

Biological study of *Hyles euphorbiae* L. (Lepidoptera:Sphingidae) in Kurdistan Region, Iraq

Hana H. Mohammed¹ and Mohammed S. Abdul-Rasoul²

¹Biology Department, College of Science, University of Salahaddin, Erbil, Kurdistan Region of Iraq

²Baghdad Natural Museum, Baghdad, Iraq

Abstract: The leafy spruce hawk moth *H. euphorbiae* is monophagous insect feed on different species of the genus *Euphorbia*. The biology of *H. euphorbiae* was studied in detail during May to November under laboratory conditions. The development of egg, larva, pre-pupa and pupal periods occupied 9.42 ± 1.65 , 20.31 ± 2.08 , 2.67 ± 0.37 and 57.10 ± 5.97 days, respectively. Total life cycle was 89.5 ± 10.1 . The sex of *H. euphorbiae* can be determined during pupal stage, in the male there are two small points at the fifth segment, while in females there's a line at the same position. Adults became active in the night. All mating observed among caged adults occurred at night. The longevity of the female ranged from 11-16 days with an average of 13.86 ± 1.73 , while in case of male it was 8-11 days with an average of 10.55 ± 1.00

Keywords - *Hyles euphorbiae*, *Euphorbia macrocalda*

I. INTRODUCTION

The spurge hawk moth *Hyles euphorbiae* L. (Lepidoptera: sphingidae) is a large hawkmoth species distributed in Central/Southern Europe and Western Asia [1], it is a large insect, strong fliers and are active nocturnally. The adult measures 2 to 3 centimeters long with a 5 to 7-centimeter wingspan, body is olive brown with white and black markings. The forewings are patterned with olive brown; the hind wings are pink with black markings. The leafy spurge hawkmoth, completes one and sometimes two generations per year and requires 42-72 days to complete development this is dependent on temperature and food source. The First-generation adults emerge in early to midsummer; if a second generation of adults occurs, it will do so sometime from late August through September, There're five life stages: egg, larva, pre-pupa, pupa and adult. First-generation larvae can be found during June; if a second generation occurs, it will in August. The larvae are large caterpillars that have a "caudal horn at the back, dorsally, on the 8th abdominal segment. Mature fifth-instar larvae drop to the ground and enter the soil to pupate. [2]

The food plants restricted to the genus *Euphorbia* and occasionally a single record on a plant species in an unrelated family which include different species of the genus *Euphorbia* (Euphorbiaceae). When damaged, leafy spurge exudes milky latex that discourages grazing by most wildlife and domestic cattle and horses. The latex contains "ingenol," a toxic compound that is highly inflammatory and emetic to most mammals, including humans. The latex causes scours and weakness in cattle and may result in death [3]. The genus *Euphorbia* is chemically defined by the occurrence of a large number of polyfunctional diterpenoids with the tiglane (phorbol), ingenane and daphnane skeletons most of them are skin irritants and toxic [4].

The caterpillar of *H. euphorbiae* does not actively sequester phorbol esters, their aposematic colouration could be based on chemical defence mediated by phorbol esters quickly present in their gut. These hawkmoth caterpillars have a large gut full of plant material, which they regurgitate into the direction of the predator when attacked in nature [5].

Several studies were undertaken in Nebraska, some of these studies involved the life cycle of the *H. euphorbiae* and its feeding behavior. Yet, there's no biological and ecological research was done in Iraq except the first known observations on the hawkmoth *H. euphorbiae*, of Iraq are those reported by [6] in 1957.

The aim of the present paper is study the life cycle of *H. euphorbiae* to provide a starting point for further studies by pulling together the various ecological and to determine the effectiveness of the spurge hawkmoth as a biological control agent for leafy spurge in Kurdistan Region of Iraq.

II. MATERIAL AND METHOD

The larvae of *H. euphorbiae* were collected and reared on *Euphorbia macrocalda* for the maintenance of pure culture in the laboratory. The larvae were kept in the room temperature during the experiment. Cotton wad dipped in 10 per cent honey solution was provided as food for the moths. The eggs laid were counted daily till the death of female moth. Freshly laid eggs were kept on leafy spruce leaf in Petri plates provided with wet blotting paper at the bottom to protect the eggs from desiccation. After hatching larval instars were studied by transferring them to the plastic containers with the help of camel hair brush. The fresh leafy spruce leaves were provided as food for developing larvae, duration of instars and pupal duration was recorded. As measurements

were taken each day, it was possible to note the number of days each larva spent as a particular instar by skin color changes of the larvae and molted head capsule. These observations were recorded with the consumption data for each larva.

III. RESULT AND DISCUSSION

1- Egg: Females lay small groups of eggs on upper surface of new foliage of leafy spurge in a clusters of 64 - 122 eggs, the eggs are light green to yellow spheres. The surface of the egg was smooth, shining and covered with liquid gum, which enables them to stick on the small leaves of the spruce. The incubation period lasted for 7 to 12 days with a mean of 9.2 ± 1.92 days. Egg measured from 1.76 to 1.99 mm length with an average of 1.86 ± 0.08 mm. The present observation on egg laying is somewhat in conformity with [2] that females oviposit 150 light green spheres, 1 mm diameter egg singly or in clusters on leaves and bracts of the spurge plants. Spurge hawkmoth lay egg in cluster on average 162 eggs per individual with incubation period of 9 ± 0.5 in laboratory condition [7].

2- Larvae: Had five instars. The caterpillar moulted for four times completing five larval instars. Duration occupied by each instar on leafy spruce is presented in the (Table 1). The length and size of the head capsule increased as the larval stages advanced. Maximum length and head capsule width was observed in fifth instars (Table 2).

2-1 First instar: Neonate larva was tiny, cylindrical with dark body and head with innumerable whitish dots. The median dorsal horn present on the 8th abdominal segment was yellowish in colour and posture was vertical to the body. No colour change was observed in the first instar larvae. First instar lasted for 4 to 5 days with an average of days 4.56 ± 0.35 . First instar larvae measured 3.7 to 7.6 with an average 5.97 ± 1.18 mm and head capsule width was 0.76 to 0.78 mm with an average of 0.77 ± 0.01 mm. The Larvae are very sociable and packed together on the Spurge leaves. Larvae fed on the leaf tissue by scraping the chlorophyll content of epidermis and as age advanced it made small holes on the leaves, the same observation was shown by *Agrius convolvuli* on greengram leaf [8].

2-2 Second instar: Remarkable change in the body color was observed. All larvae colouration was changing rapidly and taking on a more Yellow background color and blackish blotches which inside were dotted with white. They were starting to look rather beautiful. Second instar lasted for 2 to 3 days with an average of 2.54 ± 0.35 . The larvae started feeding from the margin of the leaves. Second instar larvae measured 12 to 18 mm in length with an average of 15.51 ± 2.04 mm; head capsule width was 1.16 to 1.31 mm with an average of 1.26 ± 0.04 mm.

2-3 Third instar: Larvae increased in the size with nearly vertical horn. The horn was thick, yellow at the base and black tapering at the end. Third instar occupied 2 to 3 days with an average of 2.58 ± 0.37 days. Third instar larvae measured 22 to 27 mm in length with an average of 25.08 ± 1.62 .

2-4 Fourth instar: The larvae showed their final colour pattern. Larvae have a distinctive red, black, yellow, and white color pattern, set in a ground colour which varies from yellowish to black; the head coral-red colour, and a line of the same colour runs all along the back, from the head to the horn. Horn had red base with black tip. This instar lasted for five to seven days with an average of 5.45 ± 0.68 days and 5.70 ± 0.67 . Fourth instar larvae measured 46 to 58 mm in length with an average of 50.16 ± 3.85 mm and head capsule width 3 to 3.1 mm with an average of 3.06 ± 0.05 mm.

2-5 Fifth instar: The fifth instar larva was very active and fed hungrily and the leaves were completely devoured including veins. Fifth instars occupied 6 to 7 days with an average 6.53 ± 0.34 days. Fifth instars larvae measured 85 to 99 mm in length with an average of 94.60 ± 4.03 mm and head capsule width was 5 to 5.2 mm with an average of 5.05 ± 0.08 mm diameter. This result agree with [9] who observed that fifth instar larvae of *Daphnis nerii* was measured 85 mm in length.

2-6 Total larval period: *H. euphorbia* occupied 17 to 23 days with an average of 20.31 ± 2.08 days to become full grown larva (Table 3). This result is somewhat agree [7] who observed larval development period of *H. euphorbiae* was 19 ± 2 days. *A. convolvuli* had five instars occupying on an average 24.85 ± 2.33 days with a range of 21 to 30 days on greengram [8].

3- Pre-pupa: Fully grown larvae stopped feeding and wriggled inside the remaining glued leaves. The body size gradually shortened became rough enough inside the case, and entered pre-pupal stage. The pre-pupal stage occupied 2 to 3 days with an average of 2.67 ± 0.37 (Table 3). Pre-pupal length varied from 80 to 85 mm with

an average of 82.92 ± 1.36 mm (Table 1). This result agreement with [8] who observed pre-pupa I period of *A. convolvuli* varied from 2 to 3 days with an average of 2.90 ± 0.73 days on greengram.

4- Pupa: Light brown with fine, dark striations. pupa formed within a net-like cocoon, incorporating leaves, and other debris. The time spent in this stage can vary considerably from 44 to 65 days with an average of 57.10 ± 5.97 (Table 3). Pupal length varied from 50-55 mm with an average of 52.67 ± 1.65 mm (Table 1) this result disagreement with [8] that Pupal period of *A. convolvuli* was observed to vary from 12 to 18 days with an average of 14.45 ± 2.71 days. The sex of the adult can be recognizes through watching the Pupa, there are two small points at the fifth segment of the male, while in females this feature appears as a line.

4-1 Total life cycle: Under laboratory conditions the spruce hawk moth completed its one generation (egg to adult) in (70 – 103) days with an average of 89.5 ± 10.1 days. First generation larvae can be found in April; a second generation occurs during late September and October, this result disagrees with [2], Who found that First-generation larvae can be found during June; if a second generation occurs, it will be in August .

5- Adult: Emergence of the adults usually occurred during night and rare at day time. Immediately after the emergence a brownish thick fluid oozed out from the anus of pupae in both sexes. Soon after the emergence moths were inactive and sluggish for some time. Its body is olive brown with white and black markings. The forewings are patterned with olive brown; the hind wings are pink with black markings. It is readily distinguished which is predominately pink. The longevity of the female ranged from 11-16 days with an average of 13.86 ± 1.73 While in case of male it was 8-11 days with an average of 10.55 ± 1.00 , this result is somewhat in co firmly with [8] Longevity of *A. convolvuli* adults ranged from 10 to 12 days with an average of 11.3 ± 0.82 days and 13 to 16 days with an average of 14.3 ± 0.94 days in case of male and females.

5-1 Copulation: Mating was observed during night hours a day or two after emergence. Eggs were laid individually or in cluster during night hours on the spruce leaves or on the sides of the cages in the absence of the host. The adults lived for about 3 to 5 days after completing oviposition.

IV. FIGURES AND TABLES

Table 1 Growth parameter of *Hyles euphorbia* on leafy spruge

Stage	Length (mm)		Head capsule width (mm)	
	Range	Average	Range	Average
Larvae				
I	3.70 – 7.40	5.97 ± 1.18	0.76 – 0.78	0.77 ± 0.01
II	12.00 – 18.00	15.51 ± 2.04	1.16 – 1.31	1.26 ± 0.04
III	22.00 – 27.50	25.08 ± 1.62	1.91 – 1.99	1.95 ± 0.02
IV	46.00 – 58.00	50.16 ± 3.85	3.00 – 3.10	3.06 ± 0.05
V	85.00 – 99.00	94.60 ± 4.03	5.00 – 5.20	5.05 ± 0.08
Pre-Pupa	80.00 – 85.00	82.92 ± 1.36		
Pupa	50.00 – 55.00	52.67 ± 1.65		

Table 2 Average larval period of *Hyles euphorbia* on leafy spruge

Stage number.	Instars	Duration (days)	
		Range	Average
1	I	4.0 – 5.0	4.56 ± 0.35
2	II	2.0 – 3.0	2.54 ± 0.39
3	III	2.0 – 3.0	2.58 ± 0.37
4	IV	3.0 – 5.0	4.10 ± 0.63
5	V	6.0 – 7.0	6.53 ± 0.34

Table 3 Biology of *Hyles euphorbia* on leafy spruce

Stage.	Duration of stage (in days)	
	Range	Average
Egg period	7.0 – 12.0	9.42 ± 1.65
Larval Period	17.0 – 23.0	20.31 ± 2.08
Prepupa period	2.0 – 3.0	2.67 ± 0.37
pupa period	44.0 – 65.0	57.10 ± 5.97
Total Life Cycle	70.0 – 103.0	89.5 ± 10.1

V. CONCLUSION

The leafy spruce moth, *H. euphorbiae* Linnaeus is one of the main insects which present on *Euphorbia macrocalda*. Biology was studied under laboratory conditions. The development of egg, larva, pre-pupa and pupal periods occupied 9.42 ± 1.65 , 20.31 ± 2.08 , 2.67 ± 0.37 and 57.10 ± 5.97 days respectively. The longevity of adult ranged from 8-11 days and 11 to 16 days in case of male and female. Total life cycle ranged from 70 to 103 days. Accurate information on the biology of *H. euphorbiae* is a prerequisite for developing an effective pest management programme against genus euphorbiae. The results of the experiments described here have resolved development times in Kurdistan Region of Iraq.

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