Available online at www.derpharmachemica.com

ISSN 0975-413X
CODEN (USA): PCHHAX

Der Pharma Chemica, 2016, 8(20):166-171
(http://derpharmachemica.com/archive.html)

Biology, Ecology and control Studies on Sugar-beet mining moth, *Scrobipalpa ocellatella*

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ABSTRACT

Some ecological studies on sugar-beet insect pests, were conducted in El-Behira Governorate, during the two growing seasons 2015and 2016 to studies biological and ecological on Scrobipalpa ocellatella. The results obtained that infestation by S. ocellatella observed in the 4th week of November 2014 and in 3rd week of November 2015.The population increased from November to May from 10 to 150 larvae / 100 plants. The eggs deposited in groups, each of a single layer consisting of 2-10 eggs arranged in one or two rows. The duration of the pre-pupal stage was 2-4 days with an average 2.0±0.5days. The average duration of pupal stage ranged from 5-7 days with an average of 6.7±0.9 days. The average period of pre- oviposition, oviposition and post- oviposition lasted 4.7±0.8, 7.9±0.5 and 4.0±0.7 days, respectively. Using of en tomopathogenic fungi against Scrobipalpa ocellatella was promised which B. bassiana was more virulence than M. anisopliae.

Key words: Biology, Ecology, Control, *Scrobipalpa ocellatella*, sugar-beet

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INTRODUCTION

Sugar beet was first grown in Japan around 1880 when a small factory was erected in Hokkaido and continuous cultivation of beet started around 1920. Since the middle of the 1920s beet has also been grown in Turkey. In some other Asian countries (e.g. Pakistan, Syria, China, Iran and Iraq) sugar beet was established as a field crop after World War II. Beet sugar production was also started in some regions of northern Africa, first in Egypt and Algeria and later in Morocco and Tunisia

Most of the food for the world comes from some 150 plant species cultivated as crops. Sugar (the common name for sucrose) is obtained from only two crops, cane and beet. Cane sugar has been produced in large quantities in tropical regions for many centuries and continues to dominate the world supply of sugar. In contrast, sugar beet is a relatively new crop, appearing in temperate regions in the nineteenth century and spreading widely only in the twentieth century. Sugar beet is now grown in some 50 countries and provides about a quarter of the 140 Mt sugar currently used each year, [1].

Sugar -beet, *Beta vulgaris* L. (Family: Chenopodiacea) is considered the second important sugar crop after sugarcane. In 2009, the total cultivated area 248871 feddan in the old and newly lands, produced about 5138190 ton with an average yield of 20.646 ton/fed. Under Egyptian ecosystem, sugar beet plants are subjected to be attacked by numerous insect pests during its different group stages. So many authors are attracted to study a group of insect pests cause serious problems for growers and cause yield reductions [2-7]. In recent years, the sugar beet moth, *Scrobipalpa ocellatella* has become serious pests of the sugar-beet, [8]. Biological control of some sugar beet insect, [9]. The infestation by *S. ocellatella* appeared in end of December in a few numbers and increased gradually to reach a peak in May which recorded 175 and 187 larvae/50 plants [10, 11].

The eggs of *Scrobipalpa ocellatella* are laid singly or in groups on the leaves, the whole life cycle takes about 30-35 days [12], mentioned that the total duration of a complete life- cycle averaged 53.1, 37.3 and 32.8 days for males and 55.7, 39.6and 34.6 days for females during March / May – June / July generation, respectively.

In Egypt [13-17], found the Sugar beet mining moth, *Scrobipalpa ocellatella* in Alexandria district, from March until August. About eight larvae may be found in a single tunnel, in the mid rib, leaf stalk or roots and may cause death to the infested plants.

Using of entomopathogenic fungi as a biological control agents against *Scrobipalpa ocellatella* was promised which *B. bassiana* was more virulence than *M. anisopliae* according [18-29].

The goal of this study is studies the biology, ecology and control because *Scrobipalpa ocellatella* is the most serious pest attached the sugar beet.

MATERIALS AND METHODS

1- Biology studies of sugar beet moth, *Scrobipalpa ocellatella*:
A culture of *Scrobipalpa ocellatella* was started in the laboratory from larvae collected from the field and kept in glass jars (one litre) with fresh sugar beet leaves. The emerged adult moths were removed into a glass cage (60x 100 cm.) containing sugar beet plant as an Oviposition site. Eggs laid on leaves were collected daily and transferred to petri-dishes (2x9 cm.) under the laboratory condition at 25±2°C and 65±5 % R.H.

2- Field studies of sugar beet moth, *Scrobipalpa ocellatella*:
Field studies were carried out at ElBehira Governorate during two successive seasons 2015 and 2016 to studies biology and ecology of *S. ocellatella*. The experimental area was divided into plots each of 42 m^2 (1/100 feddan). No chemicals were used for controlling sugar-beet insect pests throughout the whole period of the study; Sampling started one month after sowing and continued until harvesting. The plants were visually examined and the insect pests were counted and recorded bi-weekly on 100plants (25 plants / plantation) selected randomly.

3- Biological control:
Fungi culture:
Fungi: (*Metarhizium anisopliae* and *Beauveria bassiana*) were grown on Potato Dextrose Agar (PDA) (1 Kg potatoes, 80 gr. Agar, 100 gr. Dextrose and 4 lit. distilled water. The media was autoclaved at 120 ºC for 20 minutes, and poured in Petri- dishes (10 cm diameter x 1.5 cm). Then fungi were incubated and kept at 25 ± 2˚C and 85 ± 5% RH. The fungal isolates were re-cultured every 14 – 30 days and kept at 4˚C.

Preparing of the concentrations:
Spores of fungal isolates were harvested by rising with sterilized 0.5 % Tween 80 from 14 day old culture (PDA) media. The suspensions were filtered through cheese cloth to reduce mycelium clumping. The spores were counted in the suspension using a Haemocytometer (0.1 mm x 0.0025 mm2). The concentrations were used 2 x 10^3, 2x 10^4 and 2 x 10^5 spores / ml.

Laboratory inoculation:
The Larvae of *Scrobipalpa ocellatella were transferred to the Lab. from the field and placed in Petri-dishes with leaf disk at* 20 ± 2 ˚C and 65 ±5 % RH. Five individuals/dish, Twenty-five /concentration. *The fungi were applied in a suspension containing* 2 x 10^3, 2x 10^4 and 2 x 10^5 spores / ml. in the control treatment 1 ml. of sterilized water was added to the leaves disks. The mortality of *Scrobipalpa ocellatella* was observed daily.

RESULTS

1-Biology of sugar beet mining moth, *Scrobipalpa ocellatella*:
The egg stage:
The eggs were deposited in groups, each of a single layer consisting of 2-10 eggs arranged in one or two rows. Most of the eggs are laid on the petioles, while few on the leaf surfaces or on the root collar. The newly deposited egg is oval shaped creamy yellow in colour and darkening to yellowish green shortly before hatching.

Table (1): Average duration of the immature stage of the Sugar beet moth, *Scrobipalpa ocellatella* (Boh.) at 25±2°C and 65±5 % R.H

Stages	*Eggs incubation period (days)	% Hatch.	**larval duration(days)					Pre-pupal stage (days)	*** pupal stage (days)	Total duration (days)
			1st	2nd	3rd	4th	Total			
Average	4.0±0.3	90.5	4.2±0.7	3.0±0.6	3.3±0.6	4.5±0.6	14.5±0.7	2.0±0.2	6.3±0.6	26. 9±0.6
Range	3-5		3-6	2-3	2-3	4-6	14-20	2-3	6-7	

**Total no. of 100 eggs; **Total no. of 100 larvae; ***Total no. of 100 pupae*

The pupal stage:

The full grown larvae stops feeding then transforms to the pre-pupal stage which appears pale brown in colour and usually takes place inside the larval tunnels in the leaves or root. A small number of individuals pupate among the fallen dry leaves. The duration of the pre-pupal stage was 2-3 days with an average 2.0±0.2 days. Pupa is dark brown and rectangular oval in shape with narrow end. The average duration of pupal stage ranged from 6-7 days with an average of 6.3±0.6 days table 1.

The adult stage:

The newly emerged adult is generally blackish grey, while the hind wings are whitish grey. The two sexes could be differentiated by the abdominal sternites colour which are blackish in the male and white in the female.

The fecundity and longevity:

Table(2):Average duration of adult stage of the beet moth, *Scrobipalpa ocellatella*(Boh.) at 22±2°C and 65±2 % R.H

Pre- oviposition period	oviposition period	Post-oviposition period	Female longevity	Average number of eggs/ female
4.5±0.7	7.5±0.2	4.0±0.5	15.6±0.2	50.4±2.5
4-5	6-7	3-4	13-16	44-54

A total no. of 100 adults were tested

The average period of pre- oviposition, oviposition and post- oviposition lasted4.5±0.7, 7.5±0.2and 4.0±0.5 days, respectively. The female usually lives longer than the male According (Abdel-Raheem, 2000). The longevity of female of *Scrobipalpa ocellatella* ranged from 13-16 days with an average 15.6±0.2days. The number of deposited eggs per female ranged from 44 to 54 Eggs with an average of 50.4±2.5 eggs/ female.

Ecology of sugar beet mining moth, *Scrobipalpa ocellatella*:

- **Season 2014-2015:**

The larvae of *Scrobipalpa ocellatella* were observed on the 4th week of November 2014 with low number (10 larvae / 100 plants) in the first plantation (R1), the population increased to 33 larvae / 100 plants by the end of December in the second plantation (R2). This population increased until February2015 and reached to 83 larvae / 100 plants in R3 and continuous in increased to reach 170 larvae / 100 plants in 4th May 2015 R1.

- **Season 2015-2016**:

The larvae of *Scrobipalpa ocellatella* were observed on the 3rd week of November 2015 with low number (5 larvae / 100 plants) in the 1st plantation (R1), the population increased to 33 larvae / 100 plants by the end of December in the 1st & 4th plantations (R1& R4). This population increased until February2016 and reached to 267 & 279 larvae / 100 plants in the 1st & 3rd plantations (R1 & R3) and continuous in increased to reach 180 & 165 larvae / 100 plants in 1st & 4th May R1 & R4.

Table (3): Weekly number of *Scrobipalpa ocellatella* larvae per 100 plants at ElBehira during two seasons 2015-2016

Sampling date		season							
		2015				2016			
		Plantations							
		R1	R2	R3	R4	R1	R2	R3	R4
Nov.	3nd	0	0	0	0	5	8	9	9
	4th	10	15	5	7	7	8	12	11
Total		10	15	5	7	12	16	21	20
Dec.	1st	15	11	13	12	7	11	11	13
	2nd	30	22	33	35	27	20	19	22
	3nd	33	30	34	38	27	22	28	25
	4th	34	33	20	40	33	27	29	33
Total		112	99	100	125	94	80	87	93
Jan.	1st	39	38	28	36	33	30	29	36
	2nd	49	45	43	47	35	45	48	43
	3nd	49	43	42	45	43	47	45	40
	4th	50	48	49	48	45	50	55	53
Total		187	174	162	176	156	172	177	172
Feb.	1st	55	57	65	53	53	60	59	55
	2nd	65	65	67	65	57	63	65	68
	3nd	75	70	77	67	77	70	73	70
	4th	88	85	83	85	80	83	82	78
Total		283	277	292	270	267	276	279	271
Mar.	1st	95	100	102	99	89	99	100	100
	2nd	111	105	112	107	114	100	112	100
	3nd	100	111	118	119	120	111	113	111
	4th	120	123	122	132	119	119	127	119
Total		426	439	454	457	442	429	452	430
April	1st	135	130	127	130	133	120	130	120
	2nd	140	137	140	147	135	137	125	130
	3nd	150	160	152	150	147	140	137	140
	4th	145	150	155	145	145	133	137	150
Total		570	577	574	572	560	530	529	540
May	1st	155	150	160	160	150	140	140	143
	2nd	160	155	160	170	170	150	143	145
	3nd	167	170	180	175	170	160	160	163
	4th	170	173	185	180	180	165	165	165
Total		652	648	685	685	670	615	608	616
General total		2240	2229	2272	2292	2201	2118	2153	2142
General mean		320	318.4	324.6	327.4	314.4	302.6	305.6	306

Biological control:

The 4th instar of *Scrobipalpa ocellatella* treated with *B. bassiana* and *M. anisopliae*:

Data in table (4) revealed that the % mortality occurred by using of *B. bassiana* were 69, 95, and 100 after 10th day from treatment by using three concentration, 2 x $10^{3,}$ 2x 10^{4}, and 2 x 10^{5}, respectively.

The % mortality occurred by using of *M. anisopliae* were 55, 70, and 85 after 10th day from treatment by using three concentration, 2 x $10^{3,}$ 2x 10^{4}, and 2 x 10^{5}, respectively.

Table (4): The % Mortality of 4th instar larva of *Scrobipalpa ocellatella* infected with five concentrations of *B. bassiana* and *M. anisopliae* at 22 ± 2 ˚C and 85 % R.H.:

Days after treatment	Control	*B. bassiana*			*M. anisopliae*		
		2 x 10^{3}	2x 10^{4}	2 x 10^{5}	2 x 10^{3}	2x 10^{4}	2 x 10^{5}
2nd	0	0	0	0	0	0	0
3rd	0	10	20	30	5	7	8
4th	0	26	30	45	10	15	26
5th	0	27	34	45	20	22	27
6th	0	29	36	53	22	31	31
7th	0	31	37	56	25	33	35
8th	0	37	65	70	28	45	55
9th	0	50	74	85	35	55	68
10th	0	69	95	100	55	70	85

The Pupa of *S. ocellatella* treated with *B. bassiana* and *M. anisopliae:*

Data in table (5) indicated that no mortality was occurred in the 2nd to the 4th day with all concentrations by using *B. bassiana*. The % mortality occurred by all concentrations of were 85, 90, and 100 % after 8th day from treatment.

The % mortality occurred by all concentrations of using of *M. anisopliae* were 65, 70, and 80 % after 8th day from treatment.

Table (5): The % Mortality of pupae of *Scrobipalpa ocellatella* infected with five concentrations of *B. bassiana* and *M. anisopliae:* at 22 ± 2 ˚C and 85 % R.H.:

Days after treatment	Control	*B. bassiana*			*M. anisopliae*		
		2 x 10^3	2x 10^4	2 x 10^5	2 x 10^3	2x 10^4	2 x 10^5
2nd	0	0	0	0	0	0	0
3rd	0	0	0	0	55	60	70
4th	0	0	0	0	55	60	70
5 th	0	60	85	90	55	60	75
6 th	0	85	85	90	65	75	80
7 th	0	85	90	100	65	75	80
8 th	0	85	90	100	65	75	80

DISCUSSION

The data obtained this study according [30], mentioned that the eggs are deposited in groups (2-12 eggs) arranged in one or two rows. Most of them are laid on the petioles, while few on the leaf surface or on the root collar. Also, the larva has four instars. The first instar larva bores in tunnel into mid-rib and extends to the roots. About three larvae may be found may be found in one tunnel. The durations of each larval instar were 3-5, 2-3, 2-4 and 4-5 days for the 1st, 2nd , 3rdand 4th instar, respectively. The whole larval duration ranged between 13-16 days.

But different in degree centigrade due to the duration shorter than Abdel-Raheem, 2000, this thing is nature in the life cycle in insects. This study in biology at 25±2°C and 65±5 % R.H because it almost in ElBehira region.

The infestation by *S. ocellatella* appeared in end of December in a few numbers and increased gradually to reach a peak in May which recorded 175 and 187 larvae/50 plants at El-Malha district, Dakahlia Governorate but in ElBehira the infestation appear in the 3rd November that due to the different of temperature .

[31], studied the population fluctuations of the main insects of sugar beet plants and their associated predators and mentioned that the sugar beet plants were harbored three main insect species i.e. *Cassida vittata* Vill; *Pegomyia mixta* Vill and *Scrobipalpa ocellatella* Boyd. Four predatory species were associated with the three insect pests i.e. *Coccinella undecimpunctata* L.; *Scymnus* sp., *Paederus alfierii* Koch. and *Chrysoperla carnea* (Steph.). Also, that the highest infestation levels of these insect pests were occurred during March and April in both seasons but the highest infestation was from March to May [32].

Using of entomopathogenic fungi as a biological control agents against *Scrobipalpa ocellatella* was promised which *B. bassiana* was more virulence than *M. anisopliae* according, [33-37].

Acknowledgment
Many thanks for Assoc. Prof. Mohamed Abdel-Raheem Ali Abdel-Raheem from NRC –Cairo, Egypt for their Support.

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