Jordan Journal of Agricultural Sciences, Volume **2**, No.**3**, 2006

Flight Activity and Population Trends of the Small Red-Belted Clear Wing Borer, *Synanthedon myopaeformis* (Borkh.) (Lepidoptera: Sesiidae), in Apple Orchards in Jordan

Tawfiq M. Al-Antary* and Mazen A. Ateyyat

ABSTRACT

Experiments were conducted in Ash-Shoubak area from June 2003 to May 2005 on apple trees to study the trends of eggs and immatures of the small Red-Belted clearwing Borer (RBB), *Synanthedon myopaeformis*. Also, the flight activity of moths was studied from October 2004 to September 2005 using four pheromone dispensers brought from different companies. Results revealed that the insect has two generations per year. Eggs are laid singly beneath the bark. Six larval instars were recorded for this insect. The 4th through 6th larval instars could overwinter. Larvae of the second generation pupate in spring while larvae of the first generation pupate in summer. The pheromone dispenser brought from Agrisense company (UK) was the most active in capturing adults of the insect. However, the insect showed a flight activity from May to September and the highest peak of adult populations was recorded in June.

KEYWORDS: Flight activity, population trends, *Synanthedon myopaeformis,* pheromone.

1. INTRODUCTION

The small Red-Belted clearwing Borer (RBB), *Synanthedon myopaeformis,* has become an important insect pest in apple orchards in Jordan (Ateyyat *et al.*, 2005; Al-Antary, *et al.*, 2005). It is a relatively new problem that emerged in the late1980s which involves larvae of this insect developing in "burr knots" (adventitious root primordial) in above –ground portions of clonal rootstocks (Al-Antary *et al.*, 2005). It is a sesiid, or clearwing moth, the larvae of which are tree borers. RBB has been called the most common sesiid in Jordan and Middle East countries (Ateyyat, 2006). It causes damage similar to that caused by other insects that belong to the same family such as the dogwood borer, *Synanthedon scitula* that is highly distributed in America (Pfeiffer and Killan, 1999) and American plum borer (Kain and Straub, 2001). RBB was recorded to attack apple trees in Italy (Balazs *et al.*, 1996), Germany (Dickler, 1976), Ukraine (Tertyshny, 1995) and Egypt (Abd-Elkader and Zaklama, 1971).

Ateyyat (2005) tested a number of insecticides against this insect pest in Jordan and found that Chlormezyl® or Actellic® resulted in a significant larval mortality. Ateyyat and Al-Antary (2006) recorded that the use of a flexible wire to mechanically kill insect larvae, mounding soil over the graft-union area, wrapping tree trunks with cheese cloth from the soil surface to a height of 80 cm, and use of an insecticidal paint composed of water, copper sulfate and petroleum oil, and Durusban®, all reduced the insect population compared with untreated control trees. Ateyyat (2006) found a significant effect of

* Department of Plant Protection, Faculty of Agriculture, The University of Jordan.

** Department of Agricultural Sciences, Ash-Shoubak University College, Al-Balqa' Applied University.

Received on 14/11/2005 and Accepted for Publication on 29/5/2006.

rootstock on the number of burr knots or the percentage of burr knot infestation with RBB.

Pheromone lures in combination with sticky traps are useful and inexpensive tools to detect harmful insect species in a crop. This information can be used to predict infestations at an early stage and to apply insecticides at the right moment (Rauscher and Heinrich, 2001). Since it is the first work in Jordan and the Middle East, the main goal of this research study was to test the efficiency of four pheromone lures in capturing the adults of RBB in order to study its flight activity in apple orchards in Ash-Shoubak and to study the population trends of eggs, larvae and pupae of this insect pest.

2. MATERIALS AND METHODS

Population trends of eggs, larvae and pupae

The experiment was conducted on 10-year old apple trees, *Malus domestica cv.* Mondial Gala grafted on M26, in Al-Hashlamoun apple orchards (about 120,000 apple trees) from June 2003 to May 2005 in Ash-Shoubak area (about 1300 m above sea level and 220 km south of Amman, the capital of Jordan). The numbers of eggs, larvae and pupae were recorded weekly on 12 trees that were chosen at random from the orchard. Orchardists were requested not to interfere with any pesticide application. The meteorological data were recorded daily in Ash-Shoubak Agrometeorological Observatory. The number of larval instars was determined by using head-capsule measurements from 80 individuals as indicated by Wallace (1945).

Flight Activity of Adults

Four pheromone dispensers were installed from October 2004 to September 2005. The pheromone traps were brought from Agrisense (UK), Trifolio-M GmbH (Germany), SEDQ (Spain) and Phero.net (Sweden). Three traps were used for each pheromone lure. Traps were placed in a diagonal line from the northeastern to southeastern parts of the orchards at a height of about 1.2 m. Traps were about 50 m apart. All traps used in this study were Pherocon 1C wing-type traps. All traps were checked weekly and adults removed. Continuous replacement of septa (capsule) was made after about 45 days.

3. DATA ANALYSIS

Lure types were compared for sensitivity in capturing *S. myopaeformis*. Data were subjected to a type 1 generalized linear model analysis, using the SAS 2004 after testing for model goodness of fit. Mean separation was made, using Least Significant Differences (LSD).

4. RESULTS AND DISCUSSION

Results of the population trends of eggs, larvae and pupae of RBB revealed that the insect had two generations per year. Adults lay eggs singly in wounds on the tree and hatch in about 7 days Mondial Gala apple grafted on M26 (Ateyyat, 2006). Eggs of the first generation were laid from mid-May to mid-June, while the eggs of the second generation were laid from mid-July to the end of August (Fig. 1B). No eggs were recorded from 15th June to 10th July of the two seasons of the study. Data shown in Figure 1B represent the mean number of eggs per tree in each month. Larvae had six instars and developed in galleries beneath the tree bark of trunk and main laterals. Larvae were recorded throughout the two seasons of the study and they overwintered in various instars in the galleries and pupated in spring just below the surface of the bark (Fig.1C). Only instars four through six observed from December through March as overwintering larvae. However, a distinct peak of larvae was recorded in Sept. 2003 and generally numbers of larvae were lower in summer of 2004 than that in summer of 2003 (Fig.1C). The pupal stage lasted about 30 days i.e. from the date of the first recorded pupation to the date of the first adult capture (Ateyyat , 2006). After the moth emerged, the empty pupal skin was left protruding from the bark surface. Larvae of the second generation pupated in spring while larvae of the first generation pupated in summer (Fig.1C). Adults of the second generation started to emerge in mid-May (Figure 2B). Figures 1B and 2B showed that adults started laying eggs directly after their emergence as both eggs and adult's presence were recorded in the same day on 14th May 2005. The adults had two flight peaks; the first one was between 11th and 18th June and the second was in mid-July (Fig.2B). Sesiid sex pheromones were first isolated from the congeneric species lesser peachtree borer, *Synanthedon pictipes* (Grote and Robinson), and peachtree borer, *Synanthedon exitiosa* (Say), and identified by Tumlinson (1979) and Tumlinson *et al.* (1974) as geometrical isomers of 3, 13-octadecadien-1-ol acetate (ODDA). Even though the main component of the sex pheromone lures of *S. myopaeformis* is mainly octadeca-3,13-dienyl acetate (Worthing and Walker, 1992), the pheromone lures from the different suppliers showed different attractiveness to the target (Table 1, Fig.2B). The pheromone dispensers brought from Agrisense and Phero.net companies showed significantly the highest overall efficiency in capturing adults of *S. myopaeformis* in Jordan (Table 1). No significant differences obtained among the four-tested pheromone lures in August and September (Table 1). This could be due to the low population of adults at these months. Agrisense, Phero.net and SEDQ pheromone dispensers showed significantly higher efficiency in capturing adults of the insect than Trifolio-M GmbH dispenser (Table 1). A batch certification was proposed by the Phero.Net organization (Bengtsson *et al.*, 1999) to resolve this problem. However, the highest peak of adult populations was recorded in June and this coincides with work of Maini and Pasqualini (1980) who reported a flight peak of RBB in June in the Emilia-Romagna region of Italy by means of sex traps in 1979-80. The flight activity of the moths lasted about four months from mid-May until mid-September in Ash-Shoubak region (Fig.2B). This disagree with Sengonca and Sontgen (1987) findings who reported that the flight activity of the moths in Nordrrhein apple orchards (Germany) lasted about three and a half months from the end of May until the beginning of September. Also, Awadallah *et al.* (1978) reported a flight activity of the insect throughout the year in Al-Fayyom in Egypt in 1975-76. However, it is clear that the findings of Awadallah *et al.* (1978) were highly different from that reported in the present study and from that reported by Sengonca and Sontgen (1987). This could be due to differences in weather conditions or due to the different methodologies used by (Awadallah *et al.* 1978), which was based on counting the numbers of the empty pupal skins that could give imprecise results.

Trials were made to find a correlation between temperature and relative humidity (Figs 1A, 2A) and numbers of eggs, larvae, pupae (Fig.1) or adults (Fig.2) of the insects. Unfortunately, weak correlations were obtained except that of eggs with relative humidity (Table 2).

ACKNOWLEDGMENTS

This research is part of a project on the small red-belted clearwing borer that was supported by the Deanship of Academic Research in the University of Jordan. We thank agr. Eng. Ali Rafae'a for his field assistance.

Table (1): Mean number of adults per trap of four pheromone lures of *Synanthedon myopaeformis* on apple orchards in Ash-Shoubak region in 2005.

Pheromone lure	Mean number of adults/ trap/week ± SE					
	May	June	July	August	September	Overall
Phero.net	$4.500^{ab} \pm 0.17$	$18.00^{a} \pm 3.50$	$7.75^{a} \pm 1.50$	$2.38^{a} \pm 1.88$	$0.50^{a} \pm 0.25$	$6.63^{a} \pm 1.39$
SEDQ	$2.50^{c} \pm 0.17$	$18.50^{a} \pm 0.75$	$3.88^{b} \pm 1.88$	$1.00^{a} \pm 0.75$	$0.38^{a} \pm 0.12$	$5.25^{ab} \pm 0.32$
Trifolio-M GmbH	$3.00^{bc} \pm 0.33$	$2.50^{b} \pm 1.75$	$0.88^{c} \pm 0.38$	$0.50^{a} \pm 0.25$	$0.50^{a} \pm 0.50$	$1.48^{b} \pm 0.44$
Agrisense	$5.335^{a} \pm 0.67$	$23.5^{a} \pm 2.50$	$12.50^{a} \pm 5.00$	$3.63^{a} \pm 0.13$	$0.75^{a} \pm 0.5$	$9.14^{a} \pm 1.56$

Means in columns with the same letter are not significantly different using LSD.

Table (2): Correlations between temperature or relative humidity and the different stages of *Synanthedon myopaeformis.*

Adults vs temp. (from May to Sept. 2005)	$R^2 = 0.015$
Adults vs RH (from May to Sept. 2005)	$R^2 = 0.531$
Eggs vs temp. (from May to August 2004)	$R^2 = 2.5 \times 10^{-5}$
Eggs vs RH (from May to August 2004)	$R^2 = 0.95$
Larvae vs temp. (from June 2003 to May 2005)	$R^2 = 0.008$
Larvae vs RH (from June 2003 to May 2005)	$R^2 = 0.035$
Pupae vs temp (from April to August 2004)	$R^2 = 0.039$
Pupae vs RH (from April to August 2004)	$R^2 = 0.101$

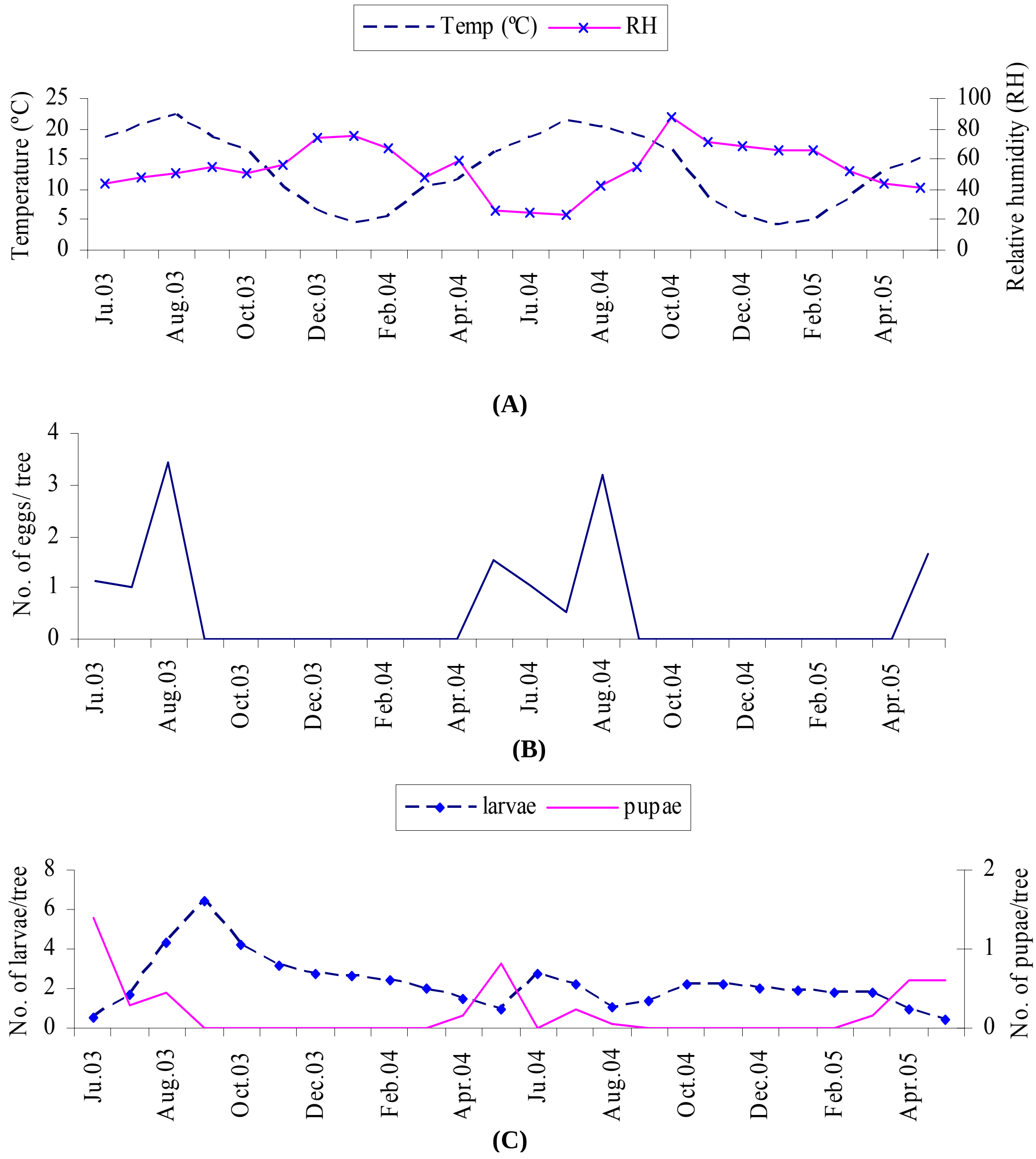
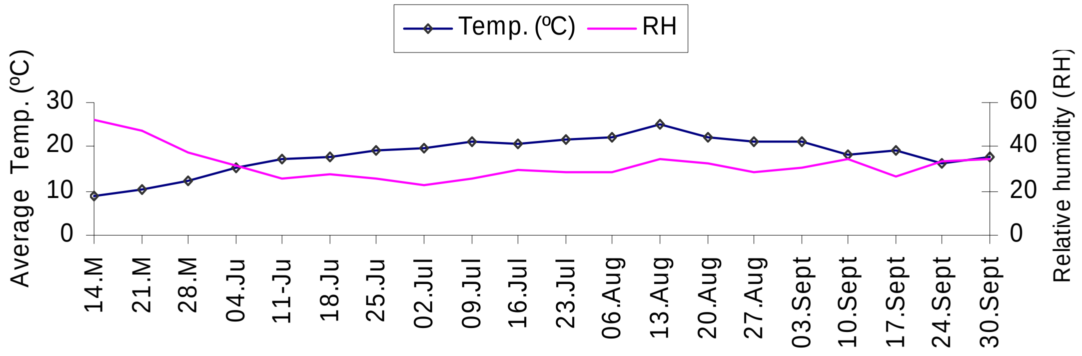
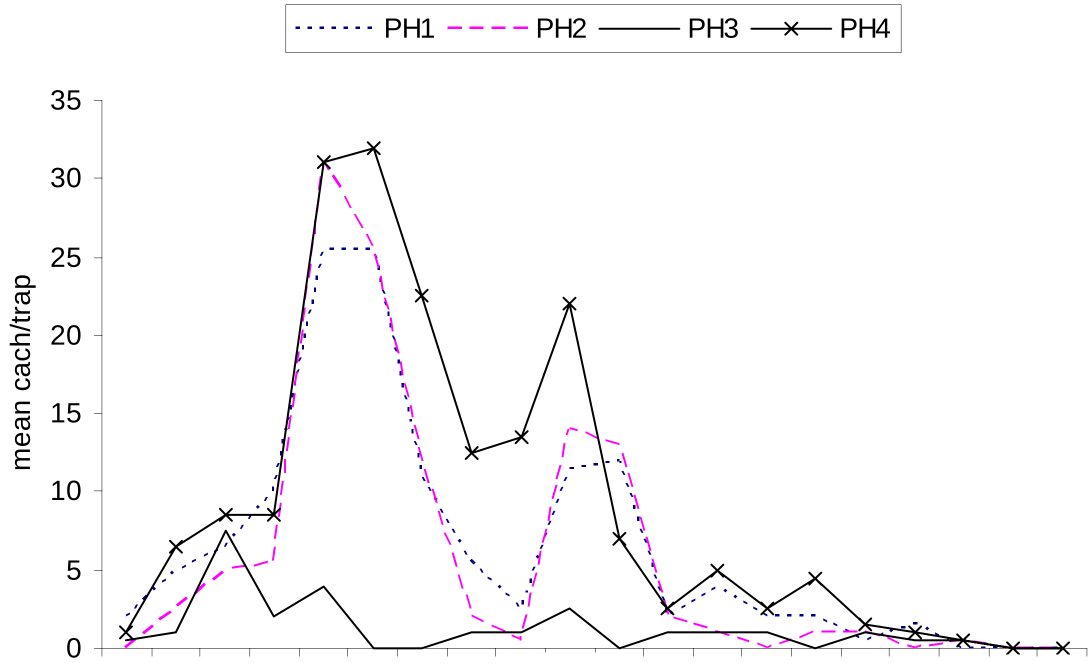


Figure 1: (A) Monthly temperature (°C) and relative humidity (RH), (B) Mean number of eggs, (C) Mean numbers of larvae and pupae of *Synanthedon myopaeformis* per tree on Mondial Gala apple grafted on M26 in Ash-Shoubak area from June 2003 to May 2005.



(A)



(B)

Figure 2: (A) Weekly temperature (ºC) and relative humidity (RH) and (B) Mean number of adults of *Synanthedon myopaeformis* per sticky trap in apple orchards in Ash-Shoubak area from May 2005 to September 2005. PH1: Phero.Net pheromone lure, PH2: SEDQ pheromone lure, PH3: Trifolio-M GmbH pheromone lure, PH4: Agrisense pheromone lure.

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النشاط الطيراني والتغيرات العددية للحفار رائق الأجنحة على التفاح في الأردن

توفيق العنتري ومازن عطيات***

ملخــص

أجريت تجارب في منطقة الشوبك في الفترة بين حزيران 2003 وأيار 2004 بهدف دراسة التغيرات العددية لبيوض ويرقات وعذارى حشرة الحفار رائق الأجنحة (*Synanthedon myopaeformis*). كما تمت دراسة النشاط الطيراني للحشرة الكاملة بين تشرين الأول 2004 وأيلول 2005، وذلك من خلال تجريب أربعة فرمونات جنسية. أظهرت النتائج أن للحشرة جيلين على مدار العام وأن البيوض توضع فرادى تحت قلف الأشجار. يوجد لليرقة ستة أعمار، حيث ان الأعمار من الرابع إلى السادس لها القدرة على الدخول في فترة التشتية . تتغذى يرقات الجيل الثاني خلال الربيع بينما تتغذى يرقات الجيل الأول خلال الصيف. أظهر الفرمون الذي تم جلبه من شركة (Agrisense) البريطانية كفاءة أكبر في التقاط الحشرة من الفرمونات الأخرى. وبشكل عام أظهرت الحشرة نشاطا طيرانياً في الفترة بين أيار وأيلول حيث كانت ذروة النشاط في شهر حزيران.

الكلمات الدالة: النشاط الطيراني، التغيرات العددية، الحفار رائق الأجنحة، فرمون.

* قسم وقاية النبات، كلية الزراعة، الجامعة الأردنية.

** قسم العلوم الزراعية، كلية الشوبك الجامعية، جامعة البلقاء التطبيقية.

تاريخ استلام البحث 2005/11/14، وتاريخ قبوله 2006/5/29.