changes in means of temperature and relative humidity in 1997.  
(C) : Corresponding changes in means of temperature and relative humidity in 1998.



at 28.6°C and 70% R.H. and the 2<sup>nd</sup> week of Oct. (168.1 beetles) at 23.7°C and 69% R.H.

In 1998, the low population (12.2-41.0 beetles) was recorded 6 weeks (at 12.5-14.0°C and 57.0-67.0% R.H.) during 6-27/1 and 15-22/12. The moderate population (54.5-97.1 beetles) was recorded 16 weeks (at 12.4-25.7°C and 57.0-76.0% R.H.) during 3-17/2, 26/5 - 9/6, 28/7, 22/9 and 17/11-8/12. The high population (100.2-148.5 beetles) was recorded 17 weeks (at 13.1-28.6°C and 58.0-76.0% R.H.) during 24/2, 5-26/5, 7-21/7, 11/8-15/9 and 20/10-10/11. The abundant population (150.3-230.3 beetles) was recorded 9 weeks (at 14.7-28.8°C and 54.0-72.0% R.H.) during 3-10/3, 28/4, 16-23/6, 4/8 and 6-13/10.

Five peaks in 1998 were also noticed during the 2<sup>nd</sup> week of Mar. (171.6 beetles) at 15.8°C and 63% R.H., the last week of April (172.9 beetles) at 22.9°C and 61% R.H., the 3<sup>rd</sup> week of Jun. (169.0 beetles) at 25.8°C and 70% R.H., the 1<sup>st</sup> week of Aug. (230.3 beetles) at 28.8°C and 72% R.H. and the 2<sup>nd</sup> week of Oct. (185.0 beetles) at 25.2°C and 70% R.H.

### **3.3 Effect of weather factors on the population level of *S. vulgaris***

The simple correlation ( $r$ ), simple regression ( $b$ ) and partial regression ( $P. reg.$ ) coefficients as well as the percentage of explained variance ( $E.V.$ ) for the relationship between the means of the weekly counts of beetles and day-maximum temperature ( $DMxT$ ), day-minimum temperature ( $DMnT$ ) and daily-mean relative humidity ( $DMRH$ ) with probability levels are shown in Table (3).

#### **3.3.1. Effect of day-maximum temperature ( $DMxT$ )**

The direct effect of  $DMxT$  on the population of adult beetles was positive and highly significant in both years of study ( $r$ , 0.67-0.74). Simple regression coefficients revealed that an increase of 1°C in  $DMxT$  increased the number of beetles by 4.9-5.8 / cut of fig branch during 1997-1998. The real effect ( $P. reg.$ ) of  $DMxT$  on the adult population was insignificant in both 1997 and 1998.



**Table (3): Simple correlation (r), simple regression (b), partial regression (P. reg.), analysis of variance (F) and percentage of explained variance (E.V.) for the relationship between day-maximum temperature (DMxT), day-minimum temperature (DMnT) and daily-mean relative humidity (DMRH) and number of *S. vulgaris* beetles emerged from fig trees in Alexandria, during 1997 and 1998.**

Years	Weather factor	r	b	P. reg.	F	E.V. %
1997	DMxT	0.67306**	4.88235	+ 10.9636	4.340*	49.1
	DMnT	0.62075*	3.93600	- 4.3995		
	DMRH	0.48614	3.12410	- 1.5901		
1998	DMxT	0.73949**	5.83458	+ 8.6235	13.860**	75.5
	DMnT	0.67004**	4.62800	+ 2.9419		
	DMRH	0.36632	2.91975	- 7.3692		

### 3.3.2. Effect of day-minimum temperature (DMnT) :

In 1997 and 1998, the direct effect of DMnT on the rate of adult beetles emergence was positive and significant (r, 0.62 or 0.67). Simple regression values indicated that an increase of 1°C in DMnT increased the population of beetles by 3.9 in 1997 and 4.6 in 1998 per cut of fig branch. The values of P. reg. of DMnT showed insignificant effect on the adult population during both years.

### 3.3.3. Effect of daily-mean relative humidity (DMRH) :

The direct effect of DMRH on the number of emerged beetles was positive and insignificant (r, 0.37-0.49) in both years of 1997 and 1998. Simple regression coefficients revealed that an increase of 1% R.H. raised the population of beetles by 2.9-3.1 during the years of investigation. In both years, the P. reg. values of DMRH showed insignificant effect on the rate of adult emergence.

### 3.3.4. The combined effect of DMxT, DMnT and DMRH

Computation of the variance analysis (F) for the combined effect of the three weather factors (DMxT, DMnT and DMRH) on

the rate of adult beetles emergence was significant and / or highly significant during the two years of 1997 and 1998.

From the percentage of explained variance (E.V.), it is clear that the combined effect of the three tested weather factors on the rate of adults emergence ranged between 49.1-75.5% in 1997-1998.

## CONCLUSIONS

The following general conclusions can be drawn from the results of the present study:

Adults emergence of *S. vulgaris* occurred all the year around and fluctuated according to the time of the year. Low population levels of beetles emergence were mostly noticed in winter and the abundant levels were recorded during spring and summer. Adult peaks were repeated five times annually under different range of temperatures. Population levels of beetles depended mainly on the combined effect of day-maximum temperature, day-minimum temperature and daily-mean relative humidity rather than the effect of each factor separately. Older trees and their apical branches were most sensitive to infestation with shot-hole borers of fig trees, these findings are in agreement with the observations of Kinawy (1981) and Shehata (1999) in Egypt.

The information contained in this paper could be of great help in developing efficient programs against this pest.

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بعض الدراسات الإيكولوجية على خنفساء قلف التين الكبيرة  
*Stephanoderes vulgaris* في حدائق التين بمنطقة الإسكندرية

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ملخص

يشتمل البحث على بعض الدراسات الإيكولوجية الهامة لخنفساء قلف التين الكبيرة (رتبة غمدية الأجنحة ، وفصيلة سكوليتيدي) على أشجار التين بمنطقة الإسكندرية خلال عامي 1997 و 1998. أظهرت النتائج أن مستوى الإصابة يرتبط معنويًا بعمر الأشجار وكذلك جزء الشجرة القابل للإصابة ، فقد وجد أن الأشجار الأكبر عمراً أكثر تعرضاً للإصابة ، وكذلك كانت الأفرع الطرفية أكثر إصابة مقارنة بالأفرع الرئيسية وجذع الشجرة . بينما لم يكن لموقع الأشجار في الحديقة تأثير معنوي على مستوى الإصابة بالחסرة . وجد كذلك أن خروج الخنافس يستمر على مدار العام وأن أعلى تعداد لخروج الحشرات الكاملة (201.2-230.3 حشرة / جزء من الفرع) تم تسجيله خلال الفترة من 5-19 أغسطس (28.6-28.8°م ، 70-72% رطوبة نسبية) ، بينما كان أقل تعداد لخروج الحشرات الكاملة (10.2-12.2 حشرة / جزء من الفرع) خلال الفترة من 6 يناير - 4 فبراير (11.7-13.3°م ، 62-67% رطوبة نسبية) . تبين أيضاً وجود 5 قمم لنشاط خروج الحشرات الكاملة وذلك خلال الأسابيع الآتية: الثاني أو الثالث من مارس ، والأخير من إبريل أو الثاني من مايو ، والثالث من يونيو أو الأول من يوليو ، والأول أو الثالث من أغسطس ، والثاني من أكتوبر . أظهرت نتائج التحليل الإحصائي أن معدل خروج الحشرات الكاملة يتأثر معنوياً بالتأثير المشترك لعوامل الحرارة العظمى والحرارة الصغرى والرطوبة النسبية معاً .

