

**Study on life cycle parameters of *Stethorus aptus* (Kapur) (Coleoptera: Coccinellidae):
A new predator of tea Red spider mite
Oligonychus coffeae (Nietner) (Tetranychidae)**



Zoology

KEYWORDS : Red spider mite, Predator, *Stethorus aptus*, life cycle.

Archita Barua	Tocklai Experimental Station, Department of Entomology TRA, Jorhat, Assam-785008
Dr. Azariah Babu	Tea Research Association, North Bengal Regional R&D Centre, Nagrakata, West Bengal
Dr. Ratul Ch Rajkhowa	Cotton College, Department of Zoology, Guwahati, Assam

ABSTRACT

A survey was carried out to find out the natural enemies of red spider mite in the tea gardens of Jorhat region of Assam. During the survey, a new predatory beetle was recorded and has been identified as *Stethorus aptus* (Kapur). Life cycle parameters such as incubation period, duration of development, longevity, fecundity of *S. aptus* was carried out under laboratory condition. The incubation period of the egg ranged from 8 to 10 days and larval developmental period varies from 2 to 4 days. The total development period from egg to adult was complete in 28 to 30 days. The longevity of the female is more than the male and a mature female laid minimum 4 and maximum 12 eggs/day.

INTRODUCTION

Tea [*Camellia sinensis* (L.) O. Kuntze] is an evergreen perennial plantation crop that plays a major role in the economy of several developing countries. A number of arthropod species survive in the tea ecosystem as it provides suitable habitat and continuous supply of food to them. More than one thousand species of arthropod have been documented from tea ecosystem worldwide (Murlreedharan, 2001) and about 3% of pests are common globally. The red spider mite, *Oligonychus coffeae* Nietner (Acarina: Tetranychidae), is considered as one of the serious pest of tea in most of the tea producing countries. For the successful management of red spider mite, synthetic pesticides are widely used. However, tea being an economically important export commodity, the production of tea has to be in compliance with the international regulations on pesticide residues. These issues necessitate the development of alternative pest control strategies for rsm management.

Biological control is one of the oldest pest management strategies that plays a vital role in the control of many tea pests below economic injury level. Among them, ladybird beetles gain considerable significance in biological control in several agro ecosystems. The predatory nature of most of the coccinellid beetles makes them economically important. They have the capacity to search and feed ravenously on larval and adult stages of aphids, mites and other soft bodied arthropods (Kim-Kyuchin *et al.*, 2000; Babu and Ananthkrishnan 1993; Ara Begum *et al.*, 2002). In the recent years, introduction of indigenous natural enemies are more favored than exotic predators for efficient biocontrol and to reduce undesirable ecological problems. (Brader, 1980). In this regard, the predacious ladybird beetles are widely used in biocontrol as majority of them feed on different tea pests (Muraleedharan *et al.* 2001). This coccinellid beetle *Stethorus aptus* (Kapur) has been newly recorded in the tea growing areas of north east region (Babu, 2012) which was earlier reported as a predator of *Panonychus citri* of citrus plant in China. (Li *et al.* 1990). Therefore the biological study on *S. aptus* in tea ecosystem is very important in order to evaluate their potential against tea red spider mite.

Materials and Methods

Stock culture of *Stethorus aptus* and red spider mite

To maintain the stock culture of *Stethorus aptus* and *Oligonychus coffeae* in the laboratory, different stages of both the predator and prey were collected from the tea fields of Tocklai Experimental Station. The culture was kept at 23±1°C and RH 90±5 in the laboratory by following the method of Perumalsamy *et al.*, 2010. The field collected red spider mites were then shifted to fresh mature tea leaves kept in large plastic trays. The leaves were placed on moist cotton pads to retain their freshness and used as stock culture for the experiment. To have the mass culture of the predatory beetle, various stages of field collected *S. aptus* were reared in small containers and provided with enormous number of red spider mite (larvae and nymphs). The pupa

were collected from the container and kept for adult emergence.

Life cycle study

Newly emerged beetles were kept in small containers and provided with mite infested leaves for their nourishment. To obtain eggs, five pairs of male and female beetles separated and kept in containers for mating. After 24 hour the male and female beetles were separated and kept individually in container for oviposition. The female laid eggs on the dorsal and ventral surface of mite infested leaves. The egg laden leaves were regularly changed and placed on trays for hatching having water soaked cotton at the bottom.

The newly hatched larval instars were collected with a fine brush and nurtured by giving mite infested leaves in rearing container. The container was covered with a muslin cloth and the lid of the container was perforated with small needle for proper ventilation. Observations on the lifecycle parameters such as pre-oviposition period, incubation period and duration of development of different stages, fecundity and body size of each stage is recorded.

RESULTS AND DISCUSSION

The biology of *Stethorus aptus* was studied during winter season of (December 2012 – January 2013), under laboratory conditions at temperature 23±1°C and RH 90±5. The description of various stages, morphometric measurements and developmental periods of different stages are presented in Tables 1 & 2.

Stages	Mean ± SD* (mm)	
	Length (mm)	Width (mm)
Egg	0.20±0.02	
First instar	0.63±0.10	0.32±0.03
Second instar	1.03±0.12	0.32±0.03
Third instar	1.28±0.12	0.41±0.03
Fourth instar	2.40±0.10	0.88±0.05
Pupa	1.50±0.08	1.09±0.09
Adult	Male	1.4 ±0.08
	Female	1.5±0.03

Table 1: Morphometric observations on life stages of *Stethorus aptus*

Life stages	Duration in days (Mean± SD)
Pre ovi position period	7.4±1.17
Ovi position period	88.85±15.38
Egg (incubation period)	8.6±0.89
I instar larva	3.2±0.45
II instar larva	3.0±0.0
III instar larva	2.6±0.55
IV instar larva	4.8±0.45
Total larval period	9.8±0.44
Pupal period	5±0.71
Total developmental period	29.2±0.84
Fecundity	72±17.22

Table 2: Life cycle parameters of *Stethorus aptus* on red spider mite

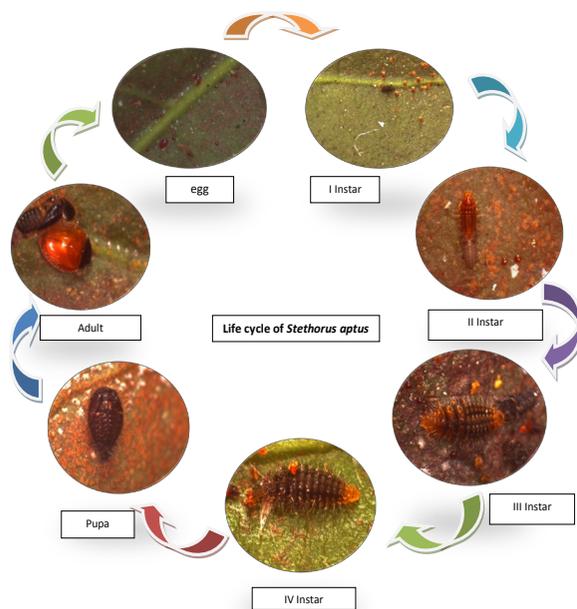


Fig1- Life cycle of *Stethorus aptus*

Present study revealed that the development stages of *S.aptus* comprise of eggs, four larval instars, pupa and adult (Fig.1).The adult started mating for 10-15 minutes after their emergence. The female started laying eggs after a pre-oviposition period of 7.4 ± 1.17 days. The eggs are deposited singly or in groups of 3-4 eggs on the dorsal and ventral surface of the leaves, gener-

ally on the midrib and veins. The eggs are shiny yellow-orange and bluntly rounded at both ends and slightly greater than the eggs of red spider mite. The incubation period of the eggs was 8.6±0.89 days

LARVAL STAGES- The newly emerged larva was small, elongated measuring about 0.639mm in length and 0.326mm in width (35 x magnification in stereomicroscope). There are four larval stages which were very similar with each other and can be differentiated on the basis of shed exoskeleton and head capsule. The fourth instar larva was 2.4±0.1mm in length and 0.88±0.05 mm in width. All instars possess numerous dark brown setae on their tergite with dark brown pigmentation on the dorsal surface of the setae. The *S.aptus* completed its larval developmental period in 9.8 days.

PUPA- The pupal stage of *S.aptus* was flattened, broad anteriorly and narrow at the posterior end. There was a pre pupal stage which was orange red in colour lasts for a short duration of time and later changes into black colour pupa. The pupal stage remains for an average of 5±0.70 days before moulting into adult.

ADULT -Newly emerged adults were initially orange red in colour and gradually changed into black colour. Morphologically the males are slightly smaller than the females. The average length and width of male and female were 1.4 ±0.08, 1±0.03 and 1.5±0.03,1.1+ 0.03mm respectively. The *S.aptus* completed its life cycle within 29.2 ±0.83 days under laboratory condition which was found comparatively higher than few related species like *S.japonicus* (17.1 days) (Mori *et al.*,2005), *S.picipes* (16.9 days) (Tanigoshi and McMurtry,1977) *S.punctillum* (17.1 days) (Royetal.,2005). *S.siphonulus* (12.7 days) (Raros and Haramoto 1974) and *S.gilvifrons*(19.2days) (Perumalsamy *et al.*,2010). The average fecundity of *Stethorus aptus* recorded as 72±17.22 which was less than *S.japonicus* (500.7 eggs)(Mori *et al.*,2005), *S.madecassus* (184.3eggs) (Chazeau,1974); *S.siphonulus* (170+52.5) (Raros and Haramoto 1974); *S. picipes* (221.0eggs) Tanigoshi and McMurtry,1977, *S.punctillum* (279.5 eggs) (Roy *et al.*,2005) and *S.gilvifrons* (149eggs) (Perumalsamy *et al.*,2010)

The predatory efficiency of this coccinellid beetle *Stethorus aptus* was found to be increase with advancement of larval instars. The fourth larval instar of the beetle was found to be more voracious than the other larval instars. Further an attempt has also been made to develop a simple mass multiplication technique for this predator on its natural prey and utilize them as one of the component of IPM of red spider mite infesting tea.

ACKNOWLEDGEMENT

Authors are thankful to the Director of Tocklai Experimental Station for his support and professor Dr. K Ramaraju of TNAU for taxonomic identification of the species. This paper is a part of PhD thesis of the first author.

REFERENCE

(1)Ara Begum, M., Jahan, M. Bari, M. M., Hossain, M. M. and Afsana, N. 2002. Potentiality of *Micraspis discolor* (F) as a biocontrol agent of *Nilaparvata lugens* (Stal).Online Journal of Biological Science, 2 (9): 630-632 | (2)Babu A., Ananthakrishnan TN (1993) Predatory efficiency, reproductive potential, and bio-energetics of *Coccinella transversalis* F. and *Menochilus sexmaculatus* F. (Coleoptera: Coccinellidae) in relation to aphid (Homoptera : Aphididae) prey quality. | (3)Babu, A. 2012. *Stethorus aptus* : A new predator of red spider mite. Tocklai news Vol(18): 2 | (4)Brader, L. 1980. Advances in applied entomology. Annals of Applied Biology, 94: 349-365. | (5)Chazeau J., (1974) Development et fecondite de *Stethorus madecassus* (Coleoptera:Coccinellidae),eleven conditions exterieures dans le sud-ouest de Madagascar.Cah.ORSTOM ser Biol 25:27-33 | (6)Das, G. M. 1965. Pests of tea in North East India and their control. Memorandum No. 27, Tocklai Experimental Station, Tea Research Association, Jorhat, Assam,India. | (7)Das, G. M. 1959. Bionomics of the tea red spider, *Oligonychus coffeae* (Nietner) . Bulletin of Entomological Research, 50: 265-74. | (8)Hazarika, L. K., Bhuyan, M. and Hazarika, B. N. 2009. Insect pests of tea and their management. Annual Review of Entomology, 54: 267-84. | (9)Kim-Kyuchin, Choi-Ducksoo, Kim, KC, Choi D S (2000) Natural enemies of citrus red mite, *Panonychus citri* McGregor and seasonal occurrence of major predators on Yuzu tree (Citrus Junos). Korean Journal of Applied Entomology, 39(1): 13-19. | (10)Li, W.Q., Yang, H.H., Deng, G.R., Jin, M.X., 1990. Study on bionomics of *Stethorus guangxiensis* and *S. aptus*. Journal of Guangxi Agricultural College 9 (4), 19-25 | (in Chinese). | (11)Mori K, Nozawa M, Arai K, Gotoh T (2005) Life history traits of the acarophagous lady beetle, *Stethorus japonicus* at three constant temperatures. Biocontrol 50:35-51 | (12)Murleedharan, N.1997.Pest and diseases of tea and their management. Journal of plantation crops 25 (1) :15-19. | (13)Muraleedharan, N., Selvasundaram, R. and Radhakrishnan, B. 2001. Parasitoids and predators of tea pests in India. Journal of Plantation Crops, 29 (2): 1-10. | (14)Perumalsamy K, Selvasundaran R, Roobakkumar A, Rahman VJ, Muraleedharan N (2010) Life table and predatory efficiency of *Stethorus gilvifrons* (Coleoptera: coccinellidae), an important predator of the red spider mite, *Oligonychus coffeae*(Acari:Tetranychidae), infesting tea.Exp Appl Acarol 50:141-150 | (15)Raros ES, Haramoto FH (1974) Biology of *Stethorus siphonulus* Kapur (Coccinellidae: Coleoptera), a predator of spider mites, in Hawaii.P Hawaiian Entomol Soc 21:457-465 | (16)Roy M, Brodeur J, Cloutier C (2005) Seasonal activity of the spider mite predators *Stethorus punctillum* (coleopteran: coccinellidae) and *Neoseiulus fallacis* (Acarina:Phytoseiidae) in raspberry, two predators of Tetranychus mcDanieli (Acarina:Tetranychidae).Bio Control 34:47-57 | (17) Roy,S, Mukhopadhyay,A.,Das,S and Gurusubramanian,G.2010. Bioefficacy of coccinellid predators on major tea pests. Journal of Biopesticides 3(1 Special Issue) 033 - 036 . | (18)Tanigoshi LK, McMurtry JA (1977) The dynamics of predation of *Stethorus picipes* (Coleoptera:Coccinellidae) and Typhlodromus floridanus on the prey *Oligonychus punicea* (Acarina:Phytoseiidae,Tetranychidae).I. Comparative life history and life table studies.Hilgardia 45:237-261 |