Study the biology of common castor butterfly, *Ariadne merione merione (*Cramer) (Nymphalidae: Lepidoptera)

Abstract

A laboratory experiment was conducted at the PC Unit Sesame & Niger, Department of Entomology, JNKVV, Jabalpur on biology of spiny castor caterpillar, *Ariadne merione merione* (Cramer) on castor. Considerable variation in larval period on castor plants was observed, with the shortest of 27.41(max.) and 25.80 (min.) days being when reared on castor leaves. Generally, females length longer than males on all the castor plants. The average developmental period of 1^{st}, 2^{nd}, 3^{rd}, 4^{th} and 5^{th} larvae were 70.92±4.89, 109.22±1.81, 134.37±1.87, 147.87±4.12 and 176.82±5.67 hours, respectively. The pupa length and width ranged from 18.79±0.74 mm and 5.62±0.11 mm, respectively. The periods of pre-oviposition, oviposition and post-oviposition in hours sequencely, 59.62±6.17, 121.42±2.42 and 61.69±3.20, respectively.

Keywords: Eclosion, revealed, leaves, developmental, departure, imitation.

1. Introduction

The spurge (Euphorbiaceae) family non-edible oilseed crop castor (*Ricinus communis* L.) is thought to have originated in Abyssinia. Due to its minimal demand on soil fertility, moderate rainfall requirements and lack of competition with food crops and food grade oils, it is extensively dispersed throughout the tropics and sub-tropics. Castor is farmed on an industrial scale in around 30 nations, with India leading the pack in terms of both acreage and production. Its fruits are attractive, but they are typically removed before ripening because the poison ricin concentrates in its beanlike seeds. It is also a host plant for the Eri-silkmoth (*Samia cynthia ricini*). The common castor butterfly is a pest of *Ricinus communis* (castor plants) and the larvae of *Tragia involucrate* and *T. plukenetti* (venomous nettles) (Kunte, 2000).

The common castor butterflies are brownish orange with black curved patterns. Females have larger curved lines that form distinct bands. The larvae of this butterfly only eat castor plant leaves. They prefer to rest on top canopy leaves, maintaining the wings slowly moving horizontally and always closer to host plants. Numerous insect pests attack castor at various stages of growth and the severity of the problem is especially high in Southern India, where the crop is mostly farmed as a rainfed crop, resulting in decreased seed yields. The dangerous but infrequent castor spiny caterpillar can be found on castor. The most important factor in managing castor spiny caterpillars is the larval stage, which feeds on the leaf tissue and results in

defoliation. This stage has been researched elsewhere in India but not yet in the region. In order to better understand the life cycle of this pest, an experiment has been conducted at JNKVV in Jabalpur, India. The purpose of doing this study is that castor producers can tell proper management strategy for the farmers.

2. Material and Methods

Insect collection and care under laboratory conditions Castor leaves with butterfly eggs were harvested from the field in 2020–21 at the Experimental Field AICRP, PC Unit Sesame & Niger, JNKVV, Jabalpur, MP. After hatching, emerging larvae were placed in an open environment inside a net cage (2mx2mx3m) on a small potted castor plant. If necessary, larvae were moved to new potted castor plants every two days to ensure they had fresh and ample food. Fully developed larvae were permitted to pupate inside the rearing cages once they reached adulthood. After pupation, pupae were collected and placed in another cages. The male and female adults emerging were collected in plastic bottles and released in separate rearing cage for mating and egg laying. Larvae were fed fresh castor leaves on a daily basis. The adults were fed with 10% honey soaked in cotton swabs. Longevity of life stages were observed with the larval instars, formation of pupa and adult emergence and until death. After death, adults were stretched and preserved for measuring their wing expanse and length. Colour, shape and incubation period observations were made. Newly hatched larvae were released singly in glass containers to determine the length of each instar. The researchers were able to document the pre-oviposition, oviposition and post-oviposition periods as well as fecundity and longevity, by keeping the paired adult moths in glass jars. Different life phases were evaluated under laboratory conditions using a digital vernier calliper.

2.1. Laboratory: AICRP, PC Unit Sesame & Niger, JNKVV, Jabalpur, MP.

2.2. Number of insects per sample collection: 12.

3. Results and Discussions

Female moths lay their eggs singly on the bottom surface of leaves between the midrib and veins, between floral buds, inside flowers and in stems and capsules. During egg laying, females spread their wings individually, in pairs and in clusters (12-15 per cluster). Similar egg laying pattern of *Ariadne merione merione (*Cramer) was observed by Bala *et al.,* (2014). The first instar began eating on empty egg shells and subsequently the skin of leaflets shortly after

emerging. The leaf epidermis, delicate and apical portion of the shoots were also consumed by 2nd instar larvae. The 3rd instar larvae, after initial feeding on the epidermis of leaves and tender parts of the plants. The 2nd instar larvae also ate the leaf epidermis as well as the sensitive and apical region of the shoots. By scrapping, 4th instar larvae feed on the leaf epidermis and delicate sections of the branches. Scrapping allowed 5th instar larvae to feed mostly on castor plant leaves and delicate portions. More or less similar damage pattern was observed by Bala *et al.*, (2014).

The freshly hatched larva was cream in colour at first, then turned brownish green on the dorsal side, with three brown horizontal stripes. The body was generally rectangular in form, with a small posterior narrowing. The head is little and brown. Larvae in their second instar were clothed in yellowish green spines with branching terminals. The brown head has two brown horns. Third instar larvae have a bright green broad stripe with a brown edge longitudinal to the body on the dorsal side. The three brown horizontal bands on the body spines were also brown. The blackish brown 1mm head had white designs on it. The larval body of the fourth instar turned green. The dorsal stripe darkened and became brown with yellowish white borders. The three black horizontal bars started to fade away. The head was square and blackish brown in colour. On the head, there were three triangular white marks. The head horns were reddish brown in colour and 2 mm long. The division was obvious. The spines on the body were green and were placed in four lines on each side of the body on all segments. When completely mature, the fifth instars were green with obvious segmentations and the dorsal stripe orange with black margins and numerous little white to cream coloured dots. Two above and one below the dorsal three horizontal stripes and white triangular marks with black edges are visible. The horns turned orange, with black tips and pale and greenish dark crossing lines on the body lateral sides. The colour of the spines altered from brown to black with yellow to orange dots at the base. Before approaching the pupal stage, the larva got sluggish and shrank significantly. This is known as the prepupal stage. The larva body tightened and it adhered itself to the substrate, its rear end dangling downwards. With pupal maturation, the brown colour shifted to black till adult eclosion. The male and female adults had the same reddish orange wings with black wavy lines. It was discovered in the field. Mating lasted 80 minutes from beginning to conclusion. Butterfly mating was seen to occur predominantly during the late morning hours (11:00 am to 2:00 pm).

The length and breadth of first instar caterpillar varied from 2.90 to 2.33 mm with an average of 2.52 mm and 0.057 to 0.054 mm with an average of 0.05 mm, respectively. Developmental period of first instar caterpillar varied from 75.10 to 65.70 hours with an average of 70.92 hours. Bala *et al.,* (2014) stated that the average length of the larva was 2-4 mm. During the Pre Monsoon (May-June), the first instar lasted 2 to 3 days and 3 to 4 days during the Post Monsoon (October-November).

The length of the second instar ranged from 6.50 to 7.11 mm with an average of 6.93 mm, while breadth varied from 0.087 to 0.083 mm with an average of 0.085 mm. Bala *et al.,* (2014) stated that the average length of the larva was 2-4 mm. During the Pre Monsoon (May-June), the first instar lasted 2 to 3 days and 3 to 4 days during the Post Monsoon (October-November).

There were no changes in other characters from previous instar. The length of the third instar caterpillar ranged from 15.49 to 11.78 mm with an average of 12.94 mm, while breadth varied from 0.15 to 0.16 mm with an average of 0.16 mm. Developmental period of third instar caterpillar varied from 136.90 to 132.60 hours with an average of 034.37 hours. Bala *et al.,* (2014) reported the average length of the larva was 8-16 mm. The third instar lasted 3 to 4 days during the Pre Monsoon (May-June) and 2 to 4 days during the Post Monsoon (October-November).

Legs were bright green. The fourth instar caterpillar's length ranged from 19.99 to 19.20 mm, with an average of 19.59 mm, while its breadth ranged from 0.21 to 0.22 mm, with an average of 0.21 mm. Bala *et al.,* (2014) stated that the average length of the larva was 2-4 mm. During the Pre Monsoon (May-June), the first instar lasted 2 to 3 days and 3 to 4 days during the Post Monsoon (October-November).

The caterpillar length ranged from 34.40 to 30.76 mm, with an average of 3.08 mm. The average breadth was 0.48 mm, with a range of 0.50 to 0.46 mm. The fifth instar caterpillar lasted from 181.60 to 169.10 hours, with an average of 176.82 hours. According to Bala et al. (2014), larvae ranged in length from 27 to 40 mm on average. During the Pre Monsoon (May-June), the larval phase lasted 2 to 3 days, and the Post Monsoon (October-November), it lasted 3 to 5 days.

The pre-pupa length ranged from 19.03 to 18.13 mm, with an average of 18.54 mm. The width ranged from 5.03 to 4.20 mm, with a mean of 4.57 mm. When the fifth instar was fully formed, it stopped feeding, turned brown and its lateral crossing lines changed to brown and

white. The larva became lethargic and shrank greatly as it approached the pupal stage. This stage, known as the prepupal stage, lasted 8 to 10 hours before forming the pupa. Bala *et al.,* (2014) reported average the pupa length ranged from 28 to 29 mm and its breadth was 3 mm. The pupal stage lasted 6 to 7 days during the Pre Monsoon (May-June) and 7 to 11 days during the Post Monsoon (October-November).

The length and width of the pupa ranged from 19.66 to 18.03 mm, with an average of 18.79 mm, and from 5.75 to 5.50 mm, with an average of 5.62 mm. The front end was extremely narrow. Both lateral sides curled inwards at their widest point, presenting two pointed projections on the dorsal side. The three early stages and adults can be found in their natural habitat all year. Rainfall appears to be the most essential component in *A. merione merione* Cramer, as it is in *Catopsilia crocale* (Chirstopher and Mathavan, 1986) and *Catopsilia pyranthe* (Atluri *et al.,* 2004). Precipitation during the North-West monsoon most likely influenced host plant reproduction. This season witnessed the largest new growth on the host plant, a resource required by the larvae for better performance due to the likely increased nitrogen and water content. Although the host plant was available all year, leaf quality in terms of nitrogen and water content could have varied. Wynter - Blyth (1957) assessed spring as the most favourable season for most of India, followed by post monsoon and South - West monsoon. Kunte (1997) discovered that peak flight activity occurred in the Northern Western Ghats during the late monsoon (August-September) and early winter (October-November). These differences in butterfly phenology demonstrate that different species respond differently to environmental seasonality and have varied life histories. Even distinct species within a genus can behave differently, as Jones and Rienks (1987) discovered in the three tropical *Eurema* species they studied.

Adult females lay eggs alone or in small clusters of 2 to 5 at a time on the underside of leaves. Adults were found eating decaying *Lantana camara* flowers, overripe, fallen and injured *Annona squamosa*, *Syzygium cumini* and *Artocarpus heterophyllus* fruits, and *Citrus aurantifolia* sap leaking from tree trunk wounds (Bala *et al.,* 2014).

Male length ranged from 61.52 to 56.89 mm, with an average of 59.70 mm and male breadth ranged from 5.52 to 4.75 mm, with an average of 5.08 mm. Female moths ranged in length from 14.23 to 13.68 mm, with an average of 13.97 mm, while breadth with wings stretched ranged from 6.15 to 5.90 mm, with an average of 6.03 mm.

Female moth pre-oviposition period ranged from 67.69 to 54.29 hours, with an average of 59.62 hours. Females had an oviposition period that ranged from 123.00 to 117.82 hours, with an average of 121.42 hours.

Ariadne merione merione Cramer has a lifespan ranging from 70 to 66 days. Bala *et al.*, (2014) determined that the overall development time from egg laying to adult eclosion is 22-32 days, allowing for up to 9 overlapping broods every year.

Table 1. The duration of several life phases of spiny castor caterpillar on castor.

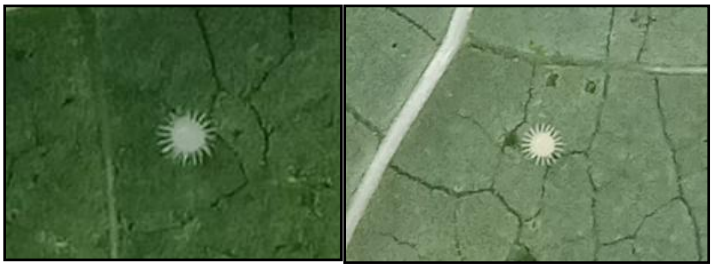
S. No.	Life phases	Period		
		Maximum	**Minimum**	**Mean±SD**
1.	**Eggs (days)**	3.30	2.80	3.05±0.24
2.	**Larvae**			
	1st instar (Hrs.)	75.10	65.70	70.92±4.89
	2nd instar (Hrs.)	111.80	107.90	109.22±1.81
	3rd instar (Hrs.)	136.90	132.60	134.37±1.87
	4th instar (Hrs.)	152.50	144.10	147.87±4.12
	5th instar (Hrs.)	181.60	169.10	176.82±5.67
	Total larval period (Days)	27.41	25.80	-
3.	Pre-pupa (Hrs.)	141.01	123.30	133.05±7.68
4.	Pupa (Hrs.)	85.99	78.15	83.31±3.67
5.	**Adults**			
	Pre-oviposition (Hrs.)	67.69	54.29	59.62±6.17
	Oviposition (Hrs.)	123.00	117.82	121.42±2.42
	Post oviposition (Hrs.)	64.45	57.11	61.69±3.20
6.	**Longevity**			
	Female (Days)	39.46	38.17	38.77±0.53

Table 2. Biometric parameters of various stages of spiny castor caterpillar on castor.

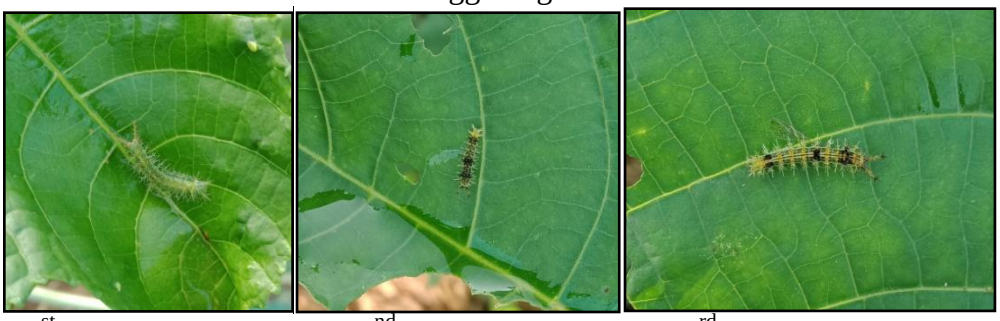
S. No.	Stage	Particulars	Measurement (mm)		
			Maximum	**Minimum**	**Mean±SD**
1.	**Larvae**				
	1st instar	Length	2.90	2.33	2.52±0.25
		Width	0.057	0.054	0.05±0.01
	2nd instar	Length	7.11	6.50	6.93±0.29
		Width	0.087	0.083	0.085±0.01
	3rd instar	Length	15.49	11.78	12.94±1.73
		Width	0.16	0.15	0.16±0.02
	4th instar	Length	19.99	19.20	19.59±0.32
		Width	0.22	0.21	0.21±0.05
	5th instar	Length	34.40	30.76	32.08±1.62
		Width	0.50	0.46	0.48±0.01
2.	Pre-pupa	Length	19.03	18.13	18.54±0.37
		Width	5.03	4.20	4.57±0.34

3.	Pupa	Length	19.66	18.03	18.79±0.74
		Width	5.75	5.50	5.62±0.11
4.	**Adults**				
	Male	Length(mm)	61.57	56.89	59.70±2.05
		Wing expanded(cm)	5.52	4.75	5.08±0.33
	Female	Length(mm)	14.23	13.68	13.97±0.23
		Wing expanded (cm)	6.15	5.90	6.03±0.13

Plate 1: Life cycle of castor butterfly



Eggs stage



1st instar larva 2nd instar larva 3rd instar larva

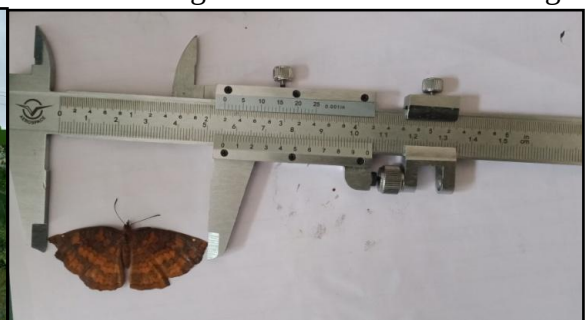
4th instar larva 5th instar larva Pre-pupal stage

Pupal stage

Adult stage

Damaged leaf

Host Plant



Adult measurement

4. Conclusion

The incubation period of eggs with an average of 3.05 days. The length and breadth of 1st, 2nd, 3rd, 4th and 5th instars caterpillar varied from 2.52, 6.93, 12.94, 19.59, 3.08 mm and 0.05, 0.085, 0.16, 0.21, 0.48 mm, respectively. The length of pre-pupa and pupa with an average of 18.54 and 5.62 mm, respectively. The male length and breadth and female moth with an average of 59.70, 13.97 mm and 5.08 and 6.03 mm, respectively. The average pre-oviposition and oviposition period of a female moth of 59.62 and 121.42 hours, respectively. The total life cycle of *Ariadne merione merione* Cramer varied from 70-66 days.

Conference disclaimer:

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5. Competing interests

Authors have declared that no competing interests exist.

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