

MONITORING THE FLATHEADED BORER *PTOSIMA UNDECIMMACULATA* HERBST (COLEOPTERA: BUPRESTIDAE) IN ORANGE ORCHARDS IN EGYPT

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Abstract

Population fluctuation of the economically important boring insect pest *Ptosima undecimmaculata* (Coleoptera: Buprestidae), attacking orange trees was monitored at Sharkia governorate during the two successive years 2015 and 2016. *P. undecimmaculata* prevailed from late March / early April to late October / early November. Three peaks were recorded during 2015, during 2nd half of June (0.28 beetle / tree), the 1st half of August (0.29 beetle / tree) and the 2nd half of September (0.18 beetles / tree). Only two peaks were recorded in 2016, during the 1st half of July (0.31 beetles / tree) and the 1st half of September (0.36 beetles / tree). Summer months recorded the maximum flight (1.23 and 1.63 beetles), followed by spring (0.69 and 0.58 beetle), then autumn (0.09 and 0.12 beetle) /tree, and nearly stopped during winter (0.0 and 0.01 beetle) / tree in 2015 and 2016, respectively. The total numbers per year were 2.01 and 2.34 beetles/tree in 2015 and 2016, respectively. The respective means per tree / month were 0.17 and 0.20 beetles / tree / half month. It had two broods of beetles' activity and the beetles activity averaged 7.8 months. Effect of weather factors on the borer activity was mostly positively significant with day maximum, day minimum, and day mean temperatures but negatively and insignificantly with day mean relative humidity. Infestation was almost doubled during only one year, thus needed urgent integrated control.

INTRODUCTION

Citrus cultivation and production rank first in Egypt; since it is the most economic local popular and favorite fruit and highly exporting income.

The most widely spread citrus / varieties could be arranged descendingly in Egypt as follows: Valencia orange (*C. sinensis*), Navel orange (*Citrus sinensis*), Balady orange (*C. sinensis*), grapefruit (*C. paradisi*), Mandarin (*C. reticulata*), lime (*C. aurantifolia*), Lemon (*C. limon*), Sour orange (*C. aurantium*) and Volkamer lemon (*C. volkameriana*). Thus, harvesting period expanded from November to May to accommodate local and exporting markets.

Ptosima undecimmaculata stem borer (Coleoptera: Buprestidae) is widely distributed all-over the Mediterranean basin area on different fruit tree hosts such as mango, peach, plum, apricot, almond, etc. (Batt, 1999 and Hashim, 2009).

Frequent field observations all-over the governorates of Egypt indicated that in citrus orchards *P. undecimmaculata* is a serious boring pest causing considerable damage.

in Egypt Kinawy *et al.* (1992) and Tadros *et al.* (2006-a) monitored *P. undecimmaculata* population fluctuation in apricot orchards and Hashim and Ahmed (2011) in mango orchards. Larvae live and feed in a shallow tunnels under the bark of tree stem and main branches and cause girdling the wood, weakness, reducing the production, and finally their death.

The present ecological study is an attempt to contribute to such a gap in the knowledge on the the rate and degree of infestation, seasonal population fluctuation of the target pest population, the progress of infestation, the seasonal cycle, and the effect of the main weather factors. The broad objective of this investigation is to add new information that may help in planning successful and effective "Integrated Control Programs" for the management of tree borers in citrus orchards (Tadros *et al.*, 2006-b).

MATERIALS AND METHODS

1. Population fluctuation of *P. undecimmaculata* on citrus trees:

1.1. Seasonal abundance:

One hundred orange trees infested with *P. undecimmaculata* randomly distributed in a citrus orchard (about 5 feddans and more than 30 years old) located at Wadi El-Mollac, east Delta, Sharkia governorate were subjected to this investigation. Monitoring studies were carried out during two successive years extending from the beginning of January 2015 till the end of December 2016. No chemical treatments were applied in the selected area throughout population fluctuation studies. A paint brush marker was used to cancel the old exit holes.

From January 1st, 2015 until December 31, 2016, the new exit holes indicating emergence of *P. undecimmaculata* beetles were counted at half-monthly intervals on the 15th and last day of every month. To avoid repeated counting new exit holes were immediately canceled with a spray paint marker after counting.

1.2. Progress of infestation:

Data of the seasonal abundance were accumulated from January 1st, 2015 until December 31, 2016 at half-monthly interval. The accumulated total number of beetles represented the number for one and two years together were calculated. To smooth the frequency distribution curve, data were smoothed according to the moving average formula:

$\{(the\ actual\ number) + the\ previous\ number + the\ following\ number\} / 3,$
(Snedecor and Cochran 1990).

The present figures indicated the periods of the seasonal cycles of beetles activity and inactivity. Progress of infestation also indicated the rate of increasing in the borer infestation year after another.

2. Effect of weather factors on the activity of of *P. undecimmaculata* on citrus trees:

Four main weather factors, the day maximum temperature (DMxT), day minimum temperature (DMnT), day mean temperature (DMT) and day mean relative humidity (DMRH) were considered. Necessary weather data were obtained from the Central Laboratory of Climate and Meteorology, ARC, MOA, Giza.

Population data of *P. undecimmaculata* and the meteorological data, both at half-monthly intervals, were presented. The relationship between the four weather factors and the target borer during the activity season was investigated for the two successive years extending from January 2015 until December 2016 in the citrus orchard.

To determine the direct effect of each weather factor on *P. undecimmaculata* activity, population counts were plotted against the corresponding weather data. The simple correlation coefficients "r" for the relationship between each weather factor and the borer population was then worked out.

RESULTS AND DISCUSSION

1. Population Fluctuation of *P. undecimmaculata* on citrus trees:

1.1. Seasonal abundance:

Tables (1 and 2) and Figure (1) showed that in citrus orchards beetles emergence of *P. undecimmaculata* prevailed during the period from the 2nd half of March or 1st half of April to the 2nd half of October or 1st half of November with two or three flight peaks during the two seasons of study.

In 2015, beetles started to emerge during the 1st half of April (0.02 beetle / tree) but during the 2nd half of March (0.01 beetle / tree) in 2016.

Three peaks were recorded during 2015, the first peak was observed during 2nd half of June 2015 (0.28 beetle / tree), a second peak was noticed during the 1st half of August (0.29 beetle / tree) and a third peak during the 2nd half of September (0.18 beetles / tree). During 2016, only two peaks were recorded during the 1st half of July 2016 (0.31 beetles / tree) and the 1st half of September (0.36 beetles / tree).

The last beetles flight was recorded during the 2nd half of October, 2015 (0.03 beetle / tree), but continued to the 1st half of November 2016 (0.02 beetle / tree) and ceased afterwards.

The maximum beetles' flight (1.23 and 1.63beetles / tree in 2015 and 2016, respectively) was in summer. Spring recorded the respective numbers 0.69 and 0.58 beetle / tree. Autumn showed the respective least beetle activity (0.09 and 0.12

beetle / tree). Beetles activity was almost stopped during winter (0.0 and 0.01 beetle / tree). Moreover, the total numbers of beetles emerged during the whole year were 2.01 and 2.34 beetles / tree in 2015 and 2016, respectively. The respective means per tree / month were 0.17 and 0.20 beetles / tree / half month.

Smoothed data in Table (1) and Figure (1) emphasized that *P. undecimmaculata* had only two broods of beetles' activity. The first one prevailed from the 1st half of April to the 2nd half of July, in the two seasons 2015 and 2016. The second brood was estimated from the 2nd half of July to early November in both years of study. The two peaks of the broods were estimated during the 2nd half of June and 1st half of August, 2015. In 2016, the two peaks of the broods were estimated during the 1st half of July and the 1st half of September, 2016.

1.2. Progress of infestation:

The cumulative numbers (seasonal cycle) of emerged beetles (Table, 1 and Figure, 1) was 7-8 months of beetles activity followed by 4-5 months of beetles inactivity. Infestation was almost doubled during only one year (from 2.01 beetles in 2015 to 4.35 beetles in 2016 / tree / year), thus, need urgent control of the pest year after another.

1.3. Effect of temperature and relative humidity on beetles activity:

Statistical analysis in Table (2) revealed that the fluctuation in beetles population was highly significant and positively correlated with the DMxT ("r" from 0.7837 to 0.8534) and DMT ("r" from 0.7592 to 0.7998), but the DMnT ("r": from 0.6573 to 0.6961) in both 2015 and 2016. On the other hand, the effect of DMRH much varied on the fluctuation in the beetles' population showing insignificant and positively correlation ("r": 0.2368) in 2015, but insignificant and negatively correlation ("r": - 0.0513) in 2016.

Table 1. Mean number of *P. undecimmaculata* beetles in citrus orchards at Wadi El-Mollac, Sharkia governorate during 2015 and 2016 seasons.

Date of inspection		Mean no. of beetles \ tree					
		2015 season			2016 season		
		Actual	Smoothed	Cumulative	Actual	Smoothed	Cumulative
Jan.	1-15	0.00	0.00	0.00	0.00	0.00	2.01
	16-31	0.00	0.00	0.00	0.00	0.00	2.01
Feb.	1-15	0.00	0.00	0.00	0.00	0.00	2.01
	16-29	0.00	0.00	0.00	0.00	0.00	2.01
Mar	1-15	0.00	0.00	0.00	0.00	0.00	2.01
	16-31	0.00	0.01	0.00	0.00	0.01	2.02
Winter		0.00			0.00		
Apr.	1-15	0.00	0.02	0.02	0.01	0.02	2.03
	16-30	0.04	0.05	0.06	0.03	0.04	2.06
May	1-15	0.08	0.07	0.14	0.10	0.09	2.16
	16-31	0.11	0.12	0.25	0.12	0.12	2.28
Jun.	1-15	0.16	0.18	0.41	0.13	0.14	2.41
	16-31	0.28	0.24	0.69	0.19	0.21	2.60
Spring		0.69			0.58		
Jul.	1-15	0.22	0.23	0.91	0.31	0.25	2.91
	16-31	0.19	0.22	1.10	0.20	0.24	3.11
Aug.	1-15	0.29	0.25	1.39	0.23	0.24	3.34
	16-31	0.21	0.21	1.60	0.28	0.29	3.62
Sep.	1-15	0.14	0.17	1.74	0.36	0.31	3.98
	16-30	0.18	0.14	1.92	0.25	0.23	4.23
Summer		1.23			1.63		
Oct.	1-15	0.00	0.08	1.98	0.00	0.11	4.30
	16-31	0.00	0.03	2.01	0.00	0.04	4.33
Nov.	1-15	0.00	0.01	2.01	0.02	0.02	4.35
	16-30	0.00	0.00	2.01	0.00	0.01	4.35
Dec.	1-15	0.00	0.00	2.01	0.00	0.00	4.35
	16-31	0.00	0.00	2.01	0.00	0.00	4.35
Autumn		0.00			0.10		
Grand Total		2.01		2.01	2.34		4.35
Mean/ tree/ Month		0.17			0.20		

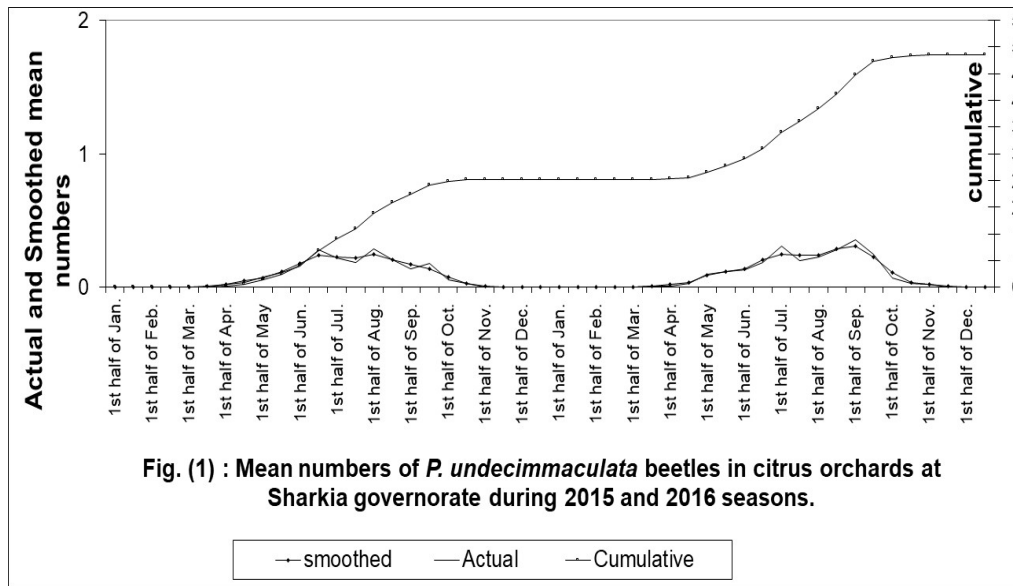


Table 2. Commencement, peak, last dates, and broods of *P. undecimmaculata* beetles in citrus orchards at Sharkia governorate, during 2015 and 2016 seasons, as well as simple correlation "r" and Simple regression "b" coefficients between the mean numbers of *P. undecimmaculata* beetles and the corresponding day maximum (DMxT), day mean (DMT), day minimum temperatures (DMnT) and day mean relative humidity (DMRH) during 2015 and 2016.

Statement	Year	
	2015	2016
Flight Commencement	2 nd week of March	1 st week of Apr.
Peaks: 1st peak	2 nd half of June	1 st half of July
2nd peak	1 st half of August	1 st half of September
3rd peak	2 nd half of September	
Last flight	2 nd half of October	1 st half of November
Broods: 1st brood	From 1 st half of April to 2 nd half of July	
2nd brood	From 2 nd half of July to 1 st half November	
Peaks of the broods		
1st brood peak	2 nd half of June	1 st half of July
2nd brood peak	1 st half of August	1 st half of September
Summer months	1.23 beetles / tree	1.63 beetles / tree
Spring months	0.69 beetle / tree	0.58 beetle / tree
Autumn months	0.09 beetle / tree	0.09 beetle / tree
Winter months	0.00 beetle / tree	0.01 beetle / tree
Total numbers / year	2.01 beetles/tree	2.34 beetles/tree
Mean nos. / month	0.17 beetles / tree	0.20 beetles / tree
Simple correlation "r" coefficients		
DMxT	0.7837**	0.8534**
DMT	0.7592**	0.7998**
DMnT	0.6573**	0.6961**
DMRH	0.2368	- 0.0513
Simple regression "b"		
DMxT	46.02**	45.64**
DMT	44.65**	42.38**
DMnT	43.53**	40.97**
DMRH	8.34	-4.05

** : Significant at 0.01 levels (Highly significant)

* : Significant at 0.05 levels (Significant)

4. Discussion and conclusion:

Monitoring studies (especially the seasonal fluctuation of insect borer population, progress of infestation, seasonal cycle, and effect of the main weather factors on the target pests) are essential in planning successful and effective "Integrated Control Programs" for the management of boring insect pests (Tadros *et al.*, 2006-b).

In citrus orchards *P. undecimmaculata* beetles activity started from late March / early April and was stopped by the end of October / early November. Summer and spring are the seasons of activity. The activity season extended for 7 to 8 months. There were 2 to 3 flight peaks for the borer activity. Infestation was almost doubled during only one year, thus needed urgent integrated control. Larvae however, are existed all the year round inside the wood tunnels, but larval duration are prolonged in winter.

Survey studies of Hashim (2009) indicated that *P. undecimmaculata* is dominating and economically important borer in mango orchards. These results somewhat in agreement with Batt (1999) who surveyed *P. undecimmaculata* in apricot orchards from very early of March until the very late of September, with three population peaks. Kinawy *et al.* (1992) stated that *P. undecimmaculata* beetles activity in apricot orchards highly affected with temperature but not with relative humidity. Also, similar results were obtained by Abd El-latif (1995) in apricot orchards in Fayoum governorate. Emergency collapsed 6.5 months, from April / May until October, and has two flight peaks. Summer and spring months recorded the maximum beetle activity. However, literature from abroad concerning *P. undecimmaculata* is lacking. Hashim and Ahmed (2011) also found that *P. undecimmaculata* beetles activity in mango orchards started to emerge from 1st half of April or 2nd half of March during 2010 and 2011 seasons respectively and has one flight peak during the 1st half of May or the 2nd half of April during 2010 and 2011 seasons, respectively.

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تتبع تعداد حفار ساق البرقوق ذو الرأس المفلطح
Ptosima undecimmaculata
 (Coleoptera: Buprestidae) في حدائق البرتقال في مصر

صلاح محروس هاشم ، راضي محمدي عبد المعطي و انطون ولسن تادرس

معهد بحوث وقاية النباتات- مركز البحوث الزراعية- وزارة الزراعة- الدقي - الجيزة- مصر.

تم تتبع تعداد حفار ساق البرقوق ذو الرأس المفلطح *Ptosima undecimmaculata* في حدائق البرتقال محافظة الشرقية في مصر علي مدار عامين متتاليين (٢٠١٥، و ٢٠١٦). إتضح من نتائج الدراسة أن النشاط الموسمي للحفار يبدأ من أواخر مارس أو أوائل أبريل، وأستمر حتي أواخر أكتوبر أو أوائل نوفمبر. تم تسجيل ثلاثة قمم لنشاط الحفار خلال النصف الثاني من يونيو (٠,٢٨، خنفساء / شجرة)، خلال النصف الأول من أغسطس (٠,٢٩، خنفساء / شجرة)، وخلال النصف الثاني من سبتمبر (٠,١٨، خنفساء / شجرة) عام ٢٠١٥، في حين تم تسجيل قمتان لنشاط الحفار خلال النصف الثاني من يونيو (٠,٢٨، خنفساء / شجرة)، خلال النصف الأول من يوليو (٠,٣١، خنفساء / شجرة)، وخلال النصف الأول من سبتمبر (٠,٣٦، خنفساء / شجرة) عام ٢٠١٦. سجلت شهور الصيف أعلى نشاط للحشرات (١,٢٣ - ١,٦٣ حشرة / شجرة)، يليها الربيع (٠,٦٩ - ٠,٥٨ حشرة / شجرة)، ثم الخريف (٠,١٩ - ٠,١٢ حشرة / شجرة)، في حين توقف النشاط تقريبا خلال الشتاء (٠,٠٠ - ٠,٠١ حشرة / شجرة) خلال عامي الدراسة علي التوالي. بلغ إجمالي عداد الحشرات التي خرجت من الشجرة خلال العام ٢,٠١ - ٢,٣٤ حشرة / شجرة خلال عامي الدراسة علي التوالي. وبلغ التعداد في الشهر ٠,١٧ & ٠,٢٠ حشرة / شجرة خلال عامي الدراسة علي التوالي. وللحفار حضنتان من النشاط خلال العام. وهناك دورة من نشاط الحشرات لمدة ٧ - ٨ شهر. وقد تضاعفت الإصابة بالحفار خلال عام واحد (من ٢,٠١ إلى ٤,٣٥ حشرة). تلاحظ أن تأثير العوامل الجوية علي نشاط الحفار موجب ومعنوي في معظم الأحوال مع درجات الحرارة الصغرى والمتوسطة والعظمى، ولكنها سالبة أو موجبة ولكن غير معنوية مع متوسط الرطوبة النسبية.

