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Studies on the Biology of *Pullus xerampelinus* Muls. (Coleoptera: Coccinellidae), a Predator of *Aspidiotus destructor* Sign. (Homoptera: Coccidae), with a Note on its Parasite

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ABSTRACT

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Pullus xerampelinus Muls., a coccinellid predator of coconut scale, *Aspidiotus destructor* Sign. was studied in the Laboratory. Its life cycle consists of the egg, four larval instars, prepupa, pupa and the adult. The description of the insect, its fecundity, feeding capacity and longevity were studied. A note on its newly recorded parasite, *Aminellus indicus* Kerrich is made.

INTRODUCTION

Indigenous natural enemies play an important role in controlling the coconut scale, *Aspidiotus destructor* Sign. (Homoptera: Coccidae) in Sri Lanka. The coccinellid predator, *Chilocorus nigritus* F. was found to be an effective natural enemy of this scale insect in Sri Lanka (S. V. Sinnathamby, unpublished data). Recently, another coccinellid predator, *Pullus xerampelinus* Muls. (Coleoptera: Coccinellidae), was also observed to be found assoicated with the coconut scale in Sri Lanka (Sinnathamby, 1977).

P. xerampelinus, originally described by Mulsant (1852-53), belongs to the tribe *Scymnini*, which with very few exceptions are predators of Coccidae (Delucchi, 1954). The genus *Pullus* differs from *Scymnus* in that all species of the former have a semi-circular ridge on the post-coxal plate, whereas in the latter genus this ridge is incomplete, disappearing towards the lateral margin.

The studies reported in this paper are on the biology and life cycle of *P. xerampelinus*, with a brief note on its recorded parasite, *Aminellus indicus* Kerrich (Hymenotpera: Encyrtidae) (Sinnathamby, 1977).

MATERIALS AND METHODS

The predator *P. xerampelinus* and its prey, *A. destructor*, were procured from laboratory reared colonies as well as from the field. Morphological studies of this predator were carried out by measuring the length and width of the different developmental stages under a stereomicroscope. These measurements were made on 20 specimens for each developmental stage. Measurements were made following the removal of the waxy tuft on the larva, prepupa and pupa.

In order to assess the fecundity of *P. xerampelinus*, a female and a male were introduced into a glass tube (15 x 2 cm) containing cut pieces of coconut leaflets infested with the third instar of *A. destructor*. This treatment was replicated five times. Egg laying was observed daily by carefully examining the cut leaflets and fresh prey individuals were supplied regularly. The observations were made over the period from June to August 1974 in the laboratory maintained at a mean temperature of 27.1°C and at 87.5% R.H.

Prey consumption by the larvae until pupation and adults in 24 h was assessed by caging each individual within a glass tube (15 x 2 cm) containing cut pieces of coconut leaflets with a known number of second and third instar of scales separately supplied. These treatments were replicated 30 times each, for the respective stages of predator.

The studies on the longevity of adults of *P. xerampelinus* was made over the period from November, 1976 to January 1977. These observations were made by caging 30 adult beetles of the same age (within a cage measuring 45 x 3 x 30 cm) and supplied with cut pieces of coconut leaflets infested with scale insects. The cages were kept in the laboratory maintained at a temperature of 28°C and a mean R. H. of 82.7%.

In order to observe the incidence of parasitism amonget the larvae, prepupae and pupae of *P. xerampelinus*, the latter were collected from the field from two estates infested with *A. destructor*, and maintained in the laboratory for parasite emergence.

OBSERVATIONS

Life Stages

Egg

The egg is oblong, shiny and creamy white in colour. It measures 0.46 mm in length and 0.2 mm in width at the broadest region. Eggs are always laid horizontally, singly or in groups of two or three under third instar female scale. Out of 1457 eggs laid by five females 1127 eggs were laid singly, 288 in groups of two and 42 in groups of three. Eggs were visible through the transparent scale covering which is actually the body of the host. The egg losses its shiny appearance as the embryo matures and hatches in 98 to 120 h.

Larva

The larval period lasts for five to six days. The larva during its development from the first instar up to the time it reaches the pupal stage is able to consume about 112 adult female (third instar) scales or 744 second instar scales (both males and females). There are four larval instars. The larva has 12 body segments with the last segment sometimes concealed within the 11th segment. The head capsule is partly hidden inside the first thoracic segment. A group of three ocelli is found on either side of the head. There are three pairs of thoracic legs. The larval body is covered with setae of different lengths. Larva (Fig. 1) develops altogether 64 waxy tufts, out of which 60 tufts are arranged in six longitudinal rows of ten, each forming three double rows. The two middle rows are seen on either side of the mid-dorsal line. Of the other rows, two are placed laterally on the right and the other two laterally on the left. Out of the remaining four tufts, two are placed at the anterior end and the other two at the posterior end of the body. These waxy tufts give the larva a "cottony" appearance. In contact with foreign bodies the waxy tufts disintergrate easily but the larva can replace them within 24 h. The larva moves fast on scale infested leaves in search of feeding material. It presses its legs against the scale, and gets a foot-hold for quick motion. The size of the larva is dependent on the amount of prey available on the leaflet. Length, width and colour of *P. xerampelinus* larva soon after moulting and the duration of its each larval instar are mentioned in Table 1. Laboratory observations showed cannibalism by the fourth instar larva which attacked the prepupa of the same species when there is lack of feeding material.

Table 1

Length, width and colour of P. xerampelinus larva soon after moulting and the duration of each larval instar.

Larval instars	*Length (mm)*	*Width (mm)*	*Colour*	*Duration of instars (h)*
First instar	0.86	0.24	creamy white	36
Second instar	1.68	0.64	whitish yellow	36
Third instar	2.24	0.80	-do-	36
Fourth instar	3.02	0.90	-do-	72

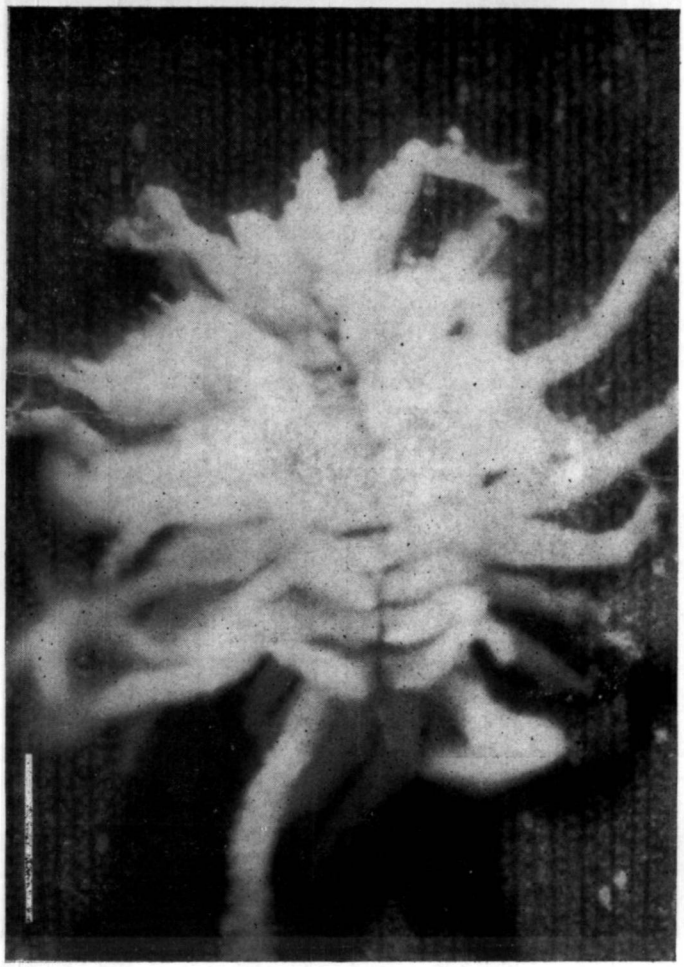

Fig. 1
Larva of *P. xerampelinus*
Bar represents 1 mm

Prepupa and pupa

During the last stages of the larval period the larvae aggregate on various part of the coconut frond and by means of an adhesive secretion attach themselves to the substratum by the posterior end. The average length of prepupa is 3.16 mm and width 1.56 mm. The prepupal period lasts for one to two days. During pupation the two rows of waxy tufts on either side of the mid-dorsal line get pushed laterally, one on each side, so that the mid-dorsal line of the pupa gets exposed (Fig. 2). It retains the other larval waxy tufts at its original places. The larval skin of the fourth instar larva changes into the pupal covering. The average length of pupa along mid-dorsal line is 2.88 mm and width 1.66 mm. The pupal skin is initially dark yellow in colour but changes to blackish brown in colour before emergence of the adult. After the adults have emerged empty pupal skins with waxy tufts can be seen left on the leaflet. The pupal period lasts for five to six days.

Fig. 2

Pupa of *P. xerampelinus*.
Bar represents 1 mm

Adult

After adult stage is reached it spends about a day within the pupal skin. Soon after emergence it starts feeding on any stage of scale that is immediately available. The adult (Figs. 3 and 4) whose body is oval, moderately convex dorsally, flat ventrally, pubescent and brown in colour. It measures (average) 2.81 mm in length and 2.05 mm width. The head capsule measures (average) 0.73 mm in length and 1.1 mm width. Generally it is difficult to differentiate sexes externally, but in males the yellow colouration of the head is faintly visible.

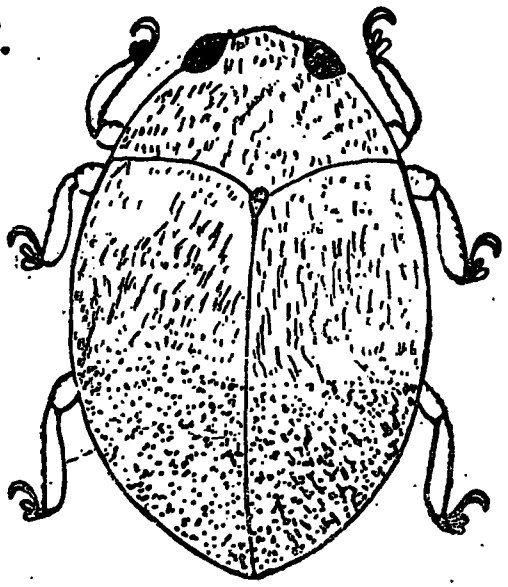

Fig. 3
Dorsal view of *P. xerampelinus*.
Bar represents 1 mm

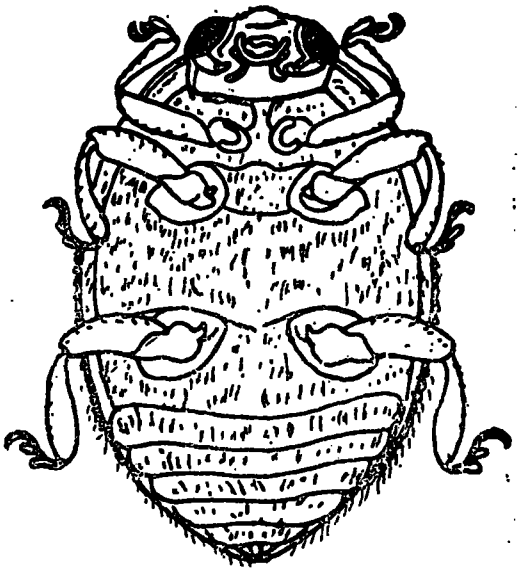

Fig. 4
Ventral view of *P. xerampelinus*.
Bar represents 1 mm

Mating occurs four to seven days after emergence. The duration of actual act of mating was observed to range from 7 to 25 min with an average of 13.1 min. One male mates with several females and each female mates several times during its life. The fecundity of female is given in Table 2.

The adults were found to consume on an average of 120 second instar scales (both males and females) or 34 third instar female scales (together with eggs and hatched out crawlers) in 24 h.

The adult life span was observed to be 49 $\pm$ 8 days.

Table 2

Fecundity of P. xerampelinus

Cage	*Duration between adult emergence and mating (days)*	*Duration between mating and oviposition (days)*	*Oviposition period (days)*	*Total number of eggs laid*	*Post Oviposition period (days)*	*Longevity (days)*
1	6	2	62	409	3	73
2	7	2	21	64	*oviposited till death*	30
3	7	2	35	296	*oviposited till death*	44
4	4	1	41	229	9	55
5	4	2	57	439	8	71
Average	5.6	1.8	43.4	287.4		54.6

Parasitism

The prepupa and pupa of *P. xerampelinus* was observed to be parasitised by *Amitellus indicus* Kerrich (Hymenoptera: Encyrtidae). However no parasites emerged from larvae. The degree of parasitism observed in the two estates (Table 3) ranged from 10.7% to 24% in 1976. Only one parasite was found to emerge from each host. It appears that the space and the amount of food available within the host pupa is sufficient for only one parasite to develop and reach maturity. The life span of the adult parasite, maintained in the laboratory on undiluted honey as feeding material, ranged from 3-19 days with an average of 9.1 days.

Table 3

Parasitisation of P. xerampelinus by A. indicus in the field in 1976

Month	*Place*	*Number of prepupae and pupae collected*	*Number parasitised*	*% parasitised*
February	Kirimetiyana	50	12	24.0
June	Madampe	226	29	12.8
July	Madampe	75	8	10.7
August	Madampe	1106	121	10.9

DISCUSSION

Observations on the facundity of *P. xerampelinus* have shown an average of 287 eggs per female. The longevity of the beetles was about 49 days. The other predator, *C. nigritus* found in the infestations of coconut scale in Sri Lanka lays an averge of 292 eggs in Pakistan (Ahmad, 1970) whereas the longevity observed in Sri Lanka was an average of 75 days (S. V. Sinnathamby, unpublished data).

The population density from field collected coconut scale infested samples showed a six fold increase in *P. xerampelinus*, compared to *C. nigritus* (S. V. Sinnathamby, unpublished data). The average consumption rate of the adult and larva of *P. xerampelinus* on coconut scale was about a third of *C. nigritus* (S. V. Sinnathamby, unpublished data). The activity of *P. xerampelinus* is somewhat reduced by the presence of the parasite *A. indicus*, but it should be noted that *C. nigritus* is attacked by two parasites (Sinnathamby, 1977). The observations indicate that *P. xerampelinus* can be compared very favourably with *C. nigritus* in its capacity to control the coconut scale pest in Sri Lanka.

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