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Bioecology of *Sympiesis hyblaeae* Surekha (Hymenoptera: Eulophidae) a parasitoid of the teak defoliator, *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae)

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ABSTRACT: The biology, behaviour and seasonal dynamics of *Sympiesis hyblaeae* (Hymenoptera: Eulophidae) an ectoparasitoid of the teak defoliator, *Hyblaea puera* (Lepidoptera: Hyblaeidae) are discussed. *S. hyblaeae* prefers to lay eggs on first or second instar teak defoliator larvae. A single egg is deposited on each host larva. Each female lays an average of 5 eggs per day and an average of 15 eggs during its lifespan. The total developmental period is about 10-13 days. A high proportion (94%) of the pupae formed during the months, December to January are observed going through a diapause period ranging from 111-156 days, with an average of 138 days. The peak activity period of *S. hyblaeae* in the field is during September to December, which does not coincide with the peak incidence period (April–June) of its host (*H. puera*). The seasonal incidence pattern indicates that *S. hyblaeae* is not a potential natural biocontrol agent of the teak defoliator.

KEY WORDS: Bioecology, *Hyblaea puera*, parasitism, *Sympiesis hyblaeae*, teak defoliator

The teak defoliator, *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae) is the most economically important pest of teak in India. More than 30 species of parasitoids are known to be natural enemies of *H. puera* (Chatterjee and Misra, 1974). Sudheendrakumar (1986; 1990) reported four larval parasitoids *viz.*, *Palexorista solennis* (Walker) (Diptera: Tachinidae), *Sympiesis* sp., *Eriborus gardeneri* (Cushman) (Hymenoptera: Ichneumonidae) and *Stictopisthus* sp. (Hymenoptera: Ichneumonidae) from Nilambur, Kerala. The *Sympiesis* sp. was later identified as *Sympiesis hyblaeae* Surekha (Surekha *et al.*, 1996).

The members of the genus *Sympiesis* Forster are in general parasitoids of the leaf miners of the order Lepidoptera. The two other *Sympiesis* spp. known from India include *S. dolichogaster* Ashmead on groundnut leaf miner, *Aproaerema modicella* (Lepidoptera: Gelechiidae) (Shekharappa and Patil, 1990), the tea leaf miner, *Caloptilia theivora* Walsingham (Lepidoptera: Gracillaridae) (Selvasundaram and Muraleedharan, 1987) and an unidentified species on cashew leaf miner, *Acrocercops syngramma* Meyr. (Sundararaju, 1984).

This paper deals with biology, ecology and behaviour of *S. hyblaeae* and its potential use as a biological control agent of the teak defoliator.

MATERIALS AND METHODS

Field studies and laboratory experiments were carried out in Nilambur, Kerala during 1993-94. A nucleus culture of *S. hyblaeae* was built up from immature stages of the parasitoid collected from teak plantations in Nilambur during September, 1993. The parasitoids were fed diluted honey (10%) and maintained in glass tubes (10x2cm) at 28-32°C; RH 70-80 percent. A culture of *H. puera* was maintained on artificial diet for obtaining larvae for rearing the parasitoid (Mathew *et al.*, 1990).

Mating behaviour

Pupae of *S. hyblaeae* were collected and kept individually in clean glass tubes (5x2cm) and observed for emergence of adults. Sexing of the adults was done based on their size and antennal morphology. Ten sets of freshly emerged females were paired with fresh males in the ratio 1:1 and kept under observation. Observations were recorded every half an hour for a period of 6 hours.

Oviposition behaviour

Oviposition behaviour was observed by keeping the mated females along with the host larvae (feeding within leaf folds) in clean glass tubes (10x2cm).To record fecundity, each female was provided with fifteen, late Ist instar or early 2nd instar larvae inside a 100ml conical flask. After 24 hours, the larvae were transferred to another glass tube and examined for parasitisation.The percentage parasitism was recorded. Each female was provided with fresh host larvae every day until death. The number of eggs laid each day was recorded and the total number of eggs laid during the life span was calculated.

Developmental biology and parasitism

For estimating parasitism under laboratory conditions, five mated females and five males were kept together in a glass bottle (15x10cm). Fifty, 1st or 2nd instar larvae feeding inside leaf folds were released into the bottle. After 24 hours the larvae were transferred to fresh glass containers and observed for parasitism. Larvae bearing parasitoid egg were transferred to fresh glass containers. Percentage parasitism and percentage adult emergence were recorded. Fresh host larvae were provided in the rearing bottle every day until the death of parasitoids. The developmental period of each life stage was recorded.

Search for an alternate host

The feasibility of using *Corcyra cephalonica* (Stainton) (Lepidoptera: Pyralidae) as an alternate host of *S. hyblaeae* was evaluated in two experiments. Ten, 2nd instar *H. puera* larvae and ten one week old *C. cephalonica* larvae were exposed to five mated *S. hyblaeae* females in a glass bottle (15x10cm). The host larvae were examined for parasitism 48 hours after exposure to the parasitoids. Similarly in the second experiment 17, 2nd instar *H. puera* larvae and 13, early instar *Corcyra* larvae were exposed to five parasitoids.

Seasonal incidence and field parasitism

Fortnightly sampling of early larval instars of *H. puera* was carried out in teak plantations in Nilambur during 1993-94 to record seasonal trend of parasitism by *S. hyblaeae* and to evaluate its efficacy as a natural mortality agent of the teak defoliator. On each sampling date, teak leaf folds containing early *H. puera* larval instars were collected at random from different trees for a duration of three hours. The number of larvae collected within a specified period could give an estimate of the pest population. In the laboratory the larvae were examined for parasitism and the percentage parasitism recorded.

RESULTS AND DISCUSSION

Adult morphology of *S. hyblaeae*

Female measures 2.0-2.8mm in length; head and body metallic green to blue in colour. Basal gastral tergites with distinct yellow spot medially.

Antenna is simple and not branched. Male measures 1.11- 1.53mm in length. Similar to female in body colour. Antenna branched.

Mating behaviour

Adults mated within 2-4 hours after emergence. The duration of mating was about 60-90 seconds. Each male mated with several females during its lifespan while females mated only once during their life spans.

Oviposition behaviour and fecundity

Egg laying started 24-36 hours after mating. Before oviposition, the female entered the leaf fold occupied by the host larva. The host larva was immobilised first and a single egg laid in the intersegmental region on the lateral side of its body. The egg is white, hymenopteriform and measures about 0.02mm in length.

Of the 50 pairs observed, only 23 pairs lived for more than 10 days. Fecundity during the lifespan varied from 10-19 with a mean of 15±2. The number of eggs laid per day varied from 1-7 with an average of 5. Egg laying occurred continuously for a period of 3 days in the case of 74 percent of the pairs and 4 days in the case of the remaining pairs. Out of the 23 pairs, 65.2 percent laid their maximum number of eggs on the first day of oviposition, 17.4 percent on the second day and 13 percent on the third day. Only 4.4 percent laid their maximum number of eggs on the fourth day. Oviposition was not observed beyond this period though the adults were alive for 2-3 days.

Developmental biology

The incubation period of the egg is about one day. The larva is ectoparasitic. The neonate larva remains on the host body and feeds on the body fluid and grows. Larval period is about 4-5 days. Pupa formed remains within the leaf fold occupied by the host until adult emergence. Pupal period is about 5-7 days. Pupa is brown in colour and measures about 1-2mm in length. The mean total developmental period from egg to adult is 10-13 ± 1.2 days.

However, those parasitoid pupae developed during late December to January took a considerably longer time to emerge as adults suggesting that the insects undergo diapause. Of the 50 pupae collected from the laboratory culture, 94 percent entered diapause and only 6 percent emerged within the normal duration. The diapause period ranged from 111 to 156 days with an average of 136 days. The diapaused pupae started emerging from the month of May and peak emergence was noted in June-July.

One of the reasons for the low population of *S. hyblaeae* during the peak pest incidence period of the pest is due to the phenomenon of diapause. This phenomenon could be disadvantageous from the mass multiplication point of view of the species for biocontrol programmes.

Parasitism

Under laboratory conditions the percentage parasitism varied from 48 to 72 with a mean of 56.8 ± 8.04 (Table 1). Parasitoid pupae developed successfully only from 78 percent of the 168 parasitised host larvae observed. Of the 131 pupae formed, 84 percent developed into adults.

Table 1. Parasitism by *S. hyblaeae* under lab. condition

Trial No	Total number of host larvae exposed	Percent parasitism
1	140	48
2	170	72
3	210	64
4	180	57
5	90	49
6	120	58
7	160	52
8	150	54
Mean ± SD	–	56.8 ± 8.04

Acceptance of an alternate host

In the first trial carried out, all the ten *H. puera* larvae exposed to *S. hyblaeae* were found parasitised. However, in the case of *Corcyra*, only 2 of the ten larvae were parasitised. Neonate larvae were noted feeding on *Corcyra*, but they did not complete their development. In the second experiment 11 out of the 17 *H. puera* were parasitised with no parasitism on *Corcyra*. The results indicate non-acceptance of *C. cephalonica* by *S. hyblaeae*.

Seasonal incidence and field parasitism

The data on population trend of *S. hyblaeae* in different months during 1993-94 is presented in Figure 1. During the peak pest incidence period from April to July the parasitoid was not active in the field. The percentage parasitism remained below 10 percent up to September and increased thereafter until February. There was no record of parasitism in the month of February, April and May. In March, there was no traceable population of *Hyblaea* larvae and hence no record of parasitism. The data indicated that *S. hyblaea* could not make a significant impact on the pest population during the peak pest incidence period.

The decline in the parasitoid population from February to May can be explained by the diapause period of the insect, which is supported by the laboratory data.

Sympiesis species have been used in biological control in the past. A classical example is the control of *Promecotheca cumingi* Baly (Coleoptera: Hispidae), the coconut leaf miner in Sri Lanka using *S. javanicus* (Ferriere) imported from Singapore and Borneo (Dharmadhikari *et al.*, 1977). However, *Sympiesis* species in general act as co-parasitoid along with other parasitoid species and contribute to the reduction of host insect population as known in the case of *S. dolichogaster* (Shekharappa and Patil, 1990; Selvasundaram and Muraleedharan, 1987). The present study indicates the role of *S. hyblaeae* as a co-parasitoid rather than an independent potential natural mortality agent.

S. hyblaeae, a monophagous parasitoid infesting the very early larval stage, is of great importance because of its ability to kill the pest before it causes economic damage. However, in teak plantations the parasitoid was not found to be active during the months of peak pest outbreaks as a very high proportion of the parasitoids being remained in diapause during the period. Mass multiplication is an important criterion on any biological control programme. It is found that mass multiplication of *S. hyblaeae* could be adversely affected by its tendency to diapause. However, the mass multiplication of the parasitoid by breaking diapause is worth exploring.

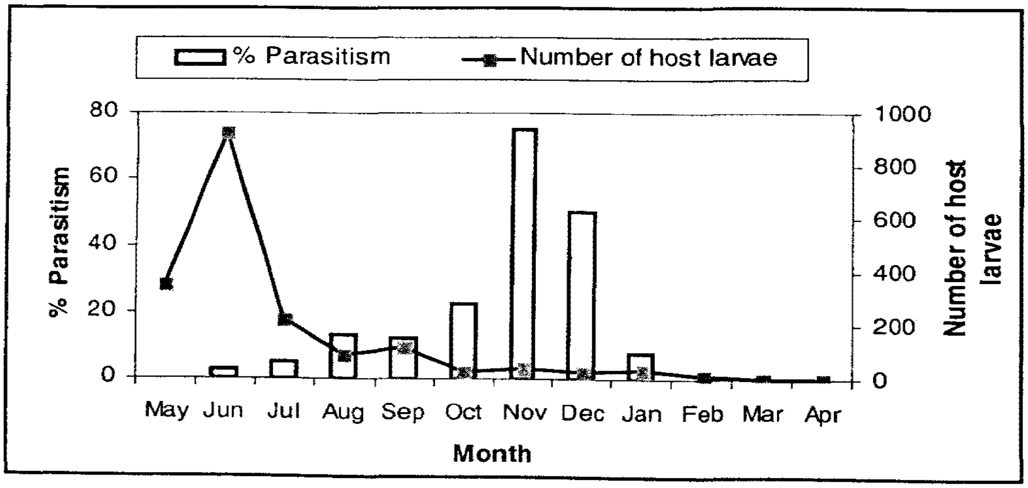

Fig 1. Seasonal incidence of *S. hyblaeae* and its host, *H. puera* in Nilamburn plantations in 1993-94

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