

Role of Ichneumonid Parasitoids in the Biological Suppression of the Coconut Leaf Eating Caterpillar, *Opisina arenosella* Wik.

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ABSTRACT

Six species of ichneumonid parasitoids were recorded on the coconut leaf eating caterpillar, *Opisina arenosella* Wik. They are big sized solitary wasps, which have many characteristics in common. Most of them develop internally and have long life span. The female parasitoids are sexually matured at the time of emergence itself and are polyandrous.

Xanthopimpla spp. and *Brachycoryphus nursei* (Cam.) partially disorganise the host tissues with strong ovipositor thrusts and feed on the host's haemolymph, at regular intervals. They have more or less similar life cycle and in most cases the adults emerge in 14 to 18 days.

Intensity of natural parasitism by *Echthromorpha agrestoria* (Swederus) is less than 1% and, as such, it is relatively an insignificant species of parasitoid of *O. arenosella*.

B. nursei is mostly ectophagous, but occasionally develops internally also in host pupae. It is unique in attacking and parasitising

host larvae, prepupae and pupae. It is the only Ichneumonid parasitoid of *O. arenosella*, which paralyses the host caterpillars. *B. nursei* has poor searching ability. It indiscriminately deposits numerous eggs on a host eventually to produce only one individual parasitoid. In laboratory, it produces more number of males. These factors make the parasitoid unsuitable for large scale bio-control operations against *O. arenosella* in the field.

Eriborus trochanteratus found in India and Sri Lanka are of two biotypes and only the latter attacks and parasitises *O. arenosella*. In Sri Lanka, this parasitoid has been used for suppressing the pest population successfully. The Sri Lankan biotype of *E. trochanteratus* has been mass multiplied and colonised in *Opisina* infested coconut gardens in Kerala. Even though the released parasitoid established in nature hyperparasitism by *Brachymeria nephantidis*, a primary pupal parasitoid of the pest itself, suppressed the parasite population, to some extent.

Xanthopimpla punctata, *X. nana nana* and *Xanthopimpla* sp. (undet.) are dominant species of pupal parasitoids effecting a high degree of parasitism towards the latter half of the year. These species breed in separate territories where relative humidity is high. *Xanthopimpla* spp. have greater searching ability and they colonise in areas of high pest population close to sea shore or backwaters. These are amenable to laboratory multiplication and can be used successfully for biological suppression of the pest. It is interesting to note that a highly polyphagous and widely distributed species like *X. punctata* turned out to be a better killer of the pest than most other host-specific and gregarious parasitoids of *O. arenosella*.

Bioecology of these parasitoids and the extent of pest suppression exerted by them are also discussed.

INTRODUCTION

The Ichneumonid parasitoids recorded on the coconut leaf eating caterpillar, *Opisina arenosella* Wik. are *Brachycoryphus*

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(= *Goryphus nursei* (Cam.) (Nirula et al., 1955; Pillai and Nair, 1987), *Echthromorpha agrestoria* (Swed.) (Kapadia, 1983), *Eriborus trochanteratus* (Morley) (Perera, 1977; Pillai and Nair, 1986a), *Xanthopimpla punctata* F. (Pillai and Nair, 1986b), *X. nana nana* Schulz (Pillai and Nair, 1983) and *Xanthopimpla* sp. (undet.) (Pillai and Nair, 1986c and 1987). Among them, *E. trochanteratus* is a larval parasitoid and *B. nursei* attacks the larvae, prepupae and pupae. *B. nursei* is mostly an ectoparasitoid, while *Xanthopimpla* spp. and *E. trochanteratus* are endoparasitoids. All of them are big sized solitary wasp and most of them are long-lived. *E. trochanteratus* has been used in Sri Lanka and India for biological suppression of *O. arenosella*. However, the other ichneumonids have not been used so far for large scale biological control programmes.

Recent observations made by the authors revealed that *Xanthopimpla* spp. are dominant species of parasitoids, which are amenable to laboratory multiplication. *X. punctata* and *X. nana nana* provide a very high degree of parasitism, particularly during September to December. In this paper, the salient features of ichneumonid parasitoids of *O. arenosella*, their relative contribution in natural pest suppression and their suitability as biocontrol agents of the pest are discussed. The rearing techniques of *E. trochanteratus* and *Xanthopimpla* spp., their life history and the salient distinguishing features of *Xanthopimpla* spp. are also furnished.

Eriborus trochanteratus (Morley)
(= *Diocetes* sp., *Nythobia* sp.,
Diadegma surendrai Gupta)
(Nair and Rao, 1972)

It occurs in Sri Lanka and India. They are morphologically identical but belong to two biotypes. The Sri Lankan biotype attacks *O. arenosella*, while the Indian biotype parasitises *Conogethes (Dichocrocis) punctiferalis* (Guen.) and the potato tuber moth, *Phthorimaea operculella* (Zeller). It is a complementary species of parasitoid in Sri Lanka, the dominant one being the tachinid *Spoggosia bezziana* (Baranoff). But, in some localities it also dominates (Perera, 1977). It is a high fecund species with good searching ability, but has difficulty in quickly locating and parasitising *O. arenosella* caterpillars remaining inside the silken galleries (Pillai and Nair, 1986a).

METHOD OF BREEDING

Breeding techniques of *E. trochanteratus* are described by Nair and Rao (1972); Perera (1977) and Pillai and Nair (1986a). The female parasitoids mate immediately after emergence, with the earlier emerged males and such females can be used for breeding or field release one day after mating. They are transferred to a glass bottle of size 18.5 cm x 8.5 cm, the mouth of which is covered with muslin cloth and fastened with rubber bands. Undiluted honey, provided as minute droplets, on a wax-coated paper is placed inside the bottle as food to the parasitoids. The

glass bottle containing the female parasitoids is inverted after removing the cloth cover and placed on a table. Full grown caterpillars of *O. arenosella* removed from the galleries are placed one by one inside the bottle. The parasitoids immediately oviposit in the host larvae. They are removed with a brush and placed in another bottle containing 12 cm long coconut leaf bits. About 30 parasitised larvae can be kept in one bottle. There is no need to change the leaf bits. The parasitoid develops internally, the fully grown larva comes out of the host and spins its own cocoon within the cocoon spun by the host caterpillar.

Full grown caterpillars of *Corcyra cephalonica* St. are also suitable hosts for rearing *E. trochanteratus*. The parasitised *Corcyra* larvae are transferred to a glass bottle containing wheat flour. The emergence of adult parasitoids will be spread out to two to four weeks, when *C. cephalonica* caterpillars are used as hosts. *E. trochanteratus* produces more number of males than females in the laboratory culture.

FIELD COLONISATION OF *E. trochanteratus*:

Six hundred and fifty one mated females of the Sri Lankan biotype of *E. trochanteratus* were released at Thottappally, Alleppey District, Kerala, during 1979-1980 and 15 parasitoid cocoons were recovered from the release site. However, *Brachymeria nephantidis* Gahan emerged from three cocoons

indicating hyperparasitism, which adversely affected the rate of multiplication and build up of *E. trochanteratus* in the field (Pillai and Nair, 1986a).

Xanthopimpla spp.

Distinguishing features:

1. *X. punctata* F.

Male: Usually there are four pairs of punctations on the alternating abdominal segments; but in some cases five pairs or even six pairs of punctations are observed.

Female: Four pairs of punctations on the alternating abdominal segments. Ovipositor sheath 2-4-mm long.

2. *X. nana nana* Schulz.

Both the sexes are as big as *X. punctata*. The trochanter femur and tibia of the hind legs and the femur and tibia of mid and fore legs bear clear black patches in *X. nana nana* and these are absent in *X. punctata*.

Male: Except the second segment all the other abdominal segments have black punctations. A centrally placed inverted 'V' like marking present towards the tip of the abdomen.

Female: All abdominal segments except the second have punctations. The second segment may or may not have a pair of linear markings. A centrally placed dumbel-shaped marking is present towards the tip of the abdomen. Ovipositor sheath 1-3

mm long. (Pillai and Nair, 1983)

Xanthopimpla sp. (undet.)

Both sexes are smaller than the other two species. The distal end of the tarsus and pretarsus are black in both sexes. On the dorsal side of the coxa of each of the metathoracic legs of both sexes, a prominent, round, black punctation is present. This is absent in the other two species.

Male: The inverted 'V' like marking found towards the tip of abdomen of the male of *X. nana nana* is absent in the male of *Xanthopimpla* sp. (undet.)

Female: A conical centrally placed marking is present towards the tip of abdomen. This is dumbel-shaped in *X. nana nana*. Ovipositor sheath is the shortest; 1-1.5mm long.

Method of breeding *Xanthopimpla* spp.

All the three species of *Xanthopimpla* can be reared in the laboratory by the glass chimney method, in which the host pupae are offered between the two layers of cloth pieces tied on the mouth of the glass bottle containing mated females.

On emergence, the females mate with the earlier emerged males. The females are polyandrous and have different pre-oviposition periods (Table - 1). The mated females of each species are kept separately in 18.5 x 8.5. cm glass bottles, in which undiluted honey is provided as droplets on wax-coated paper. The mouth of the

bottle is first covered with a piece of mosquito netting cloth and then with another piece of muslin cloth and tied to the mouth of the jar using rubber bands. On completion of the pre-oviposition period, the host pupae such as *O. arenosella*, *Sylepta derogata* and *Anadvidia peponis* are offered for oviposition. For *X. punctata*, the pupae of *A. peponis* are offered on the fifth day of emergence for host feeding. After removing the muslin cloth, leaf of snake gourd or *Coleus* is placed over the mosquito netting cloth, on which the healthy host pupae are placed and then covered with muslin cloth. The female parasitoids easily locate the hosts and oviposit in them after partially disorganising the host tissues with repeated ovipositor thrusts. The parasitised pupae are removed at regular intervals and fresh ones offered for parasitisation. The parasitised pupae are stored in glass bottles for emergence of parasitoids.

The bottle containing parasitoids should be changed, at least once in every five days, and honey provided, as and when required.

X. punctata

It is a highly polyphagous and widely distributed species, which is the most important among *Xanthopimpla* spp. parasitic on *O. arenosella*. Prior to 1981, this species was considered to be an insignificant parasitoid everywhere. However, this species was observed to dominate the parasite complex of *O. arenosella* at Salem, Tamil Nadu, during September, 1981 and at Ayiramthengu, Quilon

District, Kerala, from September to December, 1983 and 1984.

Unlike many other species of parasitoids, *X. punctata* breeds only in areas of heavy population abundance of *O. arenosella* having water sources and high relative humidity, either close to sea shore or backwaters or rivers or irrigation canals. Availability of flowering plants or weed growth in the vicinity of plantations was not always observed in such areas. The adults of *X. punctata* congregate in the selected territory and *X. nana nana* does not intrude and colonise in the area occupied by *X. punctata*. Even sturdy pupal parasitoids such as *Barchymeria nosatoi* and *B. nephantidis* are also suppressed, to some extent, by *X. punctata* in such areas.

X. punctata breeds in coconut gardens from July to January in Gujarat (Yadav and Dhamalia, 1986) and July to December in Kerala (Pillai and Nair, 1986b). No information is available on the main host insect it opts to attack and the host plants it frequents during the period from January to June. It is also desirable to study the influence of the availability of flowering plants, intercrops and the agronomic practices in coconut gardens on the population of *X. punctata* so as to create such conditions, which are quite congenial for the colonisation of the parasitoid in pest-infested tracts. The longevity of *X. punctata* female is very high. The females emerging in December — January from the pupae of *O. arenosella* can survive the summer season. Such aged

females tend to produce more males than females and such situations are quite often observed in the field collections of pupae of *O. arenosella* made during July.

Adults of *X. punctata* emerged from the field-collected pupae of *A. peponis* on snake gourd are larger in size, yellowish with big dark punctations, while those emerged from *O. arenosella* are smaller, mostly light reddish brown, with small round punctations. But, both the specimens were identified as *X. punctata* by CIE, London. In individual collections, parasitism by *X. punctata* was as high as 56.79% (92/162) in October, 1984 at Ayiramthengu, Kerala, with a sex ratio of 1 : 1.

X. nana nana :

This species occurs in India, Java and Sri Lanka (Pillai and Nair, 1983). Very little information is available on its host range and the plants on which it colonises. The parasitoid was observed to be a dominant species in some tracts around Quilon, Kerala.

In several respects, it also behaves like *X. punctata*. Instead of moving uniformly into all *Opisina*—infested coconut gardens, it also selects breeding sites near the sea shore, backwaters etc., where high relative humidity is available. In the territory occupied by *X. nana nana*, *X. punctata* also does not breed. Several adults of *X. nana nana* congregate in the selected territory. Peak period of its activity is during November-December. Highest intensity of its parasitism observed was 31.59% (97/307) (Table - 2).

Laboratory rearing of this species is more difficult than the other two species of *Xanthopimpla*. In some cases, the pre-oviposition period will be up to 24 days in the laboratory. Frequent host feeding is found as with *X. punctata* and large quantities of haemolymph are consumed by the female parasitoid, when *A. peponis* is used as host. This species also suppresses the population of *B. nosatoi* and *B. nephantidis*, to some extent.

Xanthopimpla sp. (undet).

It is the smallest among the three species of *Xanthopimpla*. It can be easily distinguished from *X. nana nana* by the presence of the punctation on the coxa of the hind leg, black pretarsus, shorter ovipositor sheath etc. This parasitoid was observed in Sarayikad area near Ayiramthengu, Quilon District, Kerala. It breeds on *O. arenosella* very easily. In laboratory also 50% females are produced. As such, it can be multiplied in sufficient numbers for field releases.

As with other species of *Xanthopimpla* it is also sexually matured at the time of emergence itself and mates easily. The female is polyandrous and its preoviposition period is the shortest, 3—4 days only. The females feed on the host's haemolymph very frequently (Pillai and Nair, 1987).

B. nursei (= *Melcha nursei* Cam., *Goryphus nursei* (Cam.))

This Indo-Pakistani, Oligophagous, reddish brown species

is an important parasitoid of *Earias* spp. in cotton in North India. It was reported on *O. arenosella* (= *Nephantis serinopa*) by Nirula *et al.* (1955), occurring in coconut gardens from July to December, with peak activity in September. *B. nursei* also paralyzes the host with its powerful ovipositor thrusts and feeds on the exuding haemolymph. Host feeding begins from the day of emergence itself and is continued throughout its long life span. It attacks and develops on larvae, prepupae and pupae. *B. nursei* is mostly an ectoparasitoid, but has the capacity to develop occasionally as an endoparasitoid in the pupae (Hussain and Mathur, 1924; Pillai and Nair; 1987). It is known to develop in the bag worm; *Cryptothelea* (= *Clania*) *Cramerii* West. *B. nursei* is high fecund with low searching ability and though solitary, lays several eggs on a host.

The females are polyandrous, mate immediately on emergence and begin oviposition the next day.

METHOD OF REARING

Pillai and Nair (1987) reared this species in the laboratory in petridishes. Four to five fully grown *O. arenosella* caterpillars are allowed to spin cocoons in a petridish and a mated female of *B. nursei* released into it for oviposition. Care should be taken that the parasitoid does not escape. After ovipositing on all hosts, the parasitoid is transferred to the rearing glass bottle, 18.5 ×

8.5 cm. Honey is provided as minute droplets on wax-coated paper, as food for the parasitoids. Mated females are kept separately from males.

The petridishes containing the parasitised hosts are kept undisturbed for further development and emergence of parasitoids. In spite of satisfactory matings, *B. nursei* produces higher proportion of males under laboratory condition.

In north India, this parasitoid is active in the winter months in cotton fields and it was rarely found in the summer (Ahmad and Ullah, 1945), where the parasitoid overwintered in larval and adult stages (Khan and Varma, 1946).

E. agrestoria (Swederus)

E. agrestoria was recorded for the first time as a pupal parasitoid of *O. arenosella* from Gujarat. The activity of the parasitoid was during winter season. Intensity of its natural parasitism was less than 1% (Kapadia, 1983). The adults are bigger than *X. punctata*. It was also recorded as a pupal parasitoid of *Mocis undata* Fab. in Madhya Pradesh (Gujarati and Gandrage, 1972). Sankaran and Syed (1972) recorded *E. agrestoria* (Swed.) as a parasitoid of the bag worm *Mahasena corbetti* Tams. infesting oil palms in Sabah, Malaysia.

Life history

There is not much difference in the developmental period of

the ichneumonid parasitoids of *O. arenosella*. Incubation period varied from 24h to 32h, larval period 4-12 days, pupal period 5-11 days; and egg to adult stages are completed in 10-21 days. However, majority of adults of each species emerged in 14-18 days. Details of the life history of five species of ichneumonids are furnished in Table 1.

DISCUSSION

The ichneumonid parasitoids of *O. arenosella* have many characteristics in common. They are all solitary species, most of them develop internally and the females are sexually matured at the time of emergence itself and are polyandrous. *Xanthopimpla* spp. and *B. nursei* disorganise the host tissues partially by repeated ovipositor thrusts and large quantities of haemolymph are fed by them at regular intervals. Life cycles are completed in almost the same period, in 10-21 days, maximum number of adults emerging in 14-18 days.

E. trochanteratus has already been used in Sri Lanka for the suppression of *O. arenosella*. Releases of laboratory reared parasitoids resulted in an increase in percentage parasitism from 11-7 to 26-3, after five months. (Perera, 1977). At Thottappally, Kerala the released parasitoids established in the field and the parasitoid cocoons were recovered from the release site.

However, its activity, to some extent, was hampered, by *B. nephantids*, which acted as a facultative hyperparasitoid (Pillai and Nair, 1986a).

Although a high fecund species which is capable of developing on larvae, prepupae and pupae, *B. nursei* has low searching ability and lays several eggs indiscriminately on the same host. It produces more number of male progeny in the laboratory. In view of its low intensity of parasitism in the field, this species is unsuitable for inclusion in the biocontrol programmes.

As *E. agrestoria* provides only less than 1% natural parasitism in Mahuva, Gujarat it appears that *O. arenosella* is not its preferred host.

X. punctata and *X. nana nana* are dominant species which even suppress sturdy parasitoids like *B. nosatoi* and *B. nephantidis*. Both the species have the capability to suppress the population of *arenosella* during the latter half of the year. Average maximum parasitism by *X. punctata* was 43.5% and the same was 31.59% in the case of *X. nana nana* (Table 2). Their populations concentrate

in selected territories in the coastal and backwater tracts. At laboratory multiplication of *Xanthopimpla* spp. is easy, they could be mass multiplied and released for the suppression of *O. arenosella* from July to December in coastal and backwater tracts of east and west coasts, where the intensity of pest infestation is quite high.

X. punctata is an outstanding example of a polyphagous species turned out to be a better killer of the pest than the other host-specific and gregarious species of parasitoids of *O. arenosella*.

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TABLE 1

LIFE HISTORY OF ICHNEUMONID PARASITIDS OF *Opisina arenosella* UNDER IDENTICAL CONDITIONS OF TEMPERATURE AND RELATIVE HUMIDITY

	<i>B. nursei</i>	<i>E. trochanteratus</i>	<i>X. punctata</i>	<i>X. nana nana</i>	<i>Xanthopimpla sp. (undet)</i>
Pre-oviposition period (days)	1	1	6-7	4-24	3-4
Incubation period	25 h 45min. —29 h	24-32h	24h	26-27h	29-30h
Larval Period (days)	6-12	5-8	4-10	5-12	6-10
Pupal period (days)	6-9	8-11	5-10	6-9	5-9
Total period from egg to adult (days)	13-21	14-19	10-20	12-21	12-20
Longevity of adults (days)	30-120	2-15	30-150	24-95	30-120

TABLE 2

DATA ON THE INTENSITY OF PARASITISM BY THE ICHNEUMONID
PARASITIDS OF *Opisina arenosella* WLK

Year and Locality	Total percent parasitism	Name of the parasitoid	Percentage parasitism by the parasitoid	Reference
1976-1980 Mahuva, Gujrrarat	11.5-62.8	<i>Xanthopimpla punctata</i>	5.2 to 20.0	Yadav and Dhamalia, 1986
1982 Sept. - Oct. Salem, Tamil Nadu	49-28 (173/351*)	do	26.50 (93/351)	Pillai and Nair, 1986b
1983 September Ayiramthengu, Quilon Dist.	57.46 (204/355)	do	37.46 (133/355)	Pillai and Nair 1986b
1984 September, Ayiramthengu	64.59 (363/562)	do	43.59 (245/562)	do
1980 Oct. Dec., Quilon	57.50 (46/80)	<i>Xanthopimpla nana nana</i>	27.50 (22/80)	Pillai and Nair, 1983
1981 January, Quilon	72.22 (39/54)	do	9.26 (5/54)	do
1984 November, Quilon	52.44 (161/307)	do	31.59 (97/307)	Data collected by authors
1984 December, Quilon	56.13 (87/155)	do	13.55 (21/155)	do
1954-55 Ayiramthengu	—	<i>Goryphus nursei</i>	1-6.0	Nirula <i>et al</i> 1955
Sri Lanka	—	<i>Eriborus trochanteratus</i>	12.79-31.42	Perera, 1977

* Figures in parantheses indicate the number of parasitised pupae and the total number of samples examined.

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