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REARING OF *Mallada astur* (Banks) (NEUROPTERA : CHRYSOPIDAE) ON A SEMI-SYNTHETIC DIET

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ABSTRACT : *Mallada astur* (Banks), an important predator of sucking pests in horticultural ecosystems, was reared on a larval semi-synthetic diet comprising hen's egg yolk (64.6 g), hydrolysed soyabean powder (2.6 g), honey (32.2 g), yeast extract (2.6 g), niphagine (0.05 g), petroleum jelly (1.4 g), paraffin wax (19.3 g) and distilled water (77.4 ml). Biological attributes of *M. astur* on reared semi-synthetic diet was compared with the host insect reared. Semi-synthetic diet reared predators laid highly fertile eggs (88.0 to 90.0%) similar to host insect reared predators. Duration of the larval stage is lengthened when reared on semi-synthetic diet. Mean adult emergence (F_0 to F_3) of semi-synthetic diet and host insect reared predator was 56.0% and 75.2% respectively and the adult emergence decreased from F_0 to F_3 generations both in semi-synthetic and host insect reared *M. astur*. Difference in fecundity between semi-synthetic diet and host insect reared predators was non-significant. The above findings revealed that *M. astur* could be reared using the semi-synthetic diet.

Key Words : *Mallada astur*, semi-synthetic diet.

INTRODUCTION

In India, the chrysopid, *Mallada astur* (Banks) (Neuroptera : Chrysopidae) was first recorded in Karnataka on guava (Singh and Narasimhan, 1992) and is an important predator of mango green shield scale, *Chloropulvinaria polygonata* (Ck11.) and spiraling whitefly, *Aleurodicus dispersus* Russel on many horticultural crops in Karnataka (Mani and Krishnamoorthy, 1998, 1999). Jalali and Singh (1994) reported that *M. astur* larvae consumed more *Aphis gosspii* Glover than *Cheilomenes sexmaculata* (Fabricius). Generally this predator is reared on factitious preys *viz.*, eggs of *Corcyra cephalonica* (Stainton), *Sitotroga cerealella* (Olivier) and *Ephestia kuhniella* (Zeller) which is laborious and expensive method, as it involves rearing of the host insect and its predator. Further, this method would hamper the large-scale production and field release of the predator against crop pests as the rearing of the predator is totally depending on host insect production. Hence, it was felt necessary to develop a semi-synthetic diet based rearing systems which would eliminate the need to rear prey species, reducing considerably the costs of mass production. Very limited work had been done on this line in India and elsewhere with varying degrees of success (Venkatesan *et al.*, 2000; Cohen and Smith, 1998;

Lee-Wen Tai *et al.,* 1994). Hence, an attempt was made to rear *M. astur* using modified semi-synthetic diet of Venkatesan *et al.* (2000).

MATERIALS AND METHODS

A. Stock culture :

Mallada astur culture was maintained on *Corcyra cephalonica* eggs (host insect) irradiated with UV rays (15 Wt UV tube for 45 minutes at distance of 2 feet to prevent hatching). Insects from this culture provided the initial stock for the semi-synthetic diet (SSD) and for the host insect *(Corcyra)* reared *M. astur.* The following treatments were used for the study.

i. Semi-synthetic diet

Table 1. Composition of semi-synthetic diet used in the study.

Diet ingredients	Quantity
Hen's egg yolk	64.6 g
Hydrolysed soybean powder	2.6 g
Honey	32.3 g
Yeast extract	2.6 g
Niphagine (antibiotic)	0.05 g
Petroleum jelly (Bioline)	1.4 g
Paraffin wax (melting point 52°C)	19.3 g
Distilled water (Millipore product)	77.4 ml

ii. Host insect (eggs of *Corcyra cephalonica*)

B. Preparation of semi-synthetic diet :

Hydrolysed soybean powder was prepared by autoclaving freshly ground soya flour and water (1:4 ratio) under pressure at 15 lb cm^2 for 30 minutes. All the diet ingredients were weighed in an electronic balance and were mixed thoroughly in a glass beaker (cap. 500 ml) and placed in a water bath at 50°C. The diet was stirred until it became paste. Petroleum jelly and paraffin wax were added to the boiling diet, which helps in encapsulation of the diet. Such SSD was kept in refrigerator for a day, which helps in removing the off flavour due to the chemicals. Semi-synthetic diet was removed from the refrigerator as and when needed and was heated slightly and then capsules (5-6 mm) were prepared by placing the droplets of the diet on polythene sheets (helps in retaining moisture of the diet) using a dropper. Fresh capsules were provided every day to the larva. The SSD was stored at 5 – 10°C in a refrigerator and fresh diet was prepared every week.

C. Rearing of *Mallada astur* :

Two day-old larvae were taken for the experiment as they readily accepted the diet in our preliminary investigations. As the larvae cannibalistic in nature, reared individually in glass vials (4.5 x 2 cm) plugged with absorbent cotton and the vials were changed once in four days. The experiment both on SSD and host insect were replicated ten times and twenty-five M *astur* larvae were taken in each replication. The study was conducted for 3 generations at 26.5±1°C and 65% RH at the Project Directorate of Biological Control, Bangalore, India during 1998. The entire experiment was conducted in an aseptic condition under laminar flow.

Freshly emerged *M. astur* adults reared from SSD and host insect were sexed and kept in pairs in a transparent plastic container (12 x 8 cm) and provided with cotton swabs soaked in 30 per cent honey solution (in water) and 50 per cent protinex (in water) separately and castor pollen grains. Then the plastic container was covered with brown sheet for egg laying and the sheets were punctured to facilitate proper aeration. The observation was recorded on per cent egg hatching, larval and pupal period, percent pupation and per cent adult emergence, longevity and fecundity. Weights of the one-day-old cocoons obtained from SSD and host insect were recorded using a Sartorius BP 210D balance. Percentage data was transformed using arc sine transformation before analysis. CRD was done for each generation to compare the differences in biology of the SSD and host insect reared M *astur.*

RESULTS AND DISCUSSION

Comparison of biology of semi-synthetic diet and host insect reared *Mallada astur.*

A. Egg hatch, larval and pupal period and cocoon weight

Results on egg hatch revealed that the difference in mean egg hatch of semi- synthetic diet (SSD) and host insect reared *M. astur* in F_0 non-significant and the same trend was observed in subsequent generations (F_1 to F_3). The egg hatch of SSD reared predators for F_0 to F_3 ranged from 88.0 to 90.0 %, which showed that eggs were highly fertile (Table 2) as in the case of host insect reared. During the rearing process, SSD reared larva was found to remove the paraffin wax coating with the help of mandible to feed on the diet. Mean larval period of the SSD reared predator in F_0 was 21.0 days, which was significantly more than that of host insect reared predator (11.6 days). SSD reared larva took long time to reach pupal stage in all the generations which is due to the fact that the larvae developed slowly on the SSD. Both SSD and host insect reared *M. astur* completed pupal period in 12.0 days each in F_0 generation. However, pupal period of SSD reared predator during F_1 to F_3 was significantly more than that of host insect reared (Table 2). Maximum (8.2 mg) and minimum (4.2 mg) cocoon weight were recorded on host insect and SSD reared predators respectively, and the difference was significant. Similar observation was also recorded for SSD and host insect reared predators during F_1 to F_3 generation (Table 2).

B. Survival, adult emergence, fecundity and longevity

Mean survival was significantly more (87.0 %) in F_0 generation for host insect reared predators, compared to 68.0 % on SSD (Table 3) and similar observations were also recorded during F_1 to F_3 generation (Table 3). Survival of SSD and host insect reared predator in F_0 generation was decreased to 65.0 and 83.0 % respectively in F_3 generation. Mean adult emergence in SSD was 61.0%, which was significantly less than that of host insect reared (87.0 %) at P=0.05. Similar to survival, adult emergence of the SSD reared predator in F_1 to F_3 generation was significantly lesser than that of host insect reared. It was also found that adult emergence of the host insect and SSD reared *M. astur* was gone down to 49.0 % and 69.0% respectively in F_3 generation which could be attributed due to the biological depreciation in the laboratory reared predators. Continuous laboratory rearing of *Pharoscymnus horni* Weise on *Hemiberlesia lataniae* Signoret was found to affect the biological attributes of the predator when compared to the field collected (Anonymous, 1992). Poor performance of successive laboratory rearing of predators *viz., Chrysoperla carnea* and *Podisus maculiventris* were attributed to inbreeding effect by Zheng *et al.* (1993) and De Clercq *et al.* (1998 a), respectively.

SSD reared *M. astur* laid 150 eggs in its life period in F_0 generation which was not significantly different from the host insect reared (170 eggs) Difference in fecundity of SSD and host insect predator in F_1 to F_3 was non-significant (Table. 3). SSD reared adults lived for 29.0 days during F_0 generation which was significantly lower than that of host insect reared (63.0 days). Cohen and Smith (1998) have reared *Chrysopa rufilabris* Burmeister using beef liver and beef based semi-synthetic diet. *Chrysoperla carnea* (Stephens) was reared for 10 successive generations using a larval SSD with an average adult emergence of 56.7 %. However the fecundity of the predator reared on SSD was significantly lesser than that of *Corcyra* reared (Venkatesan *et al.*, 2000). Longevity of SSD reared predator was significantly less than that of host insect reared in all the generations. Semi-synthetic diet reared predators are reported to be inferior to those reared on natural or factitious

Table 2 : Comparison of egg hatch, larval, pupal period and cocoon weight of semi-synthetic diet and host insect reared *Mallada astur* in different generations.

Growth Parameters	F_0 generation		F_1 generation		F_2 generation		F_3 generation	
	SSD	HI	SSD	HI	SSD	HI	SSD	HI
Egg hatch (%)	90.0 (71.6)*a	90.0 (71.6)a	89.0 (70.7)a	90.0 (71.6) a	89.0 (70.7) a	90.0 (71.6)a	88.0 (69.7)a	89.0 (70.7)a
Larval period (days)	21.0a	11.6b	18.6a	13.0b	22.0a	14.0b	23.0a	14.0b
Pupal period (days)	12.0 a	12.0 a	12.0 a	12.0 a	13.0 b	15.0 a	14.0 b	15.0 a
Cocoon weight (mg)	4.2 b	8.2 a	4.2 b	8.3 a	4.0 b	8.1 a	3.9 b	8.2 a

*Figures within parentheses are arc sine-transformed values
Figures followed by same letter in a row in each generation are not significantly different (P=0.05)
SSD-Semi-synthetic diet; HI-Host insect.

Table 3 : Comparison of survival, adult emergence, fecundity and longevity of semi-synthetic diet and host insect reared *M. astur* in different generations.

Growth Parameters	F_0 generation		F_1 generation		F_2 generation		F_3 generation	
	SSD	HI	SSD	HI	SSD	HI	SSD	HI
Survival (%)	68.0 (55.6)* b	87.0 (69.1) a	72.0 (58.1) b	76.0 (60.1) a	65.0 (53.8) b	80.0 (63.8) a	65.0 (53.9) b	83.0 (65.74)
Adult emergence (%)	61.0 (51.4) b	87.0 (60.0) a	61.0 (51.4) b	66.0 (54.4) a	53.0 (46.7) b	79.0 (62.9) a	49.0 (44.4) b	69.0 (56.2) a
Fecundity (nos.)	150.0 a	170.0 a	140.0 a	162.0 a	160.0 a	180.0 a	132.0 a	167.0 a
Longevity (days)	29.0 b	63.0 a	21.0 b	47.0 a	42.0 b	73.0 a	41.0 b	56.0 a

*Figures within parentheses are arc sine-transformed values
Figures followed by same letter in a row in each generation are not significantly different (P=0.05)
SSD-Semi-synthetic diet; HI-Host insect.

insect (Cohen and Staten, 1994). Differences in predator performance on semi-synthetic diet and on *Corcyra* eggs may be related to nutritional quality of the prey and prey acceptance (De clercq *et al.*, 1998 b). It was evident from the studies that the SSD reared *M. astur* were comparable with the host insect reared with reference to the major biological attributes *viz.*, egg hatching, per cent survival, adult emergence and fecundity. It is suggested that the research on this line should be further strengthened for the development of complete semi-synthetic diet based rearing of predators which would help in commercial mass rearing of the predators with out depending on the natural host or factitious host insects.

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