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Bio-ecology of Three Aphidiid Parasitoids of *Toxoptera aurantii* (Boyer de Fonscolombe) Infesting Tea in South India*

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ABSTRACT

In the tea plantations of south India, *Aphidius colemani* Viereck, *Lipolexis scutellaris* Mackauer and *Trioxys indicus* Subba Rao and Sharma parasitise *Toxoptera aurantii* (Boyer de Fonscolombe). At 25 ± 5°C and 75 ± 5 per cent RH, developmental period of the parasitoids varied between 15 and 18 days. The three year study revealed that the percentage of parasitism was highest from January to March. High relative humidity adversely affected the numerical abundance of aphidiids.

KEY WORDS : Tea aphid, *Toxoptera aurantii*, aphidiids, bioecology

The aphid, *Toxoptera aurantii* (Boyer de Fonscolombe) (Aphididae:Homoptera) is a ubiquitous pest of tea in south India. Adults and nymphs of this aphid suck the sap from tender shoots. Consequently, leaves curl up and shoot growth is retarded. The attack on young buds delays the recovery of bushes after pruning. Aphids in tea fields are attacked by several species of syrphid, coccinellid and hemerobiid predators and aphidiid parasitoids. This deals with studies on the life history and population dynamics of three aphidiid parasitoids affecting *T.aurantii* in tea plantations of south India.

MATERIALS AND METHODS

Surveys were carried out periodically from 1984 to 1989, in 65 large tea estates and 20 small tea holdings to study the distribution of the parasitoids of *T.aurantii*. The tea gardens covered in the present study are located in the Anamallais (Coimbatore District, Tamil Nadu), Coonoor, Kotagiri and Gudalur (Nilgiris District, Tamil Nadu), Vandiperiyar, Peermade and Munnar (Idukki District, Kerala), Nelliampathy (Palghat District, Kerala), Wynad (Wynad District, Kerala) and Chikmagalur (Chikmagalur District, Karnataka). The parasitised aphids were reared in the laboratory and adults thus obtained were sent to specialists for indentification. The weeds growing in tea fields were also examined to find out whether aphid species feeding on these plants were also parasitised by these aphidiids.

For studying the population dynamics of *T.aurantii* and its parasitoids, a large block, consisting of 500 tea bushes was laid out in the UPASI Tea Experimental Farm in the Anamallais. In the blocks, tea plants (bushes) were spaced at 1.22 x 1.05 m. They were pruned in April 1984, at a height of 60 cm above ground level and kept free from insecticide application.

At fortnightly interval (on 5th and 20th of every month), all the aphid-infested shoots from twentyfive plants selected at random were removed from the experimental block. Level of parasitism by aphidiid parasitoids was assessed by counting the number of parasitised aphids as well as the number of total aphids on the infested shoots. Observations on the field experiment were continued for a period of 42 months, from April 1984 to

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September 1987. Data on temperature, rainfall, relative humidity and sunshine were collected from the crop weather observatory of the institute.

For studying the life history of aphidiid parasitoids, field- collected aphid mummies were reared in the laboratory. Immediately after emergence, adults were sexed and a pair of male and female was introduced into glass test tube (15.5 x 2.5 cm). Cotton swabs and tea flowers, brushed with 30% honey solution were given as food and second instar aphids on a tender shoot were provided for oviposition. The parasitoids were reared at 25 ± 2° and 75 ± 5 per cent PH.

RESULTS AND DISCUSSION

During the surveys, three species of aphidiids, *Aphidius colemani* Viereck, *Trioxys indicus* Subba Rao and Sharma and *Lipolexis scutellaris* Mackauer (Aphidiidae:Hymenoptera) were found parasitising *T.aurantii* in tea plantations. Among these, *A.colemani* and *L. scutellaris* were the most common species while *T.indicus* was recorded only from the Anamallais and Nilgiris. These parasitoids were also recorded from two other aphids *viz., Aphis gossypii* Glover and *Aphis craccivora* Koch. infesting the weeds, *Lantana camara* L. and *Chromolaena odorata* (L.) growing in and around the tea fields (Radhakrishnan and Muraleedharan, 1991). Cranham (1966) reported *Eurytoma* sp., *Alictus* sp. and *Aphidius* sp. parasitising *T.aurantii* in the tea plantations of Sri Lanka. Stary (1968) recorded *Lysiphlebus ambiguus* (Hal.), *Lipolexis gracilis* (Forster) and *Trioxys angelicae* (Haliday) and *Aphidius matricariae* (Haliday) as indigenous parasitoids of *T.aurantii* infesting citrus and tea in the USSR.

In all the three species studied, adult parasitoids were ready for mating soon after emergence and eggs were laid by inserting the ovipositor into the body of the host. The posterior abdominal segments of aphids were the preferred sites for oviposition. Females laid two to five eggs per aphid but only one among them completed development. All the three aphidiids preferred second and early third instars (80 to 90 per cent) of the host. When eggs were laid into fourth instar aphids, development of the parasitoids was not completed and the larvae emerged by bursting the host body, leading to their death. However, this phenomenon was very rarely observed, clearly bringing out the efficiency of the parasitoid in determining the correct instar of the host for oviposition thereby, ensuring the successful completion of progenies. When an aphid was subjected to multiple oviposition, only one larva developed into adult. The specificity in choosing the particular instar of the aphid involved a high degree of selection by the parasitoids. This type of specificy to host instars is not uncommon among parasitoids as pointed by Askew (1971).

Females of *T.indicus* laid a maximum of 123 eggs, *L.scutellaris* 128 eggs, and *A. colemani* 110 eggs during the adult period of three to ten days. Details of the life history of the parasitoids are given in Table 1. Aphids parasitised by *T. indicus* showed a distinct colour change from dark brown to light red. The colour of the aphids parasitised by *A. colemani* changed from light yellow to green. The fully grown larvae pupated inside the host body, by spinning a loose white cocoon and the pupal period varied from four to six days. The pupae were exarate type. Adults emerged at any time of the day by splitting the host body inbetween the tubercles. The total developmental period of these aphidiids from egg to adult emergence varied between 13 and 19 days. This is in conformity with the results obtained for *Aphidius nigripes* (Clouteir *et al.*, 1981), *A.colemani* (Stary, 1990), and *Aphidius matricariae* (Rabasse and Shalaby, 1980).

The sequence of oviposition beheviour of these aphidiids involved three distinct phases, *viz.*, host location and recognition,

Table 1. Life History of three aphidiid parasitoids attacking *Toxoptera aurantii* *

Stages in the life history	*Aphidius colemani*	*Lipolexis scutellaris*	*Trioxys indicus*
Pre-oviposition period (hours)	2.00 ± 0.37	3.10 ± 0.36	4.20 ± 0.34
Oviposition period (days)	2.20 ± 0.31	2.00 ± 0.75	2.70 ± 0.49
Number of eggs laid	42.10 ± 8.40	120.70 ± 0.36	51.40 ± 1.43
Incubation period (days)	2.70 ± 0.20	3.20 ± 0.26	2.30 ± 0.73
Duration of larval instars (days)	5.40 ± 0.38	6.90 ± 0.36	5.50 ± 0.35
Pupal period (days)	5.70 ± 0.40	5.80 ± 0.24	4.90 ± 0.26
Adult longevity of female (days)	3.80 ± 0.37	5.10 ± 0.57	6.50 ± 0.59
Adult longevity of male (days)	1.30 ± 0.15	2.60 ± 0.67	1.50 ± 0.21

* Mean ± S.E. of ten replicates

host seizure and oviposition (Fig. 1). Highly active gravid females, immediately after emergence, searched for suitable aphid instar for oviposition. All the three aphidiid species showed a high degree of discrimination in selecting the specific instar of the host. Mostly, second and rarely third instar nymphs of *T.aurantii* were selected for egg laying. Parasitised aphids were generally avoided and only on prolonged non-availability of suitable hosts, did the aphidiids attempt to oviposit on parasitised aphids. After recognising the host, the aphidiids slowly followed the movement of the hosts with their vibrating antennae. Once the host was located and accepted, the aphidiids oviposited. In all the three species studied, the favoured site for oviposition was the posterior abdominal segments, the area between tubercles. After successful oviposition, the host was released and the parasitoid moved away from it.

Figure 2 shows the variations in the population density of *A.colemani, L. scutellaris* and *T. indicus* in relation to its hots, *T.aurantii*. Peaks in parasitoid activity were seen during the months of September to October and then from January to March, which were also the periods of abundance of aphids. During the dry months of Janufary to March, the level of parasitism was high, while in the rainy months of June/July it was very low. The percentage of parasitism by *A.colemani* ranged from 1.5 to 26, whereas *L. scutellaris* could parasitise only 0.5 to 19 per cent of the aphid populations. The third species, *T.indicus* was not encountered during most of the months and the percentage of parasitism by

Table 2. Simple correlation coefficient (r) of total parasitism with different weather factors

Weather factors	a	b	r
Rainfall	27.35	0.003	0.063
Temperature Minimum	178.88	8.40	0.41**
Temperature Maximum	38.44	2.44	0.17
RH Minimum	80.73	-0.78	-0.22
RH Maximum	103.14	-0.89	-0.402*
Sunshine hours	-6.196	6.669	0.383*

** Significant at 1% level
* Significant at 5% level

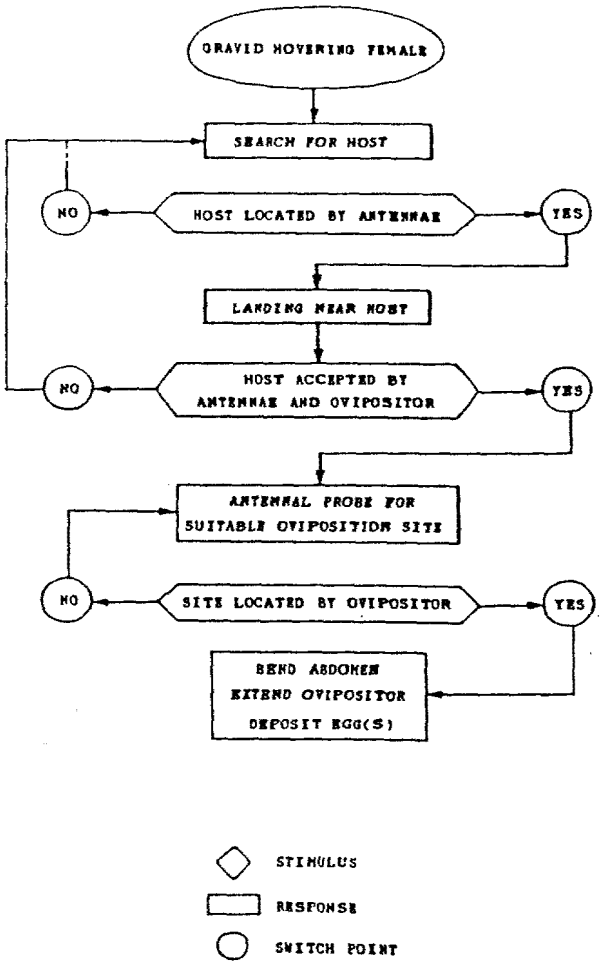

Fig 1. Oviposition behaviour in aphidiids

this aphidiid was rather negligible (0.5 to 3.0). The efficacy of the parasitoid under field conditions was 3.0 to 49 per cent while in the laboratory 60 to 75 per cent of the aphids were subjected to the attack of parasitoids. The high degree of parasitism in the latter could be due to the limited area to be searched which in turn provided more chances for the parasitoid to come in contact with the host. As discussed by Nicholson and Bailey (1935) and Varley *et al.* (1980), the area of discovery of the host by the parasitoid is one of the main criteria for determining the efficiency of the parasitoid.

Simple correlations on the effect of weather factors on total parasitism showed a positive significant relationship with minimum temperature and sunshine hours. High relative humidity adversely affected the activity of parasitoids (Table 2). However, their relationships were not significant with the populations of individual species of parasitoids.

The primary parasitoids of aphids are at times attacked by hyperparasitoids. In the present study, *T.indicus* and *A.colemani* were found parasitised by the hyperparasitoid, *Alloxysta* sp. (Charipidae:Hymenoptera). During January to March and November/December, hyperparasitism by *Alloxysta* sp. was rather high and in 1989 as high as 33.3 per cent hyperparasitism was observed.

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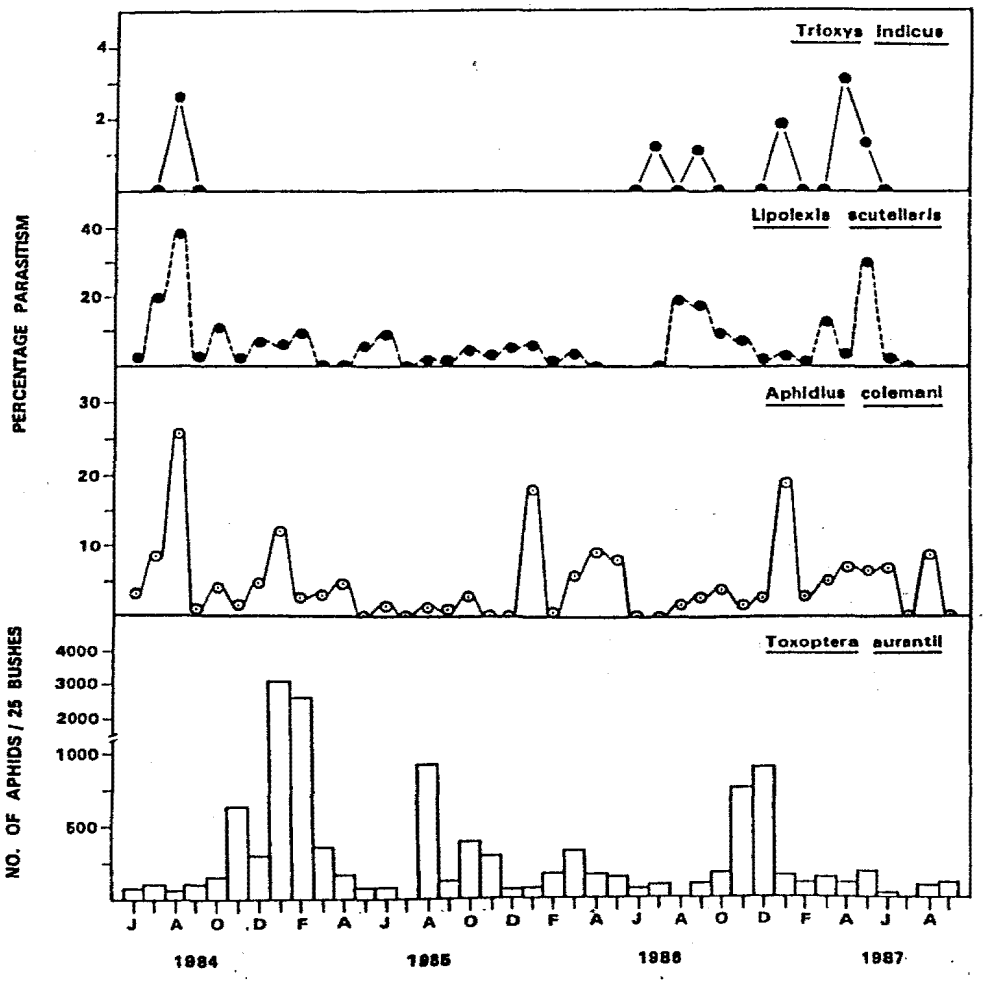

Fig 2. Population trends of *Toxoptera aurantii* and percentage parasitism by the three aphidiids

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