

Biology of Plume moth, *Sphenarches caffer* zeller on Natural and Artificial diet

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ABSTRACT: Studies on the biology of Plume moth, *Sphenarches caffer* Zeller on natural diet as well as artificial diet was conducted under laboratory conditions at S.V. Agricultural College, Tirupati during rabi 2007 at prevailing room temperature of $29 \pm 2^\circ\text{C}$ and relative humidity of 70-80%. Total life cycle of plume moth ranged between 22.5 to 45.3 days on natural diet as compared to 22.5 to 51.0 days when reared on artificial diet. The body length of different larval instars were 1.604, 2.286, 5.457 and 7.521 mm for first, second, third and fourth instar on natural diet and on artificial diet larva measured 1.263, 2.088, 4.828, and 6.880 mm, respectively and were significantly different. Pupae reared from natural diet were much bigger in size as compared pupae reared on artificial diet. About 15% larval mortality was observed on natural diet as compared to 30% on artificial diet. Suitability of artificial diet for continuous and uniform rearing of Plume moth, *Sphenarches caffer* Zeller has been discussed.

Key words: Field bean, Plume moth, *Sphenarches caffer*, Artificial diet

INTRODUCTION

Field bean is a multipurpose crop grown as pulse, vegetable and forage. Green pods of this legume forms an excellent table vegetable. This crop is suffered by a number of insect pests such as pod borers namely, gram pod borer (*Helicoverpa armigera* Hubner), legume pod borer (*Maruca vitrata* Geyer), blue butterfly (*Lampides boeticus* Linn.), plume moth (*Exelastis atmosa* Meyr.), brown caterpillar (*Anarsia ephippias* Meyr.), tobacco caterpillar (*Spodoptera litura* Fabricius) assume the status of major pests as they feed on buds, flowers and pods of field bean [Mrig 1 and Yadav 2].

The plume moth that commonly occurs on pigeon pea is recorded as *Exelastis atmosa*, but plume moths observed at S.V. Agricultural College farm, Tirupati were identified as *Sphenarches caffer* Zeller [3] and caused considerable yield losses in field bean.

Availability of high numbers of superior quality insects reared on natural diet suffer from a number of constraints such as absence of food crop throughout the year, influence of biotic and abiotic stress etc. These constraints have necessitated the work on rearing insects on artificial diet, with agar as the base media. Artificial diet can supplement the requirement

of natural food material for large scale multiplication of insects. So, an attempt was made to study the suitability of an artificial diet for continuous rearing of an important pulse insect pest *i.e.* plume moth, *S. caffer*.

MATERIALS AND METHODS

The nucleus culture of *S. caffer* was maintained on flower buds and tender pods of field bean in the laboratory (natural diet).

An artificial diet was prepared according to the protocols of Narayanan [4], by incorporating leaf powder of field bean var. TFB-1, into an agar based medium and used for continuous rearing of *S. caffer* (Table 1).

Twenty 1st instar larvae were individually released on to natural diet of field bean var. TFB-1, as well as on artificial diet that was placed in sterile vials (5.5 x 2.5 cm). The experiments were conducted at room temperature $29 \pm 2^\circ\text{C}$ and 70-80% RH in CRD. Observations were collected on morphometrics, larval duration, number of instars, instar duration, pupal duration, adult emergence, oviposition etc., both on natural and artificial diet. The data was analysed in CRD with SPSS statistical package.

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Table 1
Composition of different ingredients used for the preparation of artificial diet for *S. caffer*

Ingredient	Quantity
Soy flour	15.0 g
Lablab bean's leaf powder	5.0 g
Casein (Vitamin free)	10.0 g
Yeast	5.0 g
Glucose	4.0 g
Wheat germ	10.0 g
Ascorbic acid	1.5 g
Vitiolin	0.5 g
Multivitaflex	0.5 g
Wesson's salt mixture	4.0 g
Sorbic acid	0.5 g
Methyl-para-hydroxy benzoate	1.0 g
Streptomycin sulphate	0.12 g
Formaldehyde 10 %	1 ml
Agar	8.0 g
Water	400 ml

RESULTS & DISCUSSION

I. Instar

The mean length and breadth of the neonate larva was 1.604 x 0.204 mm when reared on natural diet as compared to 1.263 x 0.169 mm, on artificial diet and the differences were statistically different.

II. Instar

The II instar larva was greenish in the early stages, which later turned to brown in colour with hairs and spines with black head over the body. The mean length and breadth of the second instar was 2.286 x 0.275 mm when reared on natural diet against 2.088 x 0.252 mm on artificial diet and were significantly different.

III. Instar

The third instar larva was brown in colour with profuse hairs and black spines on its body. The mean length and breadth of the larva on natural diet was 5.457 x 0.570 mm diet; whereas on artificial diet it was 4.828 x 0.486 mm and were significantly different (Table 3).

IV. Instar

The fourth instar larva was densely clothed with white hairs and spines with brownish black heads. A whitish band followed by two brownish bands on either side covered with white hairs was noticed all over the body from thorax to abdomen. The brownish larva turned light green before pupation. The mean length and breadth of the larva was 7.521 x 0.941 mm when the

larvae were reared on natural diet, whereas on artificial diet it was 6.880 x 0.890 mm.

Larval duration

There were a total of 4 instars in the larval stage of *S. caffer*. The total larval duration ranged from 12.5 to 20.8 days when reared on natural diet with a mean of 14.06 as against 15.5 to 24.5 days with a mean of 14.18 days, when the larvae were reared on artificial diet. The mean larval durations of first instar; 2nd instar; 3rd instar and 4th instar larvae on natural and artificial diet were 2.66 and 3.32 days; 2.72 and 3.13 days; 4.10 and 3.76 days and 4.59 and 4.58 days respectively. The larval duration of insects reared on natural and artificial diet were not statistically different (Table 2). The sex ratio was 1: 1.125 (Female: male) in case of natural diet and 1: 1.4 in case of artificial diet.

Larval mortality

Thirty per cent larval mortality (20% in 1st instar, 5% in 2nd instar and 5% in 3rd instar) was observed when larvae were reared on artificial diet as against to fifteen per cent larval mortality (10% in 1st instar and 5% in 2nd instar), when larvae were reared on natural diet, though not statistically different (Table 2).

Pupa

Fresh pupae were light greenish in colour which turned to dark brown before adult emergence. The mean pupal length and width was 6.703 x 1.270 mm when reared on natural diet as against 6.205 x 1.165 mm when reared on artificial diet and were statistically different. In general, pupae reared on natural diet were much bigger as compared to the pupae reared on artificial diet. These results correspond to Sujithra *et al.* [3] who reported the pupal size as 6.1 x 1.14 mm when the insects were reared on natural diet.

The mean pupal period was 5.39 days with a range of 4.0 to 9.0 days on natural diet whereas on artificial diet it was 5.55 days with a range of 5.0 to 10.5 days. Per cent pupal recovery was 85 and 70 on natural and artificial diet, respectively.

Adult

The longevity of male and female moths on natural diet ranged between 2.9 days to 5.5 days (mean of 3.99 days) and 4 to 9 days (mean of 6.62 days), respectively. The longevity of males and females emerging from artificial diet was 2.0 to 5.0 days for males (mean of 3.55 days) and 3.0 to 8.0 days for females (mean of 5.60).

Table 2
Performance of plume moth *S. caffer* on both natural and artificial diet

Developmental stage	Natural Diet Range	Natural Diet Mean ± SE	Artificial Diet Range	Artificial Diet Mean ± SE	Cal F	Significance
Fecundity	80 - 100	98.3 ± 2.62	60 - 113	85.15 ± 3.5	9.100	S
Incubation period	2.0 - 6.5	4.32 ± 0.30	2.0 - 8.0	5.83 ± 0.41	8.581	S
I Instar	2.5-3.8	2.66 ± 0.27	3.0-5.0	3.32 ± 0.40	1.864	NS
II Instar	2.5-4.0	2.72 ± 0.28	3.0-5.0	3.13 ± 0.43	0.66	NS
III Instar	3.5-6.0	4.10 ± 0.44	4.0-6.5	3.76 ± 0.58	0.216	NS
IV Instar	4.0-7.0	4.59 ± 0.48	5.0-8.0	4.58 ± 0.70	0.00	NS
Total Larval period	12.5-20.8	14.06 ± 1.46	15.5-24.5	14.18 ± 2.19	0.002	NS
Pupal Period	4.0 - 9.0	5.39 ± 0.62	5.0 - 10.5	5.55 ± 0.90	0.021	NS
Total Life cycle	22.5 - 45.3	27.35 ± 2.84	25.5 - 51.0	27.26 ± 4.19	0.00	NS
Mortality		15 ± 8.19		30 ± 10.51	1.267	NS
Male longevity	2.9 - 5.5	3.99 ± 0.16	2.0 - 5.0	3.55 ± 0.26	2.026	NS
Female longevity	4.0 - 9.0	6.62 ± 0.31	3.0 - 8.0	5.6 ± 0.27	6.123	NS

* at 0.05 level

Table 3
Morphometrics of different stages of plume moth *S. caffer* on natural and artificial diet.

S No	Stage	Measurement mm	Natural diet ± SD	Artificial diet ± SD	Significance level *
1	Egg	Length	0.397± 0.035	0.381 ± 0.038	NS
		Width	0.186 ± 0.031	0.170 ± 0.033	NS
2	1st instar	Length	1.604 ± 0.08	1.263 ± 0.190	S
		Width	0.204 ± 0.017	0.169 ± 0.039	S
3	2nd instar	Length	2.286 ± 0.149	2.088 ± 0.141	S
		Width	0.275 ± 0.075	0.252 ± 0.038	NS
4	3rd instar	Length	5.457 ± 0.193	4.828 ± 0.229	S
		Width	0.570 ± 0.040	0.486 ± 0.029	S
5	4th instar	Length	7.521 ± 0.245	6.880± 0.205	S
		Width	0.941 ± 0.170	0.890 ± 0.138	NS
6	Pupa	Length	6.703 ± 0.249	6.205± 0.431	S
		Width	1.270 ± 0.035	1.165 ± 0.092	S

* at 0.05 level

Females lived longer than males. Sexual dimorphism in respect of *S. caffer* revealed that the abdomen in female moths were comparatively longer and bulged while males had tapered abdomen.

Fecundity

A single female moth reared on natural diet laid an average of 98.3 eggs as against 85.15 eggs when reared on artificial diet. The average size of the eggs deposited by insects reared on natural and artificial diet was 0.397 x 0.186 mm and 0.381 x 0.170 mm

respectively. Incubation period of the eggs ranged from 2 to 6.5 days (mean of 4.32) on natural diet and on artificial diet, it was 2 to 8 days (mean of 5.83).

The larvae and pupae that were reared on natural diet were bigger in their size as compared to the ones that were reared on artificial diet. This was evident from the morphometrical observations of larval instars and pupae (Table 3). Consequently more number of eggs were laid by the adults reared on natural diet as compared to artificial diet (Table 2). In spite of the significant differences in the

morphometrical observation and fecundity, the durations of larvae reared on natural and artificial diet were not significant.

Thus, the present study on performance of *S. caffer* on artificial diet forms an exclusive report of rearing plume moth, *S. caffer* on field bean based artificial diet that could be supplemented with natural diet in times of scarcity of natural diet.

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