International Journal of Fauna and Biological Studies
Available online at www.faunajournal.com

ISSN 2347-2677
IJFBS 2015; 2(4): 120-123
Received: 29-05-2015
Accepted: 30-06-2015

Maitrayee Dutta
Assistant Professor, Department of Zoology, Maryam Ajmal Women's College of Science and Technology, Hojai, Assam.

Correspondence:
Maitrayee Dutta
Assistant Professor, Department of Zoology, Maryam Ajmal Women's College of Science and Technology, Hojai, Assam.

Seasonal and tea varietal effect on the biology of *Oligonychus coffeae* Nietner

Maitrayee Dutta

Abstract
The clonal effect of three Tocklai released tea clones TV1, TV6 and TV10 on the biology of *O. coffeae* were studied during the seasons April-May, June-July and Aug-Sep. The life cycle of an adult female mite on an average took the longest duration to develop in TV6 (14.36 days), intermediate in TV10 (13.47 days) and the shortest durations were observed in TV1 (12.39 days). The seasonal effect on the biology of *O. coffeae* also showed profound effect on the biology of *O. coffeae* and during June-July a female mite on an average took the least time to develop (10.97 days).

Keywords: *O. coffeae*, resistance, seasonal effect, TV clones

1. Introduction
Red spider mite, *Oligonychus coffeae* Nietner is one of the major debilating pest of tea ecosystem. It causes damage mostly on the adaxial surface of the mature tea leaves and petioles recognized by interveinal small reddish spots on the leaf generally along the central and lateral leaf veins and margins [1, 4, 15, 5].
The infestation by red spider mites is in its severest form and seldom serious enough to cause extensive damage increasing the population from March with the rise in temperature which becomes farther serious during April-June. This has necessitated detailed studies on their biology on three TRA Tocklai released tea clones TV1, TV6 and TV10 with an attempt to study their significant role in host plant resistance mechanism during April-May, June-July, and August-September.

2. Materials and methods
2.1 Leaf disc culture method for biology study of red spider mite
For the study of biology of red spider mite, the leaf disc culture method (Plate 1) of Helle and Sabellis [7], modified by Hazarika *et al.* [6] and Saikia [18] was followed. Fresh mature leaves with petiole free from any insects and mites were collected from the field and cut into small leaf disc of $2.5cm^2$ with its petiole. After wrapping the petiole with moistened cotton, a disc was placed in the middle of a cotton wad in the petridish filled with water. Adult mites distinguished under the stereobinocular microscope were then released on the leaf disc and the petridish was supplied with water as and when required. The edges of leaf disc was then wrapped around with thin moist cotton wick so that the mites did not move towards the edge and hide underneath the leaf disc.

2.2 Biology study
Observations on the life cycle was conducted by maintaining together a freshly emerged male and a female quiescent deutonymph. Three such sets of red spider mites were taken on three leaf discs of a particular clone.
The observations were made daily within an appropriate time regime during morning and evening under a stereo-binocular microscope (Leica) at 10X magnification. To determine the incubation period, adult females were released on excised leaf overnight and were removed the following day and then the date of egg laying was recorded. After hatching, periodic observations were made to determine the different immature stages. On emergence of adults, they were shifted to new rearing site and the duration of development of different stages were determined. Likewise the quiescent periods were also observed. The stages of life cycle of the three different TV clones were determined during April to September for three consecutive years 2010-2013.

3. Results

The effect of TV1, TV6, TV10 and season (April-May, June-July, August-September) on the biology of *O. coffeae* are presented in Table1. The incubation period of *O. coffeae* eggs differed significantly on different tea clones at 1% and 5% level of significance. The incubation period was longest in TV6 (6.66 days) followed by TV10 (6.52 days) and TV1 (6.22 days). Seasonal observations revealed that the eggs required longest period to hatch in August-September (8.44 days), followed by April-May (6.23 days) and the shortest incubation period was observed in June-July (4.72 days). The interaction of season and clones for the incubation period was also found to be significant at both probability levels.

Larval period and quiescent larval duration presented in Table1 show that the total duration required for larval development and quiescent larval development differed significantly at P=1% and P=5% on the said tea clones (Table 1). The larva took the longest period (1.45 days) for development in TV6, which was followed by TV10 (1.31 days) and the lowest developmental period was observed in TV1 (1.17 days). Similarly, the quiescent larvae also remained in their longest inactive stages in TV6 (0.82 days), followed by TV10 (0.68 days) and TV1 (0.44 days). Larval and quiescent larval durations were observed to be longest in April-May (1.38 and0.81 days), followed by August-September (1.31 and 0.60 days), and it was the shortest during June- July (1.24 and 1.53 days). The interaction of seasons and clones also showed significant difference in terms of larval and quiescent larval durations.

Longest duration of development of protonymph was obtained in TV6 (1.07 days, 1.08 days and 1.13 days). However, the protonymphal durations were at par on TV1 and TV10. The inactive or quiescent protonymph and the deutonymph showed moderate durations of development in TV10 (0.98 days and 1.03 days). The shortest duration for quiescent protonymph and deutonymph, however, prevailed in TV1 (0.96 days and 0.98 days). Similarly, protonymphal and deutonymphal period were found to be significantly different in different seasons of the year. Further, during the months of August-September, protonymph showed longer durations of development (1.17 days) followed by June-July (0.96 days), while it took the shortest duration of development during April-May (0.88 days). Normally, the quiescent protonymph was most inactive (1.09 days) in August-September followed by April- May (1.08 days) and very minimum inactive period in June-July (0.85 days). The longest deutonymphal period occurring in April-May (1.24 days) followed by August-September (1.05 days) and with shortest duration during June-July (0.85 days). However clonal and seasonal interactions for protonymphal, quiescent protonymphal and deutonymphal durations were however not significant at both probability levels.

It appears that quiescent deutonymphal stage showed its maximum inactivity on TV10 (0.98 days). However, on TV1, this stage showed moderate levels of inactivity (0.75 days) while the minimum inactivity prevailed on TV6 (0.10 days). The quiescent deutonymph lasted for 1 day in August-September, while it was a par in April-May and June-July (0.91 days). The seasonal and clonal interactions for quiescent deutonymphal stage, however, differed significantly according to statistical analysis as illustrated in Table 1.

The results presented in Table 1 show that the developmental periods in adult male and female were longest in TV6 (0.81 days and 1.05 days) followed by TV10 (0.75 days and (1.02 days) and the comparatively shortest duration was found in TV1 (0.65 days and 0.90 days) varying at 1% and 5% level of significance. In terms of seasonal impact, the rate of development of adults was the longest-lived in August-September (1.09 days), but moderate in April- May (0.98 days) and the shortest-lived in June-July (0.91 days). The clonal and seasonal interactions differed significantly at 1% and 5% probability levels of significance for the adult development of *O. coffeae.*

Plate 1: Leaf-disc-culture for rearing of *O. coffeae*

Table 1: Effect of clones and season on biology of *O. coffeae*

Life cycle variables (Mean±SD period in days)	TV1	TV6	TV10	SEd	$CD_{0.05}$	$CD_{0.01}$	April-May	June – July	Aug. – Sept.	S.Ed	$CD_{0.05}$	$CD_{0.01}$	Season x clone		
													S.Ed	$CD_{0.05}$	$CD_{0.01}$
Incubation period	6.22±0.22	6.66±0.15	6.52±0.33	0.052	0.106	0.143	6.23±1.76	4.72±1.91	8.44±1.94	0.052	0.106	0.143	0.090	0.183	0.247
Larval period	1.17±0.05	1.45±0.14	1.31±0.05	0.026	0.053	0.072	1.38±0.21	1.24±0.11	1.31±0.09	0.026	0.053	0.072	0.046	0.092	0.125
Quiescent period	0.44±0.22	0.82±0.09	0.68±0.22	0.031	0.062	0.084	0.81±0.14	0.53±0.27	0.60±0.23	0.031	0.062	0.084	0.053	0.108	0.146
Protonymphal period	0.97±0.18	1.07±0.15	0.97±0.13	0.020	0.041	0.056	0.88±0.05	0.96±0.08	1.17±0.06	0.020	0.041	0.056	0.035	NS	NS
Quiescent protonymphal period	0.96±0.13	1.08±0.11	0.98±0.16	0.032	0.066	0.088	1.08±0.04	0.85±0.09	1.09±0.07	0.032	0.066	0.088	0.056	NS	NS
Deutonymphal period	0.98±0.14	1.13±0.18	1.03±0.28	0.045	0.092	0.124	1.24±0.11	0.85±0.10	1.05±0.08	0.045	0.092	0.124	0.078	NS	NS
Quiescent deutonymphal period	0.75±0.13	1.10±0.08	0.98±0.05	0.036	0.073	0.099	0.91±0.29	0.91±0.11	1.00±0.14	0.036	0.073	0.099	0.063	0.127	0.172
Adult longevity (female)	0.90±0.08	1.05±0.08	1.02±0.13	0.016	0.032	0.043	0.98±0.11	0.91±0.11	1.09±0.08	0.016	0.032	0.043	0.027	0.055	0.074
Adult longevity (male)	0.65±0.15	0.81±0.08	0.75±0.07	0.021	0.042	0.057	0.98±0.11	0.91±0.11	1.09±0.08	0.016	0.032	0.043	0.036	0.073	0.099

4. Discussion

The life cycle variables-incubation, larval, quiescent larval, protonymphal, deutonymphal period and adult longevity were significantly longer for those mites reared on TV6 compared to those on TV1 and TV10 in this study. It has been hypothesized that on resistant clones spider mites would take a longer period of time to complete its life cycle as against the resistant clones [9]. The results of this study in most of the occasions are in agreement with the hypothesis since the pattern of effect of clones on the life cycle variables of *O. coffeae* was TV1>TV10>TV6. This reflects that an increased duration of development lowers the chances of buildup of *O. coffeae* on resistant clones, which may eventually lead to decline in the damage level. The longer duration of various stages may be related to nutritional inferiority of TV6 or due to presence of certain inhibitory growth substances therein, which, however need further studies. Contrastingly it is rather interesting to note that the quiescent deutonymphal period was the shortest on TV6 compared to others. It is difficult to explain this phenomenon. The hybrids of Assam varieties are indigenous and less prone to attack by red spider [5]. On the other hand, this study in TV1, an Assam –China hybrid clone is more prone to attack by *O. coffeae* while TV6, an Assam type standard clone is relatively less preferred [20]. The mechanisms involved in this differential reaction is feeding non preference [6].

Our results reveal that the incubation of eggs of *O. coffeae* took the largest time to hatch in August-September (28.89 °C) followed by in April –May (24.81 °C) and the shortest duration for hatching was observed in June-July (28.49 °C). Temperature play a crucial role in the incubation of *O. coffeae* and relative humidity (RH) might be critical [14]. Low humidity and high temperature prolong the hatching of eggs [13, 14], might not be applicable to this study as other meterological parameters may be operating in this case. The larva and quiescent larva took the longest time to develop in April-May followed by August September and the shortest duration was observed in June –July. This study corroborates the studies that developmental stages of *T. urticae* from egg to larva were conducive at temperatures of 25±4 °C [12] and with temperatures higher than the favourable temperature the incubation period is prolonged. The protonymph took the longest duration to develop in August-September followed by June-July and the lowest duration was observed in April-May. Relative humidities of 75-90% R.H. is favourable for mite development [10, 11]. In this study the quiescent protonymph was most inactive in August - September followed by April-May with least inactiveness in June-July. At increasing temperatures the duration of immature stages of spider mites declined [16]. Likewise, the length of development of deutonymph was longest in April-May, intermediate in August-September and shortest in June-July. Quiescent deutonymph was most inactive in August-September followed by April-May and least inactive in June-July owing to similar temperature conditions. In this study higher the temperature more is the adult longevity which was found to be the highest in August-September and corroborates the findings of various workers that season has a profound impact on the developmental stages of *O. coffeae* [2, 17, 8, 1, 20].

5. References

1. Abou-Awad BA, Al-Azzazy MM, Afia SI. Effect of temperature and relative humidity on the rate of development, fecundity and life table parameters of the red spider mite Oligonychus mangiferus (Rahman and Sapra) (Acari: Tetranychidae). Archives of Phytopathology and Plant Protection 2011; 44(19).
2. Congdon BD, Logan JA. Temperature Effects on Development and Fecundity of Oligonychus pratensis (Acari: Tetranychidae), Environmental Entomology 1983; 12(2):359-362.
3. Das GM. Bionomics of the tea red spider Oligonychus coffeae (Nietner), Bull of Entomol. Res, 1959, 265-273.
4. Gupta SK. Handbook: Plant Mites of India, Zoological Survey of India. Calcutta, 1985, 520.
5. Hajra NG. History of tea cultivation. Tea, cultivation: Comprehensive Treatise, International Book Distributing Company, Lucknow. UP, 2001, 158.
6. Hazarika LK, Sharma M, Saikia MK, Borthakur M. Biochemical bases of mite resistance in tea. National Conference on Insect Biochemistry and Molecular Biology, Oct. 1902. Trivandrum, Kerala, 1995.
7. Helle W, Sabellis MW. Spider mites their biology, natural enemies and control. Vol. 1A, Elsevier Science Publishing Company, INC 52, Vanderbilt Avenue, New York, NY 10017, 1985; 331-335.
8. Kasap I. Development and life table parameters of Tetranychus turkestani (Acarina: tetranychidae) at different constant temperatures. Acarologia, 2009; 52(2):113-122.
9. Kazak C, Kibriţci. Population parameters of Tetranychus cinnabarinus Boisduval (Prostigmata: Tetranychidae) on Eight strawberry Cultivars, Turk J. Agric 2008; 32:19-27.
10. Kun-shan Y, Chen. Studies on the effect of relative humidity on the population dynamic of tea pink mite [Acaphylla theae (Watt)]. www.ilib.cn, 2001.
11. Kun-Shan Y, Mei Jun T, Xing - Ping Xiong, Huacai Chen. Studies on the effect of ecological factors on the population dynamics of tea pink mite (Acaphylla theae) J Tea Sci. 2003; 23:53-57.
12. Mondal M, Ara N. Biology and fecundity of the two-spotted spider mite, Tetranychus urticae Koch. (Acari: Tetranychidae) under Laboratory condition J Life Earth Sci. 2006; 1(2):43-47.
13. Mori H. The influence of temperature and relative humidity to the development of the eggs of fruit tree red spider mite Metatetranychus ulmi (Koch) (Acari: Tetranychidae), J Fac, Agric, Hokkaido Univ 1957; 50(3):363-370.
14. Mukherjee S. Aspects of spider mite biology. Two and a Bud 1977; 24(1):7.
15. Muraleedharan N. Bioecology and management of tea pests in Southern India, J Plantation Crops. 1992; 20(1):1-21.
16. Northcraft PD, Watson TE. Developmental biology of Tetranychus cinnabarinus (Boisduval) under three temperature regimes. Southwestern Entomologist, 1987; 12(1):45-50.
17. Rajakumar E, Hugar PS, Patil BV. Biology of red spider mite, Tetranychus urticae Koch (Acari: Tetranychidae) on jasmine. Karnataka J of Agric, Sci 2005; 18(1):147-149.
18. Saikia S. Morphological basis of mite resistance in tea [Camellia sinensis (L.) O Kuntze]. MSc. (Agri.) Thesis, AAU, Jorhat, 1999, 30.
19. Tsai SM, Kung KS, Shih CI. The effect of temperature on life history and population parameters of kanzawa spider mite Tetranychus kanzawai Kishida (Acari: Tetranychidae) on tea, Plant Prot Bull Taiwan, 1989;

31(2):119-130.
20. Das P, Saikia S, Kalita S, Hazarika LK. Effect of temperature on biology of red spider mite (Oligonychus *coffeae*) on three different TV clones. Indian Journal of Agricultural Sciences (India). 2012; 82(3):255-9.