

Biology and feeding potential of *Parena nigrolineata* (Chaudoir) (Coleoptera: Carabidae), a predator of the coconut caterpillar *Opisina arenosella* Wlk.

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INTRODUCTION

A large number of carabid beetles are predacious. Two species viz. *Parena nigrolineata* (Chaudoir) (*Phlaeodromius nigrolineatus* Chau.) and *Calleida splendidula* F. (*Parena laticincta* Bates.) were recorded on the coconut leaf eating caterpillar *Opisina arenosella* Wlk. (*Nephantis serinopa* Meyr.) (Rao, 1924; Rao *et al.* 1948). *P. nigrolineata* is widely distributed in South India (Rao *et al.* 1948; Nirula, 1956; Rao *et al.* 1974) and Sri Lanka (Dharmaraju, 1963). Its biology and feeding

potential were studied by Ganeswara Rao *et al.* (1978) and David *et al.* (1975) under the name *Parena laticincta*. However, those authors did not mention the rearing techniques of the predator in the laboratory. In this paper we furnish an easy technique to rear *P. nigrolineata*, so that this predator could also be reared in the laboratory and released in the field for the biological suppression of *O. arenosella*. Additional information on its biology and description of the immature stages are also furnished.

MATERIALS AND METHODS

Adults of *P. nigrolineata* collected from the field were released in groups of five in each of the specimen glass jars (size 15×5 cm) and covered with mull cloth. Fresh coconut leaf bits, 10 cm long, containing adequate numbers of fourth instar caterpillars of *O. arenosella* were provided in each jar. The leaf bits were examined daily for eggs. The eggs were removed along with small bits of the leaf lamina and kept in glass tubes of size 8×2.5 cm for hatching. The experiment was run in two sets.

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In one set, the glass tubes containing eggs were maintained in the laboratory under the normal room temperature and relative humidity, 23 to 29.5°C and 66 to 96%, respectively. In the other set, additional moisture was provided by keeping small rolls of cotton wool soaked in water. The tubes were plugged firmly with cotton rolls covered with mull cloth.

The hatched grubs were collected daily and transferred individually to separate glass vials of size 8×2.5 cm. In view of the cannibalistic behaviour of grubs in the early stages they had to be reared individually in separate glass vials. Initially, the grubs were provided with one second instar caterpillar of *O. arenosella* each as food. Thereafter they were provided with fourth instar caterpillars, as and when required. The development of the grub and its rate of predation were watched carefully.

When the grubs attained maturity and stopped feeding they were maintained in three sets. In the first set, a few grubs were transferred to a glass bottle (15×5 cm) with coconut leaflets. In the second set, the grubs were transferred to another bottle containing dry loose soil. The third set was provided with moistened loose soil in the bottle. The percentage of successful pupation and the time taken for completion of the pupal phase in each set were noted. For general laboratory

rearing the mature grubs can be conveniently transferred to petri-dishes containing moist soil.

The eggs of *P. nigrolineata* collected from the field were maintained in the laboratory for recording the emergence of egg parasites, if any.

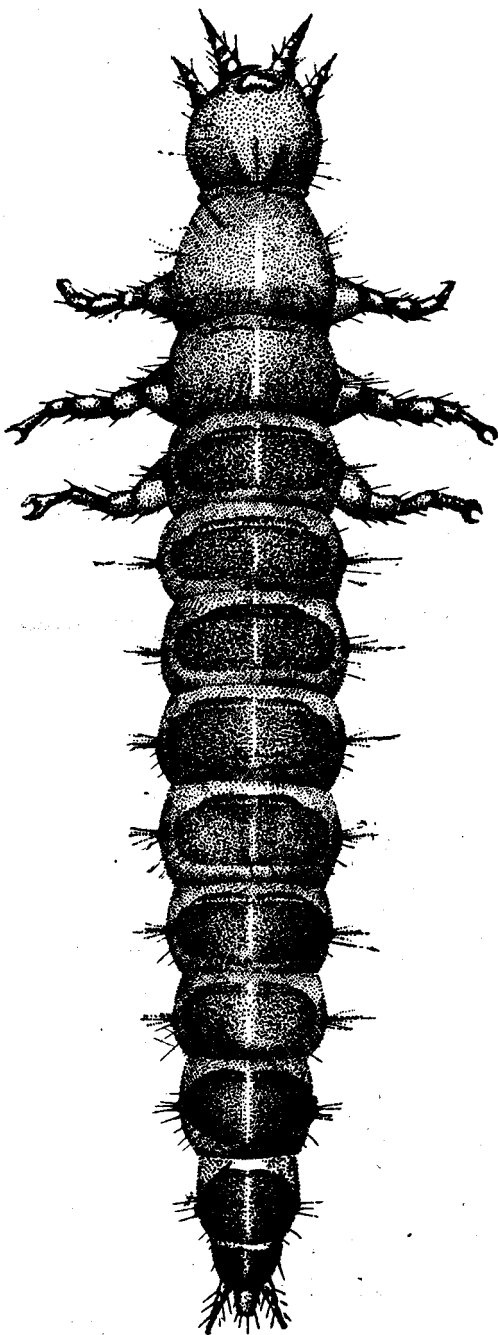


Fig. 1. Fully grown grub of *Parena nigrolineata*

RESULTS AND DISCUSSION

The eggs are oval, white with an opaque rough chorion. They were found mostly laid singly on the under surface of the leaflets firmly glued and concealed with the frass. Out of 683 eggs collected from laboratory rearing cages 469 (68.7%) were found on the margins of leaflets, 132 (19.3%) on the periphery of the area of the lamina gnawed by the caterpillar and 82 (12.0%) on other parts including the midrib of the leaflet.

At normal room temperature and relative humidity only 12.53% of the eggs hatched, whereas when additional moisture was provided the hatching rate rose to 64.46%. Incubation period of eggs ranged from 4 to 9 days. Mean incubation periods under normal laboratory condition and when provided with additional moisture were 5.66 ± 1.08 and 5.21 ± 0.62 days, respectively. According to Ganeswara Rao *et al.* (1978) the incubation period of *P. nigrolineata* was 5 to 9 days, with an average of 6.5 days. David *et al.* (1975) recorded an egg period of 4-5 days.

Description of immature stages:

First instar grub: Brownish, 0.27 cm long, head brown with black eyes, antennae

four-jointed, the third being the largest; prothorax larger than the head, body progressively tapering towards the posterior end, abdominal segments 10, smaller; anal cerci dark, four jointed, the last being the longest, last abdominal segment tubular and laterally pubescent.

Second instar grub: Similar to the first instar grub (0.5 cm long).

Third instar grub: Attains a maximum length of 1.4 cm, light reddish brown body with dark brown segmental plates, head reddish brown, smaller as compared to the body segments, eyes small, short antennae retained, prothorax biggest of all other segments, thoracic segments fully covered with segmental plates, anal cerci short and dark, tenth abdominal segment as with other instars tubular, brownish sensory hairs present on the head and body segments, legs brown terminating in two small claws (Fig. 1).

Pupa: Creamy, turns light yellow and then brown. Head small with prominent black eyes; brownish hairs present in a small area on the head, the remaining portions of the head without hairs; brownish hairs arranged in definite rows on the body; spiracles visible dorsally; 0.5 cm long and 0.3 cm wide.

The duration of each instar of the grub phase is furnished in Table I. During the entire feeding period of the grub (13.5 ± 2.18 days) each grub fed on 4.39 ± 0.38 fourth instar caterpillars of *O. arenosella*. This works out to



Fig. 2. Developing pupae of *P. nigrolineata* in moist soil

0.32 caterpillar per day. Ganeswara Rao *et al.* (1978) recorded the duration of the third instar grubs as 8.2 days. It differs significantly from our finding of 4.75 days. However, we observed that, when the third instar grubs were not provided with moistened soil for pupation, they remained active for longer periods without entering even the pre-pupal stage. Further, most of the grubs failed to pupate when moistened soil was not available. This was quite evident from the observation that the grubs maintained in bottles containing coconut leafbits and those in dry loose soil did not pupate at all.

The grubs tunnelled 0.5 to 1.0 cm deep into the moist soil,

made a round chamber of 9.07 ± 0.87 mm diameter at the end of the tunnel and remained inactive for 2-5 days (mean 3.43 ± 0.79 days) before entering the pupal phase, which lasted 5-6 days (mean 5.41 ± 0.50) (Fig. 2). The fully developed adults remained in the earthen chamber for 2-3 days (mean 2.52 ± 0.51 days) before making their way to the surface (Fig. 3).

A total of 17 male and 17 female beetles was reared individually in separate glass bottle cages to study their longevity, fecundity and the rate of predation. The male and female beetles lived for 213.88 ± 164.38 and 196.24 ± 148.14 days, respectively. During

this period, they consumed 66.65 ± 49.51 and 67.59 ± 50.01 fourth instar caterpillars of *O. arenosella*, respectively (Table II). This clearly indicates that the female beetles consumed slightly more prey (0.34 caterpillar per day) than their male counterparts (0.31 caterpillar per day). If the prey caterpillars were not avail-

able the beetles fed even on the pupae of *O. arenosella*.

The oviposition period of the female beetles was 169.18 ± 137.66 days, with the fecundity being 248.88 ± 203 eggs per female.

A scelionid, *Xenomerus* sp. was recorded as an egg parasitoid

of *P. nigrolineata* in the field. During rainy season the intensity of parasitism was quite high and was responsible for minimising the population of the predator in the field.

SUMMARY

A method to rear *P. nigrolineata* in the laboratory was developed. Biology and feeding potential of the predator both in the adult and immature stages are discussed. The rate of predation in the grub phase worked out to 0.32 fourth instar caterpillar of *O. arenosella* per grub per day. Adult female beetle fed @ 0.34 and male beetle 0.31 fourth instar caterpillar per beetle per day. A scelionid *Xenomerus* sp. was recorded as an egg parasitoid of *P. nigrolineata* in the field. Intensity of its natural parasitism was quite high during rainy season and this was responsible for minimising the population of the beetle in the field.

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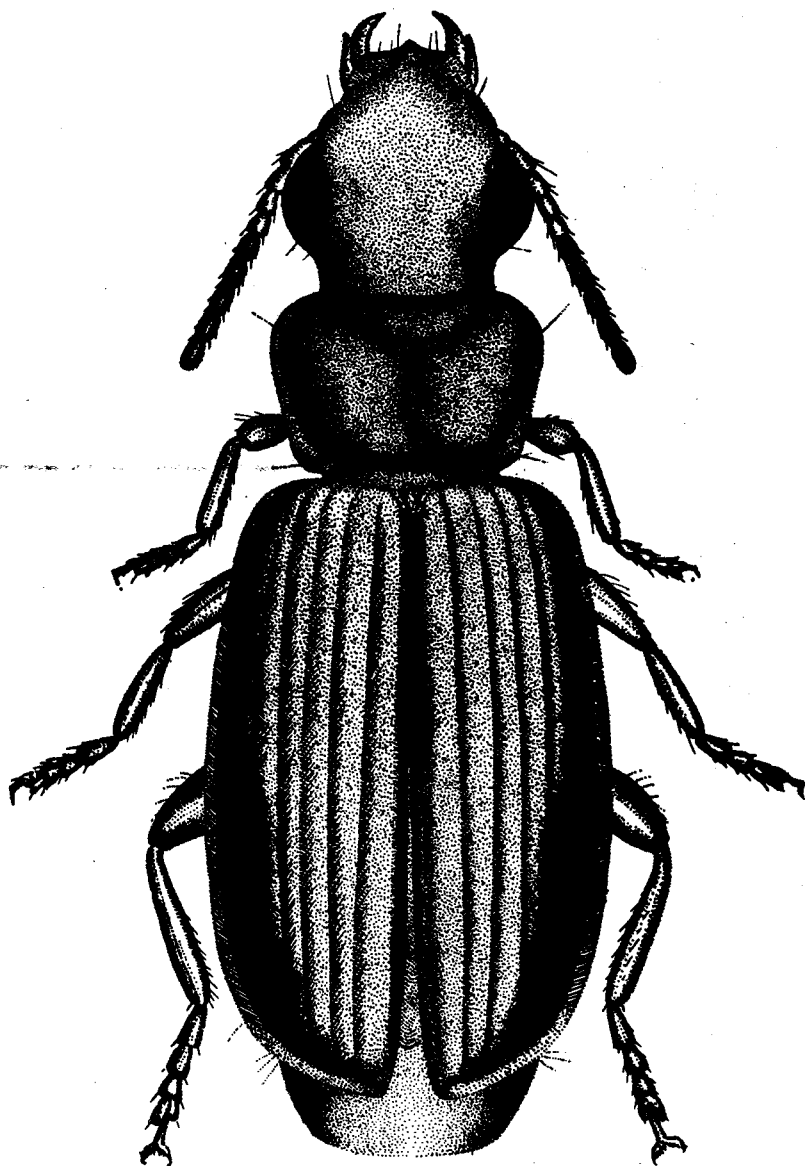


Fig. 3. Adult of *P. nigrolineata*

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TABLE - 1

Duration of different stages in the development of *P. nigrolineata* including longevity of adults

Stages	No. of samples studied	Mean days		Range (days)
Egg	332	5.21	± 0.62	4 — 9
First Instar	28	2.36	± 0.49	2 — 3
Second Instar	28	2.96	± 0.58	2 — 4
Third Instar	28	4.75	± 2.03	2 — 9
Pre-pupa	28	3.43	± 0.79	2 — 5
Pupa	27	5.41	± 0.50	5 — 6
Male beetle-longevity	17	213.88	± 164.38	7 — 497
Female beetle-longevity	17	196.24	± 148.14	21 — 486

TABLE - 2

Rate of predation by *P. nigrolineata* on *O. arenosella* caterpillars (fourth instar)

Stage of the predator	Duration of feeding (days)	No. of prey consumed (mean)
Grub	13.5 ± 2.18	4.39 ± 0.38
Adult male	213.88 ± 164.38	66.65 ± 49.51
Adult female	196.24 ± 148.14	67.59 ± 50.01