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Biology of castor hairy caterpillar (*Euproctis lunata* Walker) on castor in Haryana conditions

ROBIN KAMBOJ, RAM KARAN GAUR and YOGESH KUMAR

Regional Research Station (CCSHAU), Bawal 123501 Rewari, Haryana, India
Email for correspondence: drramkaran1965@ gmail.com

ABSTRACT

The life cycle of *Euproctis lunata* Walker consists of egg, six larval instars, pupa and adult. In the present study the eggs were found in clusters and covered with thick light brown tufts of hairs and incubation period varied from 5 to 10 days. The diameter of eggs ranged from 0.6 to 0.7 mm. The total larval period ranged from 20 to 26, 22 to 28 and 68 to 82 days in first, second and third generation respectively. The results of morphometric measurements revealed that the average size of full grown first, second, third, fourth, fifth and sixth instar larva was 2.75 × 0.23, 6.55 × 0.61, 9.46 × 1.65, 16.16 × 2.47, 25.18 × 3.51 and 35.14 × 4.48 mm respectively. The pupa measured from 12 to 14 mm in length and 5 to 6 mm in breadth and pupal period ranged from 12 to 19 days in different generations. The antennae of male moths were bipectinate whereas the female had filiform antennae. The male measured 10 to 12 mm in length and 30 to 32 mm in wing expansion whereas female measured 12 to 14 mm in length and 35 to 37 mm in wing expansion. The longevity of male adult ranged from 4 to 7 and of female 5 to 9 days in different generations. The insect completed three generations from August 2014 to March 2015.

Keywords: Castor; *Euproctis* lunata; biology; incubation; generations; egg; larva; pupa; adult

INTRODUCTION

India being a producer of substantial quantities of oilseeds occupies a prominent place in the oil seed map of the world. The major oilseed crops in India are mustard, castor, sunflower, seasemum etc and castor is an important crop among them. Castor (*Ricinus communis* L) is an important non-edible oilseed crop of dry lands which is becoming popular as a commercial oilseed crop owing to its high export potential and industrial uses. Although it is indigenous to the southeastern Mediterranean basin, Eastern Africa and India, today it is widespread throughout tropical regions (Phillips and Rix 1999).

In areas with a suitable climate, castor establishes itself easily where it can become an invasive plant and can often be found on wasteland. India ranks first among the major castor producing

countries in the world with 68 per cent of area and 76 per cent of world castor production. In India total area under castor crop for the year 2013-14 was about 9.84 lakh ha with production of 12.05 lakh tonnes and average yield of about 1225 kg/ha (Anon 2014).

Out of a number of production constraints biotic stresses steal the lion share of castor productivity in India by affecting the quantity and quality of the crop. More than 60 species of insect and mites have been reported to cause damage to castor crop (Rai 1976).

The losses in castor yield of about 40 per cent have been estimated due to insect pest attack (Kotley 1995). Gaur (2014) reported that castor semilooper, castor hairy caterpillar, castor shoot and capsule borer and leaf hopper were major insect pests of castor in southwest Haryana during 2012-13.

In a particular insect species the rate of development, number of generations per year and peak activity period may vary substantially in different regions. A thorough knowledge about the biology of the pest provides an important basis for developing efficient pest management procedures. No study on these aspects have so far been conducted in Haryana. Keeping in view the damage caused by this pest in southwest Haryana the present study on biology of castor hairy caterpillar (*Euproctis lunata* Walker) was carried out.

MATERIAL and METHODS

Biology of this insect was studied in the laboratory of Regional Research Station, Bawal, Haryana during 2014-15. Initially some mature larvae of *E lunata* were collected from the ber plants. These were reared in glass jars (15 cm diameter, 21 cm height) having castor leaves as food. The pupae were obtained from these reared larvae and freshly formed pupae were transferred to separate jars covered with muslin cloth for the emergence of adults. Daily observations were recorded on changes in colour and size of immature stages of the insect. Moths were shifted to glass chimneys for mating.

The observations on adult longevity, pre-oviposition, oviposition and post-oviposition periods, fecundity and sex ratio were made on twenty pairs of newly emerged male and female adults. The eggs laid by female moths on leaves, chimney walls and muslin cloth were removed gently with the help of moist camel hair brush. The eggs were kept in Petri plates (10 x 2.5 cm) containing moist filter paper for hatching. Insect larvae were killed in hot water and preserved in 70 per cent alcohol for the purpose of recording body measurements. The leaves were examined daily for the presence of exuviae to record data on the number of moults and duration of the respective instar. The time taken from one moult to other was taken as the duration of the respective instar. The period from complete inactivity and immobility of the

larvae to formation of the pupae was taken as the pre-pupal period. Twenty pupae were taken for recording the pupal period. The adults thus formed were released in chimneys for mating. The longevity of adults of both sexes was recorded in captivity. The observations on pre-oviposition period were taken on twenty gravid females. The pre-oviposition period was recorded as the duration in days after the adult emergence till the start of oviposition. The oviposition period was taken as the duration in days from the day it laid the first egg till the laying of last egg. The post-oviposition period taken as the duration in days after the last egg laying till the death of the female was recorded for each of the twenty pairs maintained for recording the data.

RESULTS and DISCUSSION

The freshly laid eggs were creamish white in appearance and turned darker prior to hatching. The eggs were round, pear-shaped, slightly depressed at the poles, found in clusters and always covered with thick light brown tufts of hairs. Chorion was thin and lacked any consistent pattern. In field conditions the eggs were mostly observed on underside of the leaves and less frequently on the upper surface. In the laboratory the eggs were observed on leaves, paper strips and chimney walls. The diameter of eggs ranged from 0.6 to 0.7 mm (Table 1). The present findings on egg stage are more or less similar to the finding of Singh and Grewal (1981) and Islam et al (1988).

The incubation period varied from 5 to 10 days (Table 2) depending upon the temperature which varied from 18.0 to 32.8°C and relative humidity ranging from 65 to 82 per cent. These findings are in close agreement with Atwal and Singh (1972) who reported that the incubation period varied from 6.0 to 11.26 days in temperature range of 20 to 30°C. The number of eggs laid per female ranged from 95 to 221 and egg hatchability from 80 to 100 per cent in different generations. The present findings are similar to the work of Kushwaha and Bhardwaj (1967) and Atwal and Singh (1972) who reported the fecundity per female as 90 to 230 eggs and 167 to 231 eggs.

The results of present study revealed that the larva of *E lunata* shed its skin five times before entering pupation leading to six larval instars. The measurements of head capsules of different instars indicated that the average size of head capsule was 0.34, 0.53, 0.86, 1.28, 2.18 and 3.18 mm in the first, second, third, fourth, fifth and sixth instar respectively. The results in relation to the number of instars of *E lunata* are in agreement with the earlier works (Kushwaha and Bhardwaj 1967, Singh and Grewal 1981, Islam et al 1988).

The newly emerged first instar larva was yellowish brown with light brown mouth parts and head capsule. The colour started changing to grey after sometime and brown hair emerged all over the body. The second instar larva was light grey with dark brown

Table 1. Measurements of different developmental stages of *Euproctis lunata* (n= 20)

Stage	Length (mm)		Breadth (mm)	
	Range	Mean ± SD	Range	Mean ± SD
Larva				
1st instar	2.5 - 3.0	2.75 ± 0.18	0.2 - 0.3	0.23 ± 0.03
2nd instar	6.0 - 7.0	6.55 ± 0.31	0.5 - 0.7	0.61 ± 0.06
3rd instar	9.0 - 10.0	9.46 ± 0.29	1.5 - 1.8	1.65 ± 0.13
4th instar	15.0 - 17.0	16.16 ± 0.60	2.0 - 3.0	2.47 ± 0.26
5th instar	24.0 - 26.0	25.18 ± 0.58	3.0 - 4.0	3.51 ± 0.28
6th instar	34.0 - 36.0	35.14 ± 0.49	4.0 - 5.0	4.48 ± 0.28
Pupa	12.0 - 14.0	13.25 ± 0.55	5.0 - 6.0	5.37 ± 0.26
Adult male	10.0 - 12.0	11.03 ± 0.57	30.0 - 32.0*	31.02 ± 0.54*
Adult female	12.0 - 14.0	12.99 ± 0.59	35.0 - 37.0*	36.06 ± 0.61*

Egg diameter= 0.6 - 0.7 (Range), 0.65 ± 0.03 (Mean ± SD), *Measurements with wing expanse

Table 2. Duration of different life stages of *Euproctis lunata* (n= 20)

Stage	Duration (days)					
	1st generation		2nd generation		3rd generation	
	Range	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD
Incubation period	5 - 6	5.51 ± 0.29	6 - 7	6.48 ± 0.26	8 - 10	9.26 ± 0.60
Larval period						
1st instar	2 - 3	2.38 ± 0.24	2 - 3	2.56 ± 0.25	5 - 7	6.10 ± 0.47
2nd instar	3 - 4	3.43 ± 0.26	3 - 4	3.56 ± 0.27	9 - 11	10.18 ± 0.43
3rd instar	3 - 4	3.37 ± 0.29	3 - 4	3.58 ± 0.29	11 - 13	12.12 ± 0.52
4th instar	4 - 5	4.36 ± 0.29	4 - 5	4.65 ± 0.27	12 - 15	13.62 ± 0.85
5th instar	4 - 5	4.25 ± 0.28	5 - 6	5.56 ± 0.29	14 - 17	15.73 ± 0.77
6th instar	4 - 5	4.36 ± 0.27	5 - 6	5.62 ± 0.29	17 - 19	18.03 ± 0.57
Total larval period	20 - 26	22.4 ± 2.36	22 - 28	25.3 ± 1.82	68 - 82	75.8 ± 7.60
Pre-pupal period	3 - 4	3.46 ± 0.26	4 - 5	4.53 ± 0.31	6 - 7	6.49 ± 0.24
Pupal period	12 - 14	13.29 ± 0.53	13 - 15	14.33 ± 0.56	17 - 19	18.29 ± 1.30
Adult male	4 - 6	5.42 ± 0.30	4 - 6	5.46 ± 0.28	5 - 7	6.61 ± 0.25
Adult female	5 - 7	6.50 ± 0.77	5 - 8	6.68 ± 0.82	6 - 9	7.88 ± 0.73
Temperature (°C)	30.0 - 33.5	31.6	18.0 - 32.8	25.0	14 - 20	17.9
Relative humidity (%)	63 - 85	73.4	72 - 82	78	75 - 87	81.5

head and mouth parts. A white dorsal stripe appeared on abdominal segment and long hair all over the body. The third, fourth, fifth and sixth instar larvae were dark grey with dark brown head and mouth parts. The pattern of white dorsal strip remained same as in the second instar.

The total larval period ranged from 20 to 26 days, 22 to 28 days and 68 to 82 days in first, second and third generation respectively. The present results fall in line with the results of Yazdani et al (1989) who reported that total larval period varied from 18 to 93 days in different generations. However according to Singh and Grewal (1981) the total larval period varied considerably during different months as it was 13.5 days during July-August, 23.1 days during October and 114.2 days during December-March. This might be due to the variation in techniques adopted during rearing of *E lunata* and test food. The prolonged larval period in the third generation may be due to restricted growth and development of the insect at low temperature (17°C).

The average size of full grown first, second, third, fourth, fifth and sixth instar larva was 2.75 × 0.23, 6.55 × 0.61, 9.46 × 1.65, 16.16 × 2.47, 25.18 × 3.51 and 35.14 × 4.48 mm respectively (Table 1). The results are slightly different from the findings of Kushwaha and Bhardwaj (1967) who reported that first, second, third, fourth, fifth and sixth larval stage measured 1.62, 4.31, 9.28, 15.1, 18.4 and 29.14 mm in length. Different climate, rearing techniques and test food might have affected the measurements of different development stages of *E lunata*.

The pupa was obtect type with broad anterior end and tapering posteriorly to a pointed tip. Freshly formed pupa was light reddish brown; turned dark brown before adult emergence and measured from 12 to 14 mm (mean 13.25 ± 0.55 mm) in length and 5 to 6 mm (mean 5.37 ± 0.26 mm) in breadth (Table 1). The pupae from which the adults could not emerge turned reddish black and got reduced in size. The pupa became soft before the emergence of the adult. Pupal period ranged from 12 to 14 days in first, 13 to 15 days in second and 17 to 19 days in third generation (Table 2). Kushwaha and Bhardwaj (1967) and Islam et al (1988) made similar observations on the pupa and reported that pupa of *E lunata* was brownish in colour and pupal period ranged from 9 to 19 and 12 to 15 days.

Emergence of moths occurred mostly during the evening hours. The adult was pale yellow in colour and was seen sitting on castor plants during the day time. A centrally located semilunar black spot was observed on the upper side of the forewings of both the sexes. Abdominal tip was round in female and pointed in male. The anal tuft of female was more conspicuous than male and the female was larger than the male. The antennae of male moths were bipectinate whereas the female

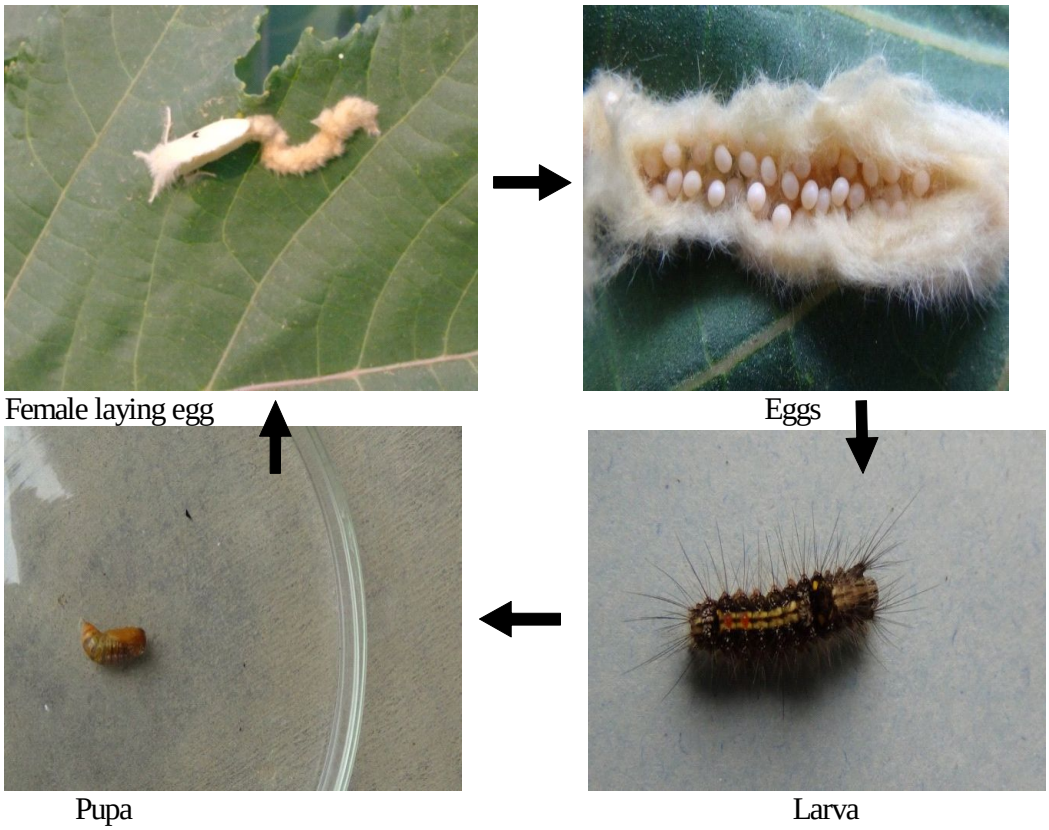

Plate 1. Life cycle of *Euproctis lunata*

Plate 2. Bipectinate antennae of male and filiform antennae of female *Euproctis lunata*

had filiform antennae. The male measured from 10 to 12 mm in length and 30 to 32 mm in wing expansion whereas female measured from 12 to 14 mm in length and 35 to 37 mm in wing expansion. The longevity of male adult ranged from 4 to 7 days and of female from 5 to 9 days in different generations. The present findings about the longevity of adults are in close agreement with the findings of Yazdani et al (1989) who reported that male survived for 5 to 6 and female for 5 to 7 days.

The pre-oviposition period was 1 to 2 days with a mean of 1.53, 1.57 and 1.51 days in three consecutive generations respectively. The oviposition period varied from 1 to 2 days (mean 1.52 ± 0.28 days) in first, 2 to 3 days (mean 2.36 ± 0.26 days) in second and 2 to 3 days (mean 2.58 ± 0.29 days) in third generation. Islam et al (1988) also reported similar observations on oviposition period of *E lunata*. The post-oviposition period varied from 2 to 3 days (mean 2.48 ± 0.31 days) in first, 2 to 3 days (mean 2.55 ± 0.26 days) in second and 3 to 4 days (mean 3.47 ± 0.30 days) in third generation. Similar observations on the post-oviposition period were also recorded by Atwal and Singh (1972).

The number of eggs laid per female was 95 to 172, 120 to 221 and 85 to 132 in 1st, 2nd and 3rd generations with mean number of 133.7, 168.8 and 110.7 repectively. The observations on the sex ratio showed that males were less in proportion than females. In laboratory reared insect population, male to female ratio was 1:1.1 whereas in the field collected insect population it was 1:1.2. Yazdani et al (1989) made similar observations on sex ratio and reported that it was 1:1.2.

The total duration of life cycle of male was 45 to 56 days in first, 50 to 61 days in second and 101 to 124 days in third generation. In case of females it varied from 45 to 58 days in first, 50 to 63 days in second and 102 to 127 days in third generation. Under laboratory conditions the insect completed three generations from August 2014 to March 2015. From the eggs of first generation laid on 20 August by the adults which emerged from the larvae collected from ber plants, the adult emergence took place on 4 October and they lived up to 9 October. Similarly the eggs of second generation were laid on 6 October, adults emerged on 25 November which lived up to 30 November. The eggs of third generation were laid on 27 November and adult emergence took place on 17 March 2015. Singh and Grewal (1981) reported three generations of *E lunata* from August to April under laboratory conditions. Similarly Kushwaha and Bhardwaj (1967) reported that insect completed three generations during the year.

The larval population of *E lunata* fluctuated from 1.0 to 9.0 larvae per plant during the study period. The first

appearance of larvae started from 21 August (2.3 larvae per plant) at temperature range of 25.1 to 30.4ºC and relative humidity from 48.8 to 76.3 per cent. The population increased gradually and reached peak level of 9.0 larvae per plant between 20 to 29 September 2014 when temperature ranged from 21.7 to 37.1ºC and relative humidity from 33.7 to 75.3 per cent. Thereafter declining trend was observed due to fall in maximum and minimum temperature. The second (5.2 larvae/plant) and third (3.5 larvae/plant) peaks were observed between 19 to 28 November 2014 and 19-28 March 2015. The results of the present field studies corroborate the findings of Yazdani et al (1989) who reported the peak activity of *E lunata* on castor from July to October and unfavourable period from April to June. However Biswas and Ray (2009) observed that *Euproctis* spp were found in the field round the year with two peaks: first during the month of October with 5 to 6 larvae/five twigs of plant and second during March with 4 larvae/five twigs of plant in northeastern India. The variation in the peaks may be due to the varying environmental conditions during these different periods.

CONCLUSION

On the basis of results it is concluded that insect laid eggs in cluster and number of eggs laid per female was 95 to 221. There were six larval instars and total larval period varied from 20 to 82 days in different generations. The pupa was obtect type and pupal period ranged from 12 to 19 days. The adult was pale yellow in colour and seen sitting on castor plants during the day time. There was a slight difference in sex ratio being in favour of female. The insect completed three generation under laboratory conditions. Three peaks of pest were observed in the field from August to April and maximum number of larvae (9.0 larvae/plant) was recorded between 20 to 29 September 2014 when temperature ranged from 21.7 to 37.1ºC and relative humidity 33.7 to 75.3 per cent.

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REFERENCES

Anonymous 2014. Annual report of AICRP on castor 2013-14. Directorate of Oilseed Research (ICAR), Hyderabad, Andhra Pradesh, India, 219p.

Atwal AS and Singh R 1972. The development of *Euproctis lunata* Walker (Lepidoptera: Lymantriidae) in relation to different levels of temperature and relative humidity. Journal of Research, Punjab Agricultural University **9(1):** 50-54.

Biswas S and Ray N 2009. Occurrence and damage of stem borer, *Zeuzera multistrigata* Moore and hairy caterpillar, *Euproctis* sp on host plant (Som) of Muga silkworm. Indian Journal of Entomology **71(1):** 90-93.

Gaur RK 2014. Diversity of insect pests of castor, *Ricinus communis* L and their ecological

interaction in southwest Haryana. International Journal of Farm Sciences **4(4):** 147-152.

Islam W, Nargis A and Joarder OI 1988. Biology, seasonal occurrence, host range and damage potential of the castor hairy caterpillar, *Euproctis lunata* Walker. (Lymantriidae: Lepidoptera). Crop Protection **7(5):** 332-335.

Kotle SJ 1995. Castor diseases and crop improvement. Shipra Publications, New Delhi, India, 85p.

Kushwaha KS and Bharadwaj SC 1967. Biology and external morphological characters of forest pests. I. Tussock caterpillars, *Euproctis* spp (Lymantriidae: Lepidoptera). Indian Journal of Agricultural Sciences **37(2):** 93-107.

Phillips R and Rix M 1999. Annuals and biennials. Macmillan, London, 106p.

Rai BK 1976. Pests of oilseed crops in India and their control. ICAR, New Delhi, India, pp 77-80.

Singh G and GS Grewal 1981. Biology of castor hairy caterpillar, *Euproctis lunata* Walker in the Punjab. Entomon **63:** 197-200.

Watt G 1892. A dictionary of economic products of India.

Yazdani SS, Hameed SF and Alam MM 1989. Biology and seasonal history of castor hairy caterpillar, *Euproctis lunata* Walker in north Bihar. Research and Development Reporter **6(1):** 83-86.

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