Tropical Agricultural Research Vol. 15: 188-198 (2003)

Biology of the Cashew Pest *Helopeltis antonii* Sign. and it's Predators

P.M.A.P.K. Wijetunge, D. Ahangama[1] and B. Ranaweera[2]

Postgraduate Institute of Agriculture
University of Peradeniya
Peradeniya, Sri Lanka.

ABSTRACT. *Biology of cashew pest Helopeltis antoni Sign. was studied under laboratory and field conditions. Morphometric studies indicated 5 nymphal instars in the development of H. antonii. Mean duration of the developmental period of males and females are 26.9 and 28.2 days respectively. Females predominate in the natural population with a sex ratio of 1: 0.46. Mean duration of mating was 1 h and 15 minutes and resulted in a fecundity of 15 - 42 eggs with an oviposition period of 6 days under 31°±2°C and 75±5%RH. Mean pre-oviposition period of 5 days was recorded. While first to third instar nymphs were active and found on young shoots and inflorescence the older instars were not active and were concentrating in older tissues of the trees. The red ant Oecophylla smaragdina and the praying mantis were observed to prey on H. antonii in the field.*

INTRODUCTION

The cashew pest *Helopeltis antonii* Signort, 1858 (Heteroptera: Miridae) is the most serious pest of cashew in all cashew-growing areas of Sri Lanka. It feeds on tender succulent shoots, inflorescences, immature nuts and apples resulting in drying of shoots, blighting of inflorescences and immature nut fall. Severe infestation causes about 30% yield loss (Anon, 1996). *Helopeltis* populations begin to develop with the on set of new flushes on trees coinciding with the monsoon rains in December and increase during January to mid-March and are least abundant in later months.

H. antonii has a wide host range consisting of tea, guava, cocoa, mahogany, cinchona, red gum, apple, grapes, neem, henna, black pepper and all spice (Devasahayam and Radhakrishnan, 1986). Extensive studies on the biology of *H. antonii* have been carried out by Pillai and Abraham (1974), Pillai *et al.* (1976), Sathiamma (1977), Ambika and Abraham (1979), Jeevaratnam and Rajapakse (1981) and Sathiamma (1984). Mass rearing techniques of *H. antonii* have been developed by Sundararaju and John (1992) and Sundararaju and Babu (2000). This research was carried out to study the biology of *H. antonii* and its predators in a selected cashew plantation in the Sri Lanka.

MATERIALS AND METHODS

The study was carried out at the Cashew Research Centre, in the Kamandaluwa plantation belonging to the Sri Lanka Cashew Corporation at Andigama.

[1] Department of Agricultural Biology, Faculty of Agriculture, University of Peradeniya, Sri Lanka
[2] Department of Horticulture and Landscape Gardening, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka.

It was conducted during November 2000 to April 2003. To study the biology, insects were mass reared in the laboratory in aluminum cages (15 × 15 × 20 cm) and in clear plastic bottles (12 cm diameter and 18 cm height) at 31°±2°C and 75±5% RH. Two sides of the rearing cages were covered with muslin cloth and the other two sides with clear polyester film. Top surface of cages and the bottles were covered with muslin cloth in order to provide ventilation.

At the start of the season adults (males and females) of *Helopeltis* were collected using a sweep net and by hand picking. Paired males and females were placed in rearing cages. One or two tender cashew shoots dipped in water filled glass vials were provided daily as food and for egg laying. The pairing of bugs was observed and the duration of mating of each pair and pre-oviposition as well as oviposition period of the bugs was recorded. Shoots were replaced every other day after counting the number of eggs laid on the shoots. Shoots with the eggs were retained to observe egg hatching and incubation period was recorded. The first instar nymphs were transferred on to fresh tender shoots for further development. Durations of each nymphal instar were observed by counting and checking the number of moults until adult emergence. This procedure was repeated to determine the duration of mating and fecundity of adults and longevity of each stage of the bug. Shoots on which eggs had been embedded were collected from the field and length and width of the eggs and length of the processes were measured by removing the eggs.

Preliminary studies were carried out to find out the number of instars of the *H. antonii* by measuring body length and width and the length of antennae of 400 nymphs of different growth stages, using the Profile Projector (PJ 311). Males and females of *Helopeltis* bugs on trees were collected by hand and by sweep net and their numbers were recorded.

Predation by the red ant (*Oecophylla smaragdina)* and praying mantis were assessed by providing different growth stages of *Helopeltis* in cages held in the laboratory. Predation by the red ants in the field too was observed.

RESULTS AND DISCUSSION

Number of nymphal instars of *H. antonii*

Cumulative frequency distribution of antennal length of *Helopeltis* bugs of different developmental stages showed five peaks indicating five nymphal instars (Fig. 1). In a detailed study conducted in India the life cycle of *H. antonii* is reported to consist of five nymphal instars (Ambika and Abraham, 1979).

Although the length and width of the body of *H. antonii* showed a gradual increase no discrete groups indicating different instars could be observed (Fig. 2 and 3) unlike in the case of antennal length (Fig. 1).

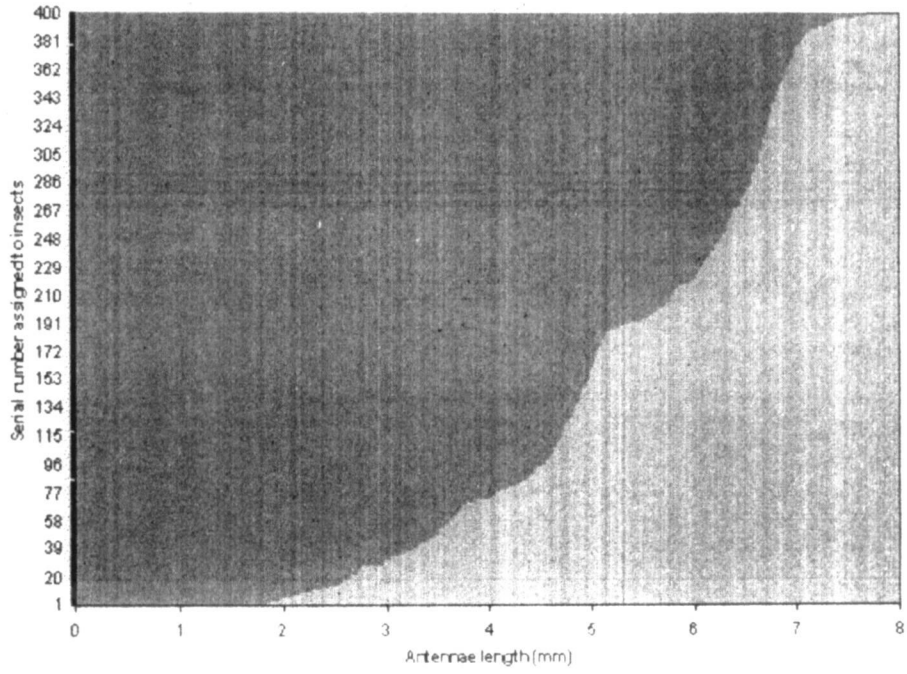

Fig. 1. Cumulative frequency distribution of antennae length of different instars of *H. antonii*.

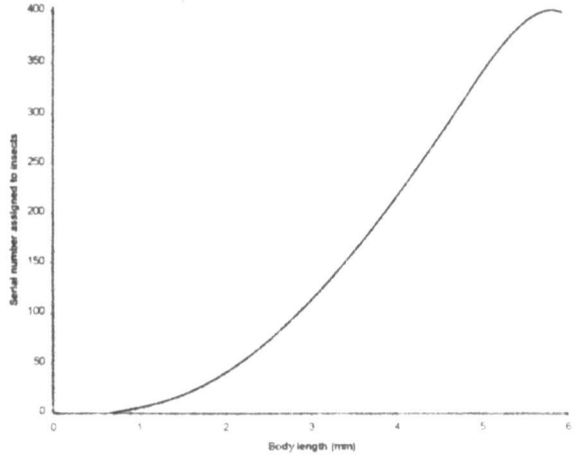

Fig. 2. Distribution of body length of different instars of *H. antonii*.

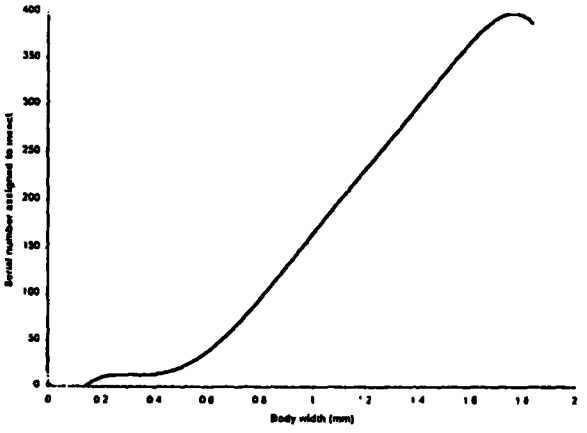

Fig. 3. Distribution of body width of different instars of *H. antonii.*

Life cycle of *Helopeltis antonii*

Adult stage: Males and females of *Helopeltis* were distinguishable by the size of the body (Fig. 4). Newly emerged adults were light brown and develop the characteristic colouration within 30-60 minutes. Dorsum of the thorax was reddish orange or dark brown in both sexes. Tergum of abdomen is creamy white. Mean body length of adult male was 5.87±0.36 mm (n=30) and mean body width was 1.49±0.13 mm (n=30). Mean body length of adult female was 7.10±0.54 mm (n=30) and mean body width was 1.80±0.14 mm (n=30) across the thorax.

Antennae were four segmented with a mean length of 9.40±0.37 mm and 9.47 ±0.43 mm for females and males respectively (n=30) (Table. 1). First segment of antennae was thicker than other three segments; second segment was the longest while last one was the shortest.

A special character of the genus *Helopeltis* was the presence of an erect pin like process called scutellar horn. It arises from the scutellum and was reddish brown in colour and about 1 mm long. Apex was swollen and funnel shaped. Antennae bear short stout bristles especially in the 3rd and 4th segments. Basal segment was stout with less bristles. The two pairs of wings overlap over the body when at rest. Hind-wings were shorter while the forewings cover the entire body. Tip of the forewing has a triangular brownish black discoloration when wings were held one over the other.

Males and females were observed to pair end-to-end during copulation (Fig. 5). Mean copulation period of the *Helopeltis* is 1 h and 15 minutes under laboratory conditions (n=10). Jeevarathnam and Rajapakse (1981) stated that copulation range from 10 minutes to 2 h and female mate up to 6-8 times during her life time. Oviposition period lasted 6 days. Mean pre-oviposition period was 5 days (Range 3-6 days). Ambika and Abraham (1979) stated that pre-oviposition and oviposition periods lasted for 4 and 6 days respectively at 25±0.5°C in India.

Table 1. Morphometrics (mean value in mm) of adults and immature stages of *H. antonii.*

Stage	Antenna length (mm)	Body length (mm)	Body width (mm)
1st Instar	2.33 ± 0.33	1.63 ± 0.29	0.46 ± 0.09
2nd Instar	3.41 ± 0.26	1.92 ± 0.21	0.62 ± 0.07
3rd Instar	4.71 ± 0.32	2.98 ± 0.36	0.94 ± 0.08
4th Instar	5.59 ± 0.23	4.18 ± 0.11	1.46 ± 0.28
5th Instar	6.61 ± 0.35	5.22 ± 0.49	1.60 ± 0.17
Adult female	9.40 ± 0.34	7.10 ± 0.54	1.80 ± 0.14
Adult male	9.47 ± 0.43	5.87 ± 0.36	1.49 ± 0.13

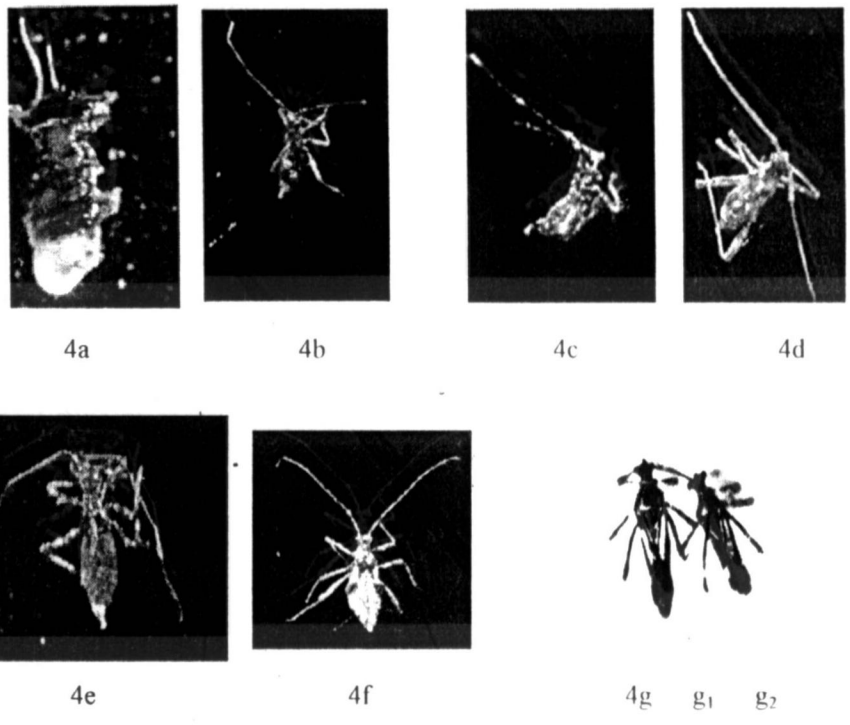

Fig. 4. Developmental stages of *H. antonii.*
4a- an egg, 4b- 1st instar nymph, 4c- 2nd instar nymph, 4d- 3rd instar nymph, 4e- 4th instar nymph, 4f- 5th instar nymph, 4g- g_1- Female, g_2- Male

Mean longevity of males and females were 7.90 (Range 3-14) and 9.22 (Range 3-18) days respectively (Table. 2). Females are numerous and active in the field prior to mating and oviposition. Female to male ratio during November 2000 to April

2003. was 1:0.46. The mean fecundity of the female is 25.14 eggs (n=10, Range 15 - 42) at 31°±2°C and 75±5% RH, under laboratory conditions. The highest number of eggs laid by a single female was 42 of which 26 hatched. More eggs (more than half) were laid on the 1st day of oviposition and the number of eggs laid decreased with time.

Fig. 5. Copulation of *Helopeltis* by end-to-end system.

Table 2. Mean longevity (days) of nymphs and adults of *Helopeltis* in two different seasons.

Stage	Season –I	Season-2	Mean	Range
1st Instar	2.33 (n=20)	2.95 (n=20)	2.64	2-3
2nd Instar	2.25 (n=20)	2.43 (n=20)	2.34	2-4
3Rd Instar	1.62 (n=20)	1.80 (n=20)	1.71	1-3
4Th Instar	2.32 (n=20)	2.05 (n=20)	2.18	2-4
5Th Instar	3.16 (n=20)	3.62 (n=20)	3.09	3-5
Adult female	9.30 (n=20)	9.14 (n=20)	9.22	3-18
Adult male	7.94 (n=20)	7.86 (n=20)	7.90	3-14

Egg stage

Minute eggs (Fig. 4a) were observed embedded in the epidermal tissues of the tender shoots, leaf stalks, and inflorescence axes and rarely in the nuts and mid ribs of leaves. Eggs were laid most often singly; if laid as a batch, frequently on tender shoots. An egg batch consists of a maximum of 8 eggs. Eggs were sub-oval in shape with neck near the anterior end. Two unequal silvery processes arise laterally on either side of the anterior end of the egg. Mean length of egg was 1.33 mm (n=10) and the mean width at the neck was 0.38 mm. Mean length of the larger process was 0.52 mm while the shorter process is 0.33 mm. Mean incubation period of eggs was 7 days (n= 150).

First instar nymph (Fig. 4b)

Nymphs that hatch out from the eggs were minute and light orange in colour. Mean body length of the instar was 1.63±0.29 mm and it was 0.46±0.09 mm broad across the thorax. These measurements were recorded to determine the number of instars by distribution of antennae length, which gave five distinct peaks (Fig. 1). Head and thorax were dull light orange and the abdomen is light orange in colour. Lateral margins of the abdomen have two rows of bristles. Antennae were 4 segmented with a mean length of 2.33±0.33 mm and with a light orange club shaped terminal segment.

Legs were long with 2 tarsal segments. Legs, antennae and thoracic segments also have bristles. Wings and scutellar horn was absent in the 1st instar nymphs. Mean longevity of 1st instar nymphs is 2.64 days, ranged from 2-3 days (Table 2).

Second instar nymph (Fig. 4c)

The entire body was deep orange with a mean body length of 1.92±0.21 mm and breadth of 0.62±0.07 mm across the thorax. Scutellar horn was present and wing buds are clear. Antennae were 4 segmented and the mean length was 3.41±0.26 mm. Sexes were not distinct, mean longevity of instar was 2.34 days (n=40, Range 2-4 days) (Table 2).

Third instar nymph (Fig. 4d)

Wing buds and scutellar horn were clear to the naked eye. Antennae were four segmented, with a mean length of 4.7±0.32 mm. Tarsi were 2 segmented. Sexes were not distinct. Mean body length and width of third instar nymph was 2.98±0.36 mm and 0.94±0.08 mm respectively (Table. 1). Mean longevity of the 3rd instar wass 1.71 days (n=40, Range 1-3 days) (Table. 2). This instar of *Helopeltis* has the shortest duration. First, second and third instar nymphs move actively over tender and mature parts of shoots and inflorescences of the cashew plants.

Fourth instar nymph (Fig. 4e)

Fourth instar nymphs were less active than younger instar nymphs and were often found in mature parts of cashew branches. To feed they come to young shoots. Dark brown wing buds extended over their abdomen. Dorsum of abdominal segments 1-8 were distinct and have creamy white sickle shaped markings, developed towards posterior end. Tergum of the abdomen is creamy white. Mean body length and width of 4th instar nymph was 4.18±0.11 mm and 1.46±0.28 mm respectively. Antennae were 4 segmented with a mean length of 5.59±0.23 mm (Table 1). Tarsi were 2 segmented. Sexes were not distinct. Mean longevity of the instar was 2.18 days (n=40, Range 2-4 days) (Table. 2).

Fifth instar nymph (Fig: 4f)

Nymphs were 5.22±0.49 mm long and 1.60±0.17 mm width across the thorax (Table 1). Mean antennal length was 6.6±0.35 mm and were segmented with a long pedical. The thorax was reddish orange or dark brown and the dorsum of the abdomen and other appendages were darker than the turgum. Wing buds cover half the abdomen and do not overlap. Scutellar horn was clearly visible. Tarsi were two segmented. Fifth instar nymphs were less active and were found mostly on mature parts of the branches. The longevity of the instar was 3.09 days (n=40, Range 3-5 days). This instar has longest duration.

Life cycle from eggs to adult emergence takes 18.96 days at 31±2 °C. Females survived for a longer period (9 days) than the males (8 days). Longevity of males and females were 27 and 28 days respectively. These findings and descriptions were in accordance with those reported by Ambika and Abraham (1979) and differ from those of Pillai and Abrahum (1974) and Pillai *et. al* (1976).

Feeding habits and nature of damage

Feeding habits of adults and nymphs were similar. Nymphs congregate, most often on the feeding site while adults were solitary. Both nymphs and adults inserted their rostrum into the tender shoots, leaf petioles, developing nuts and fruits and sucked the sap continuously. Feeding lasts for 10 – 30 min. and fore tarsi were only used as a support during feeding (Jeewarathnam and Rajapaksa, 1981). When large numbers of nymphs get confined to small twigs, dense necrotic lesions can be observed. Two to three days after feeding the brownish lesions expand and dry up forming large necrotic patches (Fig. 6). From every feeding punch on shoots a resinous substance exudes and eventually dries up and hardens upon exposure to air. The gummy exudation was greater around punctures on relatively harder tissues on the shoots (Ambika and Abraham, 1979).

Inflorescences were attacked by bugs at primary stage or before flower initiation causing necrotic brownish lesions on the main and lateral branches (Fig. 7). These lesions broaden along the axis and shrinking and dry up, eventually become blackish in colour giving a blight appearance to the whole inflorescence. *Colletotricum spp.* was one of the causal organisms responsible for inflorescence blight. *H. antonii* may be the primary causal agent for inflorescence blight. Studies in India have showed that *H. antonii* was the primary causal agent and fungal species *Gloesporum mangifera* and *Phomopsis anacardiae* were only secondary saprophytic colonizers (Nambiar *et al.*, 1973). Jeewarathnam and Rajapakse (1981) revealed that *H. antonii* was the primary incitor and *Gloesporium mangifera, Pestaliopsis spp., Btrydiplodia* spp. were also associated with it.

Bugs also feed on the immature nuts and apples of floral branches causing shallow sunken lesions (Fig. 8) that were unclear after turning blackish in colour and nuts shrank and ultimately fell down. When insects attacked intermediate mature nuts and apples characteristic scabby spots developed on these parts.

Fig. 6. Dense necrotic lesions on shoot of cashew due to feeding by *H. antonii*.

Fig. 7. Necrotic brownish lesions on cashew inflorescence caused by *H. antonii.*

Fig. 8. *H. antonii* bugs feeding on immature cashew nuts and apples.

Predators

During the study period the red ant *Oecophylla smaragdina* (Hymenoptera: Formicidae) was found feeding on *H. antonii* under laboratory and field conditions. Red ants when provided as a colony inside cages, fed on nymphs and adults of *H. antonii*. *Helopeltis* bugs caught by the red ants were dragged into the colony and were eaten leaving behind schlerotized legs, antennae and head of the bugs. Bugs caught by ants were held for a period of 5 to 10 min. during which the prey is paralyzed and then were dragged into the nest (Fig. 9).

Predatism by praying mantis was also observed during the study period. Both nymphs and adults of praying mantis were observed to feed vigorously on nymphs and adults of *H. antonii* (Fig. 10). Adults were preferred by mantis than nymphs. *Crematogaster wrougtonii* Forel (Hymenoptera: Formicidae) was recorded for the first time as a predator of eggs and early instars of *H. antonii* (Ambika and Abraham 1979). Jeewarathnam and Rajapakse (1981) revealed that *Trichogramma minutum* Rile. (Hymenoptera: Trichrogramatidae) was parasitic on eggs of *H. antonii*.

Fig: 9. Red ants attacking an adult *H. antonii.*

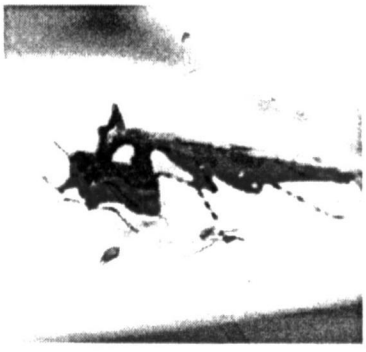

Fig: 10 . Praying mantis attacking an adult *H. antonii.*

CONCLUSIONS

Bugs of *H. antonii* were found damaging young flushes, inflorescences and immature nuts of cashew. Life cycle of *H. antonii* includes of 5 nymphal instars with durations of 2.6, 2.3, 1.7, 22.2, 3.1 days respectively. Females were predominant in the field with a female to male sex ratio of 1: 0.46. Each female lays 15-42 eggs within a period of 6 days. Predation of *H. antonii* by red ants *Oecophylla smaradgina* and praying mantis was observed in the field.

ACKNOWLEDGEMENTS

The authors acknowledge the Sri Lanka Cashew Corporation for providing the cashew blocks and for the assistance rendered by Mr. H.M.S.K. Herath and other staff. Authors appreciate the assistance given by Dr. B. Kelaniyangoda and his staff at National Plant Quarantine Service at Katunayaka. We also extend our sincere thanks to Mr. T. Rajapaksa for his valuable assistance.

REFERENCES

Anon, 1996. Survey on cashew cultivation in Sri Lanka. Dept. of Census & Statistics and Sri Lanka Cashew Corporation.

Ambika, B. and Abraham, C.C. (1979). Bio- ecology of *Helopeltis antonii* Sign. (Miridae: Heteroptera) infesting cashew trees. Entomon. 4(4): 335-342.

Devasahayam, S. and Radhakrishnan Nair, C.P. (1986). Tea mosquito bug on cashew in India. J. Plant. Crops. 14: 1-10.

Jeevaratnam, K. and Rajapakse, R.H.S. (1981). Biology of *Helopeltis antonii* Sign. (Heteroptera: Miridae) in Sri Lanka. Entomon. 6(3): 247-251.

Nambiar, K.K.N., Sarma, Y.R. and Pillai, G.B. (1973). Inflorescence blight of cashew.(*Anarcardium occidentale* L.) J. Plant. Crops 1(No. 1 and 2) : 44-46.

Pillai, G.B. and Abraham V.A. (1974). CPCRI Annual Report for 1973.138-139, Kasargod, India.

Pillai, G.B. Singh, V. and Premkumar (1976). CPCRI Annual Report for 1975. 134, Kasargode, India.

Sathiamma, B. (1977). Nature and extent of damage by *Helopeltis antonii* Sign. The tea mosquito on cashew. J. Plant. Crops., 5(1): 58-59.

Sathiamma, B. (1984). Biology of tea mosquito *Helopeltis antoiinii* Sign. reared on mango seedling in the laboratory. Cashew Bull. 21: (1): 6-8.

Sundararaju, D. and Babu, P.C.S. (2000). Improved mass culture technique for neem mosquito bug *Helopeltis antonii* Sign. (Heteroptera: Miridea). J. Ent. Res. 24(1): 73-82.

Sundararaju, D. and Jone, J.N. (1992). Mass rearing technique for *Helopeltis antonii* Sign. (Heteroptera: Miridae) – an important pest of cashew. J. Plant. Crops. 20 (1): 46-53.