Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

J E Z S Journal of Entomology and Zoology Studies

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2015; 3(4): 454-457

Received: 16-04-2015
Accepted: 19-05-2015

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

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

Morphological resistance of certain tea clones to red spider mite (*Oligonychus coffeae*) in tea

Maitrayee Dutta

Abstract
Certain morphological attributes of tea leaf varieties TV1, TV6 and TV10 were studied to understand their resistance against the red spider mite *Oligonychus coffeae* Nietner which acts as a decap towards the tea economy of India. Varietal studies revealed that TV1 the resistant variety is highly palatable by the mite in comparison to TV6 and TV10. Life parameters of *O. coffeae* viz., fecundity showed significant positive correlation with length of leaf axil (r = 0.71169**) and % leaf area damage (r = 0.83574**). Similarly, hatching of *O. coffeae* also showed significant positive correlation with % leaf area damage (r = 0.69839**).

Keywords: *Oligonychus coffeae*, life parameters, resistance, morphological attributes, damage

1. Introduction
Due to the inherent extensive monoculture habitat of tea in India and also almost in all the districts of Assam tea bushes harbour various pests which plagues various parts of the tea bush causing uncontrolled damage [2]. More than 300 insect and mite pests [3] sustain themselves in the monoculture habitat and plague various parts like root, stem, leaf and bud causing 7-10% loss in the yield [5]. Mites are regarded as perennial pests of tea, and one of such most debilitating pests of tea plants after *Helopeltis* sustaining themselves in the monoculture habitat is *Oligonychus coffeae* [25].

As such *O. coffeae* is one of the most destructive pests today infesting the tea estates of North eastern parts of India reducing yield and quality of tea and causing serious economic loss. *O. coffeae* also follows a great reproductive capacity and breeds at an alarming rate owing to its short life cycle and is a major constraint in the tea industry and they are the most difficult to eradicate. The quality and taste of tea is sensitive to chemical pesticides and so there is an increased interest in the use of eco friendly methods as well as exploiting the inherent resistance present in the different cultivars to devise suitable IPM strategies for the management of the different pests and diseases of tea as well as *O. coffeae*. With this aim the present investigation was carried out to study comparative morphological characteristics amongst three tea clones.

2. Methodology
In the year 2010-2013 tea clones TV1, TV6 and TV10 released from Tocklai Experimental Station, Jorhat was selected to study their morphological characteristic conferring their resistance to the red spider mite, *O. coffeae*. Freshly collected fourth leaf from the top of the tea plant were used for various morphological experiments. The comparative morphological characters *viz.* leaf length, leaf width, leaf angle, leaf area, leaf axil length, per cent leaf area damage and trichome density of the three tea clones were analysed as suggested by earlier workers [26, 17, 27]. The relationship between life parameters of the three tea varieties was determined by correlation and regression analysis.

3. Results
3.1 Length of leaf blade and leaf width
In the present investigation no significant varietal difference for length of leaf blade was observed, it is also evident from the results (Table 1) that the largest width of leaf was recorded in TV6 followed by TV10 and TV1. The results of correlation studies (Table 2) suggested that length (r = -0.53417*, R^2=0.7839 and r = -0.62794, R^2=0.3943) and width(r = -0.88537**, R^2=0.7839 and r = -0.75244**, R^2=0.5662) showed significant negative correlation with fecundity and hatching. The magnitude of the relationship for length of leaf blade was

expressed by the equations y=138.42-4.9594x and y=168.93-7.3491x and the magnitude of the relationship for width of leaf blade was expressed by the equations y=123.26-7.6248x and y=125.82-8.1685x.

3.2 Leaf angle
Amongst the three clones studied the leaf angle was greatest in TV6, followed by TV1 and TV10. The leaf angle (Table 2) of the respective clones however did not show any correlation with fecundity and hatching (r = 0.48758 and r = -0.16862)

3.3 Leaf area
Varietal difference was observed for leaf area showing maximum leaf area in TV 6 followed by TV10 and TV1 (Table1). While studies of leaf area (Table 2) showed significant negative correlation with fecundity and hatching percentage of *O. coffeae* (r = -0.83310** and r = -80299**). The magnitude of the relationship for width of leaf blade was expressed by the equations y=114.5-67.397x, R^2=0.6941

3.4 Leaf thickness
Observations on leaf thickness (Table1) revealed no significant difference. The attribute of leaf thickness presented in Table 2 show negative significant correlations with fecundity.

3.5 Percent leaf area damage
Investigations made on per cent leaf area damage (PLAD) on different portions of leaf by *O. coffeae* as depicted on Table1 show that the highest damage was made by *O. coffeae* in TV1 followed by that in TV10 and the least damage shown was in TV6 cultivars and positive correlation of PLAD (Table 2) was shown with fecundity and per cent hatching(r = 0.83574**, R^2=0.4878 and r = 0.69839**). The magnitude of the relationship for width of leaf blade was expressed by the equations y= -30.944+1.2147x.

3.6 Length of leaf axil
The length of leaf was the largest in TV1 (55.80°), followed by TV6 (44.40°) and TV10 (41.00°). As depicted in Table 2 for correlation studies the length of leaf axil show significant correlations with fecundity (r = 0.71169**, R^2=0.0.5065). The regression equation for leaf axil was expressed by the equation y=57.582-16.161x

3.7 Trichome density
The density of trichomes or leaf hairiness was more in TV6 followed by TV10 and TV1 (Table 1). However significant negative correlation between the trichome density with fecundity and hatching (Table 2) was observed (r = -80898**, R^2=0.6544 and r = -80299**). The magnitude of the relationship for width of leaf blade was expressed by the equations y=0.0709-82.545x

4. Discussion
Leaf form and size play a significant role in phytophagy [22, 23]. Tea cultivars vary in their leaf geometry (length: breadth ratio) and the plant architecture may help in attraction and accumulation of a large number of phytophagous herbivores [3]. In this study the length: width ratio determines the preference, smaller the ratio more the preference (Table 1). This confirms the suggestion made earlier by Banerjee (1987) [3]. Spider mites construct three dimensional webs for egg deposition [6, 13]. If the leaf blade is long there are less eggs and low hatching this means spider mites prefer low length: width ratio not only for feeding but also for laying eggs. There was significant difference in the length of leaf among the TV clones, being longest in TV10 followed by TV1 and TV6 but negative significant correlation with fecundity of *O. coffeae* was observed as certain deterrents on the leaf surface may also be present for insect feeding and oviposition. This may corroborate that leaf size selection by phytophagous insects is an important criteria for its accumulation [4]. In this study the width of leaf blade and leaf area was the largest in TV6, followed by TV10 and smallest width and leaf area were in TV1 and results showed a negative significant correlation of leaf width with fecundity. This indicates *O. coffeae* tends to fecund in larger leaves but unable to continue its generation. Broader leaf may lack gripping surface to lay eggs. Physicochemical factors along with visual apparency may be helpful in searching for leaf size and shape, which may be in line with this study [10, 1]. Leaf thickness or toughness was greatest in TV6 followed by TV10 and TV1. Thickness of leaf may provide resistance as lower densities of feeding was observed in thick TV6 leaves than thin and moderate TV1 and TV10 leaves. The cuticle of TV1 is thin enough to pierce and caused damaged by *O. coffeae* which confirms the findings of Hanna *et al.* [12] that toughness and hardness are the major mechanical defences of plants and leaves with thin cuticle are infested more easily by tetranychids. Similarly, cases may arise for stylet penetration of mite, *O. coffeae* into the TV clones for more feeding and fecundity. Thus thickness of leaf may reduce the incidence of *O. coffeae* attack. It is reported that *O. coffeae* mostly invade the upper tea leaf surface in comparison to other tea pests which also invades the stem [18]. Various workers corroborated that the deflected tip and incurved margins of the upper leaf surface show damage symptoms [6, 19, 27] which is in conformity with this study as selection of leaf axil for study against *O. coffeae* damage revealed greatest leaf axil length in TV1 followed by TV6 and TV10 with significant correlations with fecundity. Thus narrow and curved leaves of TV1 may favour more egg laying and web building for protection of eggs. The present study thus reveal clonal variation in leaf axil length for its relation against *O. coffeae* damage. Our observations revealed leaves with long axil, thinness and forming angle around 45° are preferred by the red spider mite. In this study the leaf angle of TV clones is greatest in TV10, moderate in TV1 and smallest in TV6 with no correlation with fecundity. This indicates that leaf angle varies in resistant, moderate and susceptible clones but do not play a role in fecundity. Leaf angle favour high light interception for using the nutrients and superior light efficiency is more in traits with erect leaves [11]. The present finding reports narrow and erect leaves with moderate leaf angle in TV1, which may be favourable for higher light interception for preparation of suitable nutrients and *O. coffeae* damage. Long, thin and simple nonglandular trichomes on the upper surface was found in this study with greatest density on leaves of TV6, followed by TV10 and lowest density was observed in TV1 which confirm the latter workers [15, 7]. This study is in line with Parnell *et al.* [21] showing consistent relationship of hairiness with degree of jassid resistance towards cultivars of *Gossypium.* Increased density of trichomes for increased oviposition of *T. urticae* may be consistent with this study [9]. Luczynki *et al.* [16] observed that increase in density of nonglandular trichomes decreased egg laying of *T. urticae* which may be in line with this work. The present investigation revealed density of trichomes in the three TV clones to be negatively correlated with fecundity indicating partial fecundity and oviposition of *O. coffeae*. Larval contact with higher trichome density was partially responsible for less infestation [20]. Hence, less density of trichomes in TV1 may be partially responsible for feeding and

fecundity of *O. coffeae*. The negative correlation between the density of nonglandular trichomes and resistance against *T. urticae* confirms this study [14] although no association was found with leaf pubescence and feeding damage by *E. fabae* [8]. Thus, there is a significant difference in trichome density amongst the clones which may be responsible for highest damage in TV1, followed by TV10 and lowest damage in TV6 indicating protective function of trichomes and the negative correlation studies of trichome density may hence be responsible for partial oviposition and fecundity of *O. coffeae*. This study shows that trichome density has a negative relationship with feeding and oviposition (Table 2). However this study contradicts that the presence of pubescence encourage egg laying of *Typhlodromus pyri* [24].

Table 1: Comparison of certain physical leaf characters amongst the three TV clones

Clones Physical characters (mean±SD)	Leaf blade (dm)		Leaf thickness (μm)	Leaf area (dm^2)	Leaf area damage (%)	Length leaf axil (dm)	Leaf angle (degrees °)	Trichome density (no/cm^2)
	Length	Width						
TV1	12.450±0.465	37±2.739	0.466±0.038	92.68±2.704	1.190±0.273	44.400±12.057	0.466±0.038	92.68±2.704
TV6	12.400±2.634	46.2±12.050	0.730±0.075	79.528±0.916	0.770±0.149	55.800±8.651	0.730±0.075	79.528±0.916
TV10	13.250±0.735	39.2±1.095	0.665±0.061	81.944±0.706	0.690±.202	41.100±9.422	0.665±0.061	81.944±0.706
S.Ed	0.7161	4.530	0.0268	1.074	0.0958	4.5386	0.0268	1.074
$CD_{0.05}$	NS	NS	0.0549	2.340	0.1966	9.3125	0.0549	2.340
$CD_{0.01}$	1.984	NS	0.074	3.280	0.265	12.577	0.074	3.280

Table 2: Correlation of biological characters of *O. coffeae* on various biophysical characters of leaf of TV clones

Correlation coefficient		
Biophysical characters	Fecundity	% Hatching
Length of leaf blade	r = -0.53417*	r = -0.62794*
Width of leaf blade	r = -0.88537**	r = -0.75244**
Leaf thickness	r = -0.56881*	r = -0.68149**
Leaf area	r = -0.83310**	r = -80299**
% leaf area damage	r = 0.83574**	r = 0.69839**
Length of leaf axil	r = 0.71169**	r = 0.46338
Leaf angle	r = 0.48758	r = -0.16862
Trichome density	r = -80898**	r = -0.47796

** indicates significance at 1% level
* indicates significance at 5% level
r=correlation coefficient

5. References

1. Aizen MA, Patterson WAIII. Leaf phenology and herbivory along a temperature gradient: A spatial test of the phenological window hypothesis. J Vegetation Sci. 1995; 6(4):543-550.
2. Banerjee B. Arthropod diversity on a monoculture of tea in young and old habits. Sci. Cult 1979; 45:454-455.
3. Banerjee B. Can leaf aspect affect herbivory? A case study with tea. Ecology 1987; 68(4):839-843.
4. Bokuchava MA, Skobeleva NI. The chemistry and biochemistry of tea and tea manufacture. Adv. Food. Res 1969; 17:215-292.
5. Chakravartee J, Hazarika LK. Management of tea pest. Field Management in Tea, Tea Research Association, Tocklai Experimental Station, Jorhat-8, 1995, 125-135.
6. Das GM. Bionomics of the tea red spider *Oligonychus coffeae* (Nietner). Bull. of Entomol. Res., 1959, 265-273.
7. Dayanandan P, Kaufman PB. Trichomes of *Cannabis sativa* L. (Cannabaceae). Am. J Bot. 1976; 63(5):578-591.
8. Elden TC, Elgin JH, Soper JF. Inheritance of pubescence in selected clones from two Alfalfa populations and relationship to potato leaf hopper resistance. Crop Sci 1986; 26(6):1143-1146.
9. Gillman JH, Dirr MA, Braman SK. Gradients in susceptibility and resistance mechanisms of *Buddleia* L. taxa to the two-spotted spider mite (*Tetranychus urticae* Koch). J Am. Soc. Hort. Sci. 1999; 124:114-121.
10. Godfray HCJ. Clutch size in a leaf-mining fly (*Pegomya nigritarsis*: Anthomyidae). Ecol. Ent 1986; 11:75-81.
11. Gutschick VP. Research reviews. Biotic and abiotic consequences of differences in leaf structure. New Phytol. 1999; 143:3-18.
12. Hanna MA, Zather MA, Ibrahim SM. Some probable causes of host preference in six species of phytophagous mites. Z. Ange. Entomol 1982; 93:329-333.
13. Hattori M, Sato A. Substrate factors involved in oviposition response to the Limabean pod borer. *Etiella zinckenella* Treitshke (Lepidoptera: Pyralidae). Appl. Entomol. Zool 1983; 18:50-56.
14. Kishaba AN, Voth V, Howland AF, Bringhurst RS, Toba HH. Two-spotted spider mite resistance in California strawberries. J Econ. Entomol. 1972; 65:117-119.
15. Levin DA. The role of trichomes in plant defence. The Quart. Rev. Biol 1973; 48(1):3-15.
16. Luczynski A, Isman MB, Raworth DA, Chan CK. Chemical and morphological factors of resistance against the two-spotted spider mite in beach strawberry. J Econ. Entomol. 1990; 83:564-569.
17. Maite RK, Bidinger FR, Sheshu Reddy KV, Davies JC. Nature and occurrence of trichomes in sorghum lines with resistance to the sorghum shootfly. Joint Progress Rep. Sorghum Physiology-3. Sorghum Entomology-3 ICRISAT. Patancheru, India, 1980.
18. Mukherjee S. Aspects of spider mite biology. Two and a Bud 1977; 24(1):7.
19. Nair MRG. Plantation Crops. Insects and Mites of Crops in India. ICAR. 1975, 331.
20. Oghiakhe S, Jackai LEN, Makanjuola WA, Hodgson CJ. Morphology, distribution and the role of trichomes in cowpea (*Vigna unguiculata*) resistance to the legume pod borer, *Maruca testulalis* (Lepidoptera: Pyralidae). Bull. Entomol. Res 1992; 82:499-505.
21. Parnell FR, King HE, Ruston DF. Jassid resistance and hairiness of cotton plant. Bull. Entomol. Res 1948; 39:539-575.
22. Prokopy RJ, Owens ED. Visual detection of plants by herbivorous insects. Annu. Rev. Entomol 1983; 28:337-364.
23. Rivero-Lynch AP, Brown VK, Lawton JH. The impact of leaf shape on the feeding preference of insect herbivores: Experimental and field studies with Capsella and Phyllotreta. Phil. Trans. R. Soc. Lond. B 1996; 351:1671-1677.
24. Roda A, Nyrop J, English-Loeb G, Dicke M. Leaf pubescence and two-spotted spider mite rubbing influence phytoseid behaviour and population density. Oecologia. 2001; 129:551-560.
25. Roy S, Muraleedharan N, Mukhopadhyay. The red spider

mite, *Oligonychus coffeae* (Acari: Tetranychidae): its status, biology, ecology and management in tea plantations. Experimental and Applied Acarology, 2014, 63(4)

26. Sass JE. Botanical microtechnique, Third edition. The Iowa State University Press, Ames, Iowa, 1958, 1-228.
27. Saikia S. Morphological basis of mite resistance in tea [*Camellia sinensis* (L.) O. Kuntze]. M.Sc. (Agri.) Thesis, AAU, Jorhat, 1999, 30.