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Monitoring the Clearwing Moth, *Synanthedon myopaeformis* Borkhausen (Lepidoptera: Sesiidae), in Pear Orchards at Behaira Governorate, Egypt

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ABSTRACT

Monitoring studies of *S. myopaeformis* were conducted at Behaira Governorate during the two successive seasons 2015 and 2016 in pear orchards for the first time in Egypt. Moths of *S. myopaeformis* were found to be existed all year round on the course of two successive years of study. Three flight peaks were recorded during both years of study, the 1st peak was recorded in the 1st half of March, (mean number 1.8 moth/tree), the 2nd peak occurred in the 1st half of May (mean number 2.2 moth/tree) and the 3rdpeak was recorded in the1st half of August (mean number 2.4 moth / tree) during 2015 seasons. In 2016 seasons, three flight peaks were also recorded, the 1st peak was recorded during the 2nd half of February (mean number 1.9 moth / tree), the 2nd peak occurred in the 2nd half of May (mean number 2.5 moth / tree)and the 3rd peak was also during the 1st half of August (mean number 2.7 moth / tree). The effect of prevailing weather factors upon moths' density population was studied.

Keywords: Clearwing moth, Sesiidae, pear, borers, monitoring, ecology.

INTRODUCTION

The apple clearwing moth, *Synanthedon myopaeformis* (Borkhausen, 1789) (Lepidoptera: Sesiidae), is a serious borer of commercial apple orchards in Europe (Dickler, 1976), Mediterranean countries (Ateyyat, 2006), Canada (Philip, 2006) and the USA (LaGasa *et al.*, 2009), this pest is also known as the small red belted clearwing borer and proved to be very injurious to commercial apple and pear orchards in different European countries (Maini and Pasqualini, 1980). This borer is a xylophagous species that attacks pome and stone fruit trees (Mustafa and Sharaf 1994; Canadian Food Inspection Agency 2006). The larval form of this insect lives under the bark of fruit trees, especially apple (*Malus*), but sometimes pear (*Pyrus*), almond (*Prunus amygdalus* Batsch) and a few other closely related plant species (Bartsch 2004). The larvae located under the bark of tree trunk and thick branches bore deep sub-cortical galleries 20 to 25 mm long and cut into the phloem (Dickler 1976; Iren and Bulut 1981). The control of this pest is difficult because the adults have a long emergence period and the larvae develop inside the trunk and thick branches. Failure to prevent injury can lead to reduced tree vigor and yield (Iren *et al*. 1984; Kovancı 1986). In Egypt, Tadros (1977), conducted biological, ecological and control studies on *S. myopaeformis,* moreover, none of the previous studies monitored *S. myopaeformis* in pear orchards, so, the present work aim to monitor this serious pest in pear orchards in Egypt for the first time to help planning for control programs of this serious borer in pear orchards in Egypt.

MATERIALS AND METHODS

1. Monitoring the clearwing moth *Synanthedon myopaeformis*:

Seasonal abundance:

Monitoring studies were carried out during two successive years extending form early January, 2015 until late December, 2016.

The selected pear orchard for the trial was located at Behaira Governorate, it was about three feddan, with approximately 200 *Pyrus communis* trees (Le Conte), of about eight years old and severely infested with *S. myopaeformis*. No chemical treatments were applied in the selected orchards throughout monitoring studies.

During December 2014, 50 randomly 30 distributed trees were marked with spray paint. The old empty pupal skins of *S. myopaeformis* were removed. From January 1st, 2015 until December 31st, 2016, the orchard was inspected every two weeks. New pupal skins indicating emergence were counted and removed.

The direct effect of daily-mean maximum and minimum temperatures and relative humidity on moths' flight of *S. myopaeformis* was studied through the simple correlation "r".

Effect of weather factors on the activity of *S. myopaeformis* in pear orchards:

The main weather factors; the daily mean temperature (DMT), daily mean relative humidity (DMRH) and daily mean wind speed (DMWS) were considered. Necessary weather data were obtained from the Central Laboratory of Climate and Meteorology, ARC, MOA, Giza.

Population data of the boring insect pest and the meteorological data, both at half-monthly intervals, were presented in Tables.

To smooth down the population fluctuation to an almost normal form, three reading running means were worked out.

The relationship between the weather factors and the boring insect pest during the activity season was investigated for two successive years extending from January 2016 until December 2017 in pear tree orchards.

To determine the direct effect of each weather factor on the boring insect species activity, population counts were plotted against the corresponding weather data. The simple correlation coefficients "r" for the relationship between each weather factor and the target pest population was then worked out (Snedecor and Cochran, 1990).

RESULTS AND DISCUSSION

1. Monitoring the clear wing moth *S. myopaeformis* in pear orchards:

Population fluctuation and seasonal abundance:

Tables (1, 2, and 3) and Figure (1) showed that the pattern of the seasonal distribution of moths

emergence as dates of commencement, last and peak of adult flight at Behaira Governorate during 2015 and 2016 seasons.

Data indicated that moths started to emerge during the 1st half of January in 2015, while in 2016 moths' emergence half of January Moths` activity continued until the 2nd half of November started in during the 2nd 2015 or 1st half of December 2016. Three peaks of *S. myopaeformis* moths` flight were detected during the 1st half of March, May and August in 2015 or 2nd half of February, May and 1st. half of August in 2016. Spring and summer months recorded the maximum flight activity, (6.1, 6.1 and 7.2, 7.7 moths mean number per tree during 2015 and 2016, respectively). However during autumn and winter months, moths' flight activity recorded 1.1, 4.2 and 1.7, 4.9 during 2015 and 2016, respectively, almost moths ceased to emerge during the 1st and 2nd halves of December in 2015, while in 2016 they were ceased to emerge only during the 2nd half of December. Smoothed data of *S. myopaeformis* moths' activity showed that the borer pest is abundant all year round during both years of study.

Table 1. Mean number of adult moths of *S. myopaeformis* moths in pear orchards at Behaira Governorate during 2015 season together with the corresponding weather factors.

Date of Inspection		Mean No. of moths /tree actual	smoothed	Mean temp. C°	Mean R.H.%	Mean wind speed
January	1-15/1	0.1	0.1	14.3	65	9.8
	16-31/1	0.0	0.1	13.7	56	10.9
February	1-15/2	0.3	0.3	15.4	64	12.1
	16-28/2	0.7	0.9	16.7	48	11.2
March	1-15/3	1.8	1.4	18.2	52	11.7
	16-31/3	1.3	1.3	20.2	57	7.7
winter		4.2				
April	1-15/4	0.8	0.9	22.0	61	16.0
	16-30/4	0.7	1.1	20.5	66	15.2
May	1-15/5	2.2	1.6	27.3	71	12.4
	16-31/5	1.1	1.3	29.0	69	13.2
June	1-15/6	0.7	0.8	30.1	79	14.2
	16-30/6	0.6	0.6	31.0	77	13.3
Spring		6.1				
July	1-15/7	0.7	0.7	33.2	79	15.9
	16-31/7	0.9	1.3	37.0	76	14.4
August	1-15/8	2.4	1.7	36.1	80	16.7
	16-30/8	0.9	1.2	29.0	78	14.5
September	1-15/9	0.5	0.7	35.1	77	15.7
	16-31/9	0.7	0.6	32.1	76	14.6
Summer		6.1				
October	1-15/10	0.3	0.4	27.0	75	12.2
	16-30/10	0.4	0.3	23.1	65	13.5
November	1-15/11	0.2	0.3	24.0	76	9.9
	16-30/11	0.2	0.2	21.2	75	14.9
December	1-15/12	0.0	0.05	19.2	73	11.2
	1-15/10	0.0	0.0	15.1	66	9.3
Autumn		1.1				

Table 2. Mean number of adult moths of *S. myopaeformis* moths in pear orchards at Behaira Governorate during 2016 season together with the corresponding weather factors.

Date of Inspection		Mean No. of moths /tree actual	smoothed	Mean temp. C°	Mean R.H.%	Mean Wind speed
January	1-15/1	0.0	0.1	12.8	64	11.2
	16-31/1	0.3	0.3	13.5	59	9.9
February	1-15/2	0.7	0.9	17.4	65	11.8
	16-28/2	1.9	1.4	16.5	50	12.2
March	1-15/3	0.9	1.2	18.2	51	12.7
	16-31/3	1.1	1.0	21.2	55	10.1
winter		4.9				
April	1-15/4	0.8	0.9	23.1	61	13.0
	16-30/4	0.8	1.0	21.5	63	15.1
May	1-15/5	1.6	1.6	28.4	73	14.4
	16-31/5	2.5	1.8	29.2	70	13.8
June	1-15/6	0.7	1.2	32.1	78	15.2
	16-30/6	0.8	0.8	30.0	79	13.3
Spring		7.2				
July	1-15/7	1.0	1.0	33.6	75	15.7
	16-31/7	1.1	1.5	37.1	79	16.4
August	1-15/8	2.7	1.9	35.8	81	16.7
	16-30/8	1.2	1.5	29.0	77	15.5
September	1-15/9	0.9	0.9	31.3	79	13.7
	16-31/9	0.7	0.7	32.1	65	14.8
Summer		7.6				
October	1-15/10	0.5	0.5	25.0	73	13.1
	16-30/10	0.4	0.4	21.1	65	13.9
November	1-15/11	0.1	0.2	24.1	71	10.1
	16-30/11	0.3	0.2	21.2	73	15.2
December	1-15/12	0.2	0.2	17.2	73	13.4
	1-15/10	0.0	0.1	15.3	65	9.9
Autumn		1.7				

Table 3. Commencement, peak and last dates of *S. myopaeformis* adult moths in pear orchards at Behaira Governorate during 2015 and 2016 seasons.

Dates	Seasons 2015	2016
Flight commencement	1st half of January	2nd half of January
Peak(s)	(1) 1st half of March. (2) 1st half of May. (3) 1st half of August.	(1) 2nd half of February. (2) 2nd half of May. (3) 1st half of August.
Last flight	2nd half of November.	1st half of December.

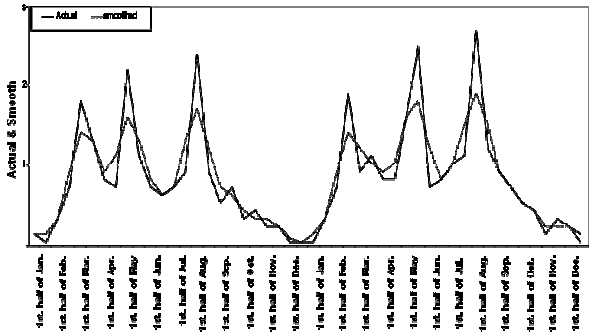

Fig. 1. Mean number of *S. myopaeformis* moths in pear orchareds at Behaira Governorate during 2015 and 2016 seasons

Such results are somewhat in agreement with those obtained by Tadros (1977),he recorded three peaks for *S. myopaeformis* in apple orchards during 1974 and 1975 seasons, moreover, he proved that moths activity were prevailing all year round in apple orchards in Alexandria and Fayoum Governorates during both years of study, respectively. Results are completely in disagreement with Judd *et al.* 2015, who indicate that moths had a single flight period that started in late-May and culminated by mid-August during 2008 – 2010 in Cawston, British Columbia in apple orchards, also, disagree with Kutinkova *et al*. 2006, in Bulgaria, they proved that the flight of *S. myopaeformis* moths began in the middle of May and lasted from three to three and half months. Mass flight occurred between the middle of June and the end of July.

All the previous result disagreements might due to the different host plant as monitoring and previous studies were conducted in apple orchards, or it might be a result of the different weather factors or experimental orchard.

The seasonal cycle:

Tables (1 and 2) and Figure (1) illustrated the seasonal cycle of *S. myopaeformis* moths in pear orchards at Behaira Governorate in Egypt. It consisted of an activity season prevailing of about 11 months (from 1st half of January or 2nd half of January to late November or early December) followed by an inactive month during early or late December.

Effect of weather factors on moths activity:

The prevailing weather factors, daily mean temperature (DMT), mean relative humidity (DMRH) and mean wind speed (DMWS) dominating in the Behaira Governorate were studied for their effectiveness on the moth activity during 2015and 2016 seasons.

Table (4) indicated that The direct effect (simple correlation) of DMT on the moths activity, period from Early January to late-November, 2015 was highly significant (r: 0.874) and during the activity period in 2016 from late January to early December, it was also highly significant (r: 0.750).

Table 4. Simple correlation "r" between the mean numbers of *S. myopaeformis* moths and the prevailing weather factors at Behaira Governorate during 2015and 2016 seasons together with their probability values "P".

Season	Period		Weather	Simple correlation	
	From	To	Factor	"r"	"p" value
2015 (n=22)	Early-January	Late-November	D. Mean T.	0.874	0.01
			D. Mean R.H.	0.759	0.01
			D. Mean W.S.	0.613	0.05
2016 (n=22)	Late-January	Early - December	D. Mean T.	0.750	0.05
			D. Mean R.H.	0.648	0.05
			D. Mean W.S.	0.186	0.00

D. Mean T. : Day-mean temperature
D. Mean R.H. : Day-mean R.H.
D. Mean W.S. : Day-mean W.S.

The direct effect of DMRH on the moths activity period was also highly significant during 2015 (r: 0.759) and significant during 2016 (r: 0.648).

The direct effect of DMWS on the moth activity period was significant during 2000 season (r: 0.613) but it was insignificant during 2001 season (r: 0.186).

The present results are somewhat in agreement with Tadros (1977), who stated that emergence of *S. myopaeformis* moths highly affected with the temperature but the relative humidity had less effect. Also, Bąkowski *et al*. (2013) in western Poland, conducted a monitoring study of *S. myopaeformis* moths in apple orchards and proved that in January and February 2008, the average mean temperatures were considerably higher than in 2009 and 2010, which undoubtedly could have affected the survival of caterpillars in winter in apple orchards.

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تتبع تعداد حفار ساق الحلويات رائق الاجنحة في حدائق الكمثرى في محافظة البحيرة في مصر

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أجريت دراسة تتبع تعداد فراشات حفار ساق الحلويات رائق الاجنحة *Synanthedon myopiformis* على مزارع الكمثرى في محافظة البحيرة خلال عامي ٢٠١٥ ، ٢٠١٦ للمرة الاولى في مصر حيث وجد ان الفراشات متواجدة علي مدار العام ولها ثلاث قمم خروج اثناء عامي الدراسة ، ففي عام ٢٠١٥ كانت القمة الاولي خلال النصف الاول من شهر مارس (متوسط ١.٨ فراشه لكل شجرة) و القمة الثانية لنشاط الفراشات كانت خلال النصف الاول من شهر مارس (متوسط ٢.٢ فراشه لكل شجرة) أما القمة الثالثة فكانت فى النصف الاول من أغسطس (متوسط ٢.٤ فراشه لكل شجرة) . أيضا تم تسجيل ثلاث قمم لنشاط الفراشات خلال العام الثاني من الدراسة ٢٠١٦ حيث كانت القمة الاولي فى النصف الثاني من فبراير (متوسط ١.٩ فراشه لكل شجرة) ، بينما كانت القمة الثانية فى النصف الثاني من مايو (متوسط ٢.٥ فراشه لكل شجرة) وتوافقت القمة الثالثة في التوقيت مع نظيرتها فى العام السابق من الدراسة حيث كانت ايضا خلال النصف الاول من أغسطس (متوسط ٢.٧ فراشه لكل شجرة) ، كذلك تم دراسة تاثير العوامل الجوية من حرارة ورطوبة وسرعة رياح علي تعداد ونشاط الفراشات خلال عامي الدراسة ٢٠١٥ ، ٢٠١٦.