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RESEARCH ARTICLE

Evolution of meteorological factors on incidence of red spider mite of tea, *Oligonychus coffeae* (Nietner) under the natural conditions of Assam

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ABSTRACT : The incidence of red spider mite, *Oligonychus coffeae* on tea crop was maximum during the month of April to May-June and September-October (2011). The minimum number of mites were recorded from July- August and November (2011) to February (2012). The data taken from 1st week of April, 2011 to last week of March, 2012. That population build up of *O. coffeae* showed a significant positive correlation with the maximum temperature and minimum temperature (r = 0.320 and r = 0.268, respectively). Whereas, the red spider mite population was negatively correlated but significant with average relative humidity (r = -0.357). Rainfall had a negative non-significant correlation with the mite population (r = -0.049).

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Key Words :
Red spider mite (*Oligonychus coffeae*), Incidence, Meteorological factors

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Tea from the tea plant (*Camellia sinensis* L. var. *assamica*) is the most important non-alcoholic beverage in the world. The tea is appreciated both for its stimulant properties and health benefit (Shimizu *et al.,* 2012).

India is the largest producer of tea in the world that contributes 27.49 per cent of the world production and 13.09 per cent of the world trade (Muraleedharan, 2006). At present the tea is grown in 13 states of India of which Assam, West Bengal, Tamil Nadu and Kerala are the largest producers. During 2010-2011 total production of tea was 9,66,733 tones, out of which 7,28,526 tones was produced from north east India. The total tea exported from India in the year 2010 - 2011 was 2, 13,789 tones (Anonymous, 2010 - 2011). More than one thousand species of arthropod pests are known to attack tea crops over the world, though only about 300 species of insect are recorded from India of which 167 species from North East India resulting 11 to 55 per cent annual loss in yield (Das, 1965). In north east India, tea plant is colonized by a complex of pest species including the tea mosquito bug, red spider mite, pink mites, thrips, termites, red slug caterpillar, looper caterpillar and green leaf hopper etc.

Mites, as a group, are persistent and the most serious pests of tea in almost all tea producing countries (Cranham, 1966). The most important one is the red spider mite (RSM) *Oligonychus coffeae* Nietner (Acarina: Tetranychidae). This pest is widely distributed in India, Bangladesh, Sri Lanka, Taiwan, Burundi, Kenya, Malawi, Uganda and Zimbabwe (Gotoh and Nagata, 2001).

Nymphs and adults of RSM lacerate cells, producing minute characteristic reddish brown marks on the upper surface of mature leaves, which turn red in severe cases, resulting 17 per cent to 46 per cent crop loss (Das, 1959). High temperatures, dry conditions and the absence of shade are conducive to outbreak of this pest. The optimum temperature for growth and development is 30ºC (Gotoh and Nagata, 2001), the lower threshold for development is 10º C and 23.26 degree days are required to complete the life cycle from egg to egg (Gotoh and Nagata, 2001). Mites inhibiting the upper leaf surface are easily dislodged by heavy rainfall. Leaf temperature and light penetration within tea bushes also influence mite distribution. Red spider mite, *O. coffeae* prefers the middle zone of the bush (30 cm below the plucking surface) because of optimum temperature associated with plant shading (Banerjee, 1979).

As a result of infestation by the RSM, plant growth and leaf productivity are seriously affected. This pest has been causing a considerable damage to tea cultivation in India since 1960, but recently its havoc is more prominent in North Bengal tea plantation due to environmental changes (Mukhopadhyay *et al.*, 2009). The present investigation was carried out to study the incidence of red spider mite of tea, *Oligonychus coffeae* (Nietner) with the macro and micro climates.

EXPERIMENTAL METHODOLOGY

The observations on the incidence of red spider mite were recorded at weekly interval, beginning from April, 2011 and continued up to March, 2012. For sampling, 30 random leaves were plucked from an area where no treatments of any chemicals were done. These samples were held in separate properly labelled polythene bags and brought to the laboratory for numerical mite count (live) from whole leaf under microscope at 4X magnification. The data so obtained were summed up and converted to total population per leaf. The observation on mite counts was recorded for a period of one year. During the experimental period all data on meteorological factors *viz*., temperature (maximum and minimum), relative humidity, total rainfall and bright sunshine hours were collected for the entire period of study from the Department of Agro meteorology, Assam Agricultural University, Jorhat. Weekly population of mites/leaf was subjected for correlation studies with the prevailing meteorological factors like temperature, relative humidity, rainfall and bright sun shine hours. The impact of these abiotic factors on mite population was studied through regression analysis. The results were interpreted to see the effect of different weather parameters on the incidence of mites.

EXPERIMENTAL FINDINGS AND DISCUSSION

In the present findings, the incidence of the red spider mite, *O. coffeae* was observed to reach the peak population of 28.55 mites/leaf in the month of April. From April to June overall higher population of mites/leaf was noticed ranging from 28.55 mites/leaf to 10.66 mites/leaf. Afterwards the population of the mites declined from 3.46 mites/leaf during first week of July to 2.11 mites/leaf during 4th week of August. Again population increased in the month of September to October with 15.33 mites/ leaf in the first week of September to 7.86 mites/leaf in the last week of October. In the month, November to January very minimum population was observed with 5.55 mites/leaf in the first week of November to 1.22 mites/ leaf in the last week of January. From February (2012) onwards population of mite was found to be increased with 8.55 mites/leaf to last week of March with 17.44 mites/ leaf (2012). The incidence of red spider mite, *O. coffeae* on tea crop started in February and fluctuated throughout the year. Then there was gradual increasing trend in mite population which was observed to reach peak in the month of March to May-June. During rainy season (July-August) the population of mites declined because mites were washed away with rain water. This pattern of incidence was also reported by Das (1959). Muraleedharan and Chandrasekharan (1981) reported that the incidence of red spider mite of tea, *O. coffeae* was built up during month of April to May due to high temperature and the population declined gradually and reached very low during November to January due to adverse effect of cold weather (low temperature). Sharp decline of mite population was noticed during July- August due to heavy shower (Table 1) (Fig. 1).

In case of eggs population, there was a gradual increasing trend in egg number to reach the peak population of 65.22 eggs/leaf in the month of April. From April to June overall higher population of eggs/leaf was noticed ranging from 65.22 eggs/leaf to 13.55 eggs/leaf. Afterwards sharp decline in number of eggs was noticed during July and August with a record of 10.86 eggs/leaf in the third week of July to 6.76 eggs/leaf in the 3rd week

Table 1 : Seasonal incidence of red spider mite on tea and the correlation with abiotic factors during April, 2011 to March, 2012

Standred meteriological week with month	Number of red spider mite (*Oligonychus coffeae*)		Average temp. (°C)		Average relative humidity	Rainfall	BSSH
	Motile	Eggs	Maximum	Minimum			
14 April/2011	28.55.	65.22	27.1	18.8	79.6	24.6	4.6
15	24.55	62.33	29.8	18.8	71.5	10.6	5.1
16	23.85	61.22	29.1	20.5	76.5	22.5	4.8
17	21.22	60.55	29.3	20.3	73	3.9	5.1
18	20.00	60.86	29.4	21.3	78.5	7.8	5.3
19 May /2011	13.22	55.22	32	22.6	79.5	85.5	6.2
20	15.60	41.22	32	23.7	79.5	27.6	3.9
21	16.22	38.52	30.1	23.8	80	63.3	4.6
22	10.00	22.66	31.6	24.5	87.5	246.1	4.3
23 June/2011	12.33	21.22	31.5	24.5	82	35.2	4.2
24	11.46	24.66	32.9	25.4	81	6.9	3.3
25	10.22	23.66	33.2	26.1	81	48.7	4.3
26	10.66	15.33	33	25.6	81	97.2	3.5
27 July/2011	3.46	18.99	32.3	25.2	82.5	42.6	2.5
28	2.56	13.55	32	25.5	86.5	101.5	3.6
29	1.23	10.86	31	25.5	85	86	2.0
30	2.33	8.46	33	25.5	84.5	114.6	4.6
31	1.21	12.77	33	25.8	84.5	87.5	4.5
32 August/2011	1.19	8.22	30.5	25.5	84.5	120.1	1.9
33	0.96	11.23	30.6	25	87	80.3	2.5
34	2.11	6.76	33	25.6	84.5	22.6	5.1
35	14.55	20.33	35.1	25.4	78.5	49.1	8.5
36 September/2011	15.33	18.65	33.7	25.7	81	77.6	5.3
37	18.55	17.53	33.6	25.9	82	57.3	6.3
38	18.22	20.22	32.8	25.9	80.5	13.9	4.2
39	12.66	22.63	32.3	25.2	81	39.3	4.2
40 October/2011	7.22	24.35	3.2	23.8	76	0	6.8
41	6.45	32.33	33.7	23.7	76.5	0	7.9
42	7.35	20.33	31.4	22.7	77.5	7.2	5.9
43	7.25	18.56	30	20.1	78.5	19.7	7.2
44	5.55	13.22	27.8	16.7	79	10.8	7.2
45 November/2011	7.86	12.33	28.1	14.5	76	0.7	8.4
46	8.36	11.55	25.3	15.3	78	6.9	4.3
47	5.33	11.25	27.1	12.4	74	0	8.1
48	0.33	9.66	27.5	163.8	75	0	7.6
49 December/2011	0.21	10.22	26.5	14.9	76.5	1.6	6.00
50	0.66	11.22	23.7	12.3	82.5	17.6	3.7
51	0.33	3.22	23.7	8.5	75	0	7.6
52	0.66	2.60	24.9	8.7	74	0	7.3
1 January/2012	0.96	1.96	21.5	12.1	86	8.1	2.1
2	0.86	1.95	21.6	10.5	78.5	1.9	4.0
3	0.36	0.96	19.5	9.9	86	5.7	3.4
4	1.36	8.99	22.1	9.7	78	0	3.2
5	1.96	10.22	24	8.1	77.5	0	6.3
6 February/2012	1.22	14.55	24.5	12.6	75.78	2.5	2.5
7	8.55	16.23	25.51	11.6	71.35	5.6	5.1
8	9.56	22.22	26.6	14.4	73.92	2.2	3.5
9	12.66	21.22	27.2	14.3	68.5	3	6.1
10 March/2012	16.22	23.22	27.2	14.3	64.42	3	6.1
11	14.55	28.42	25.1	14.3	74.35	1	4.4
12	16.56	29.11	28.8	13.2	64.92	0	6.5
13	17.44	30.00	28	15	70	2	4.0
Correlation with mite population (r=)	0.320*	0.268*	-0.357*	-0.049^{NS}	0.110^{NS}		
Correlation with number of eggs (r=)	0.286*	0.279*	-0.282*	-0.036^{NS}	0.055^{NS}		

* indicate significance of value at P=0.05 NS=Non-significant

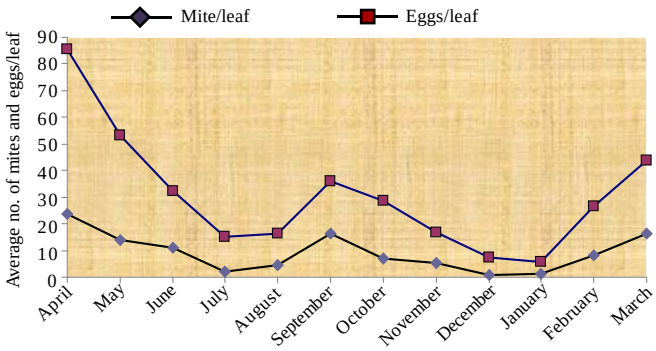

Fig. 1 : Seasonal incidence of red spider mite, *O. coffeae* during April, 2011 to March, 2012

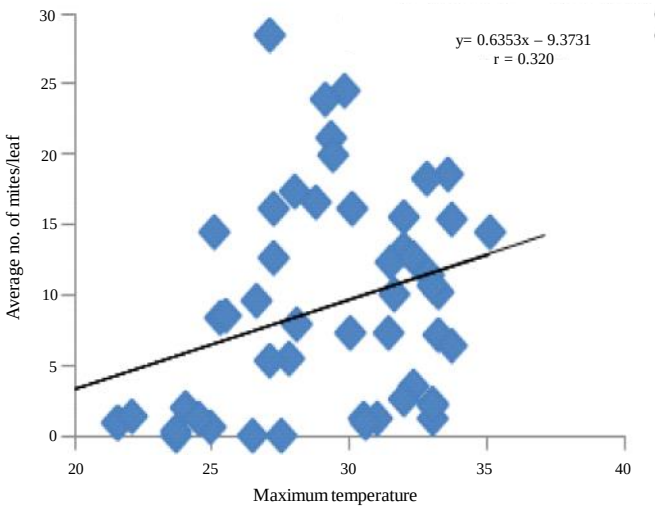

Fig. 2 : Relationship of number of eggs/leaf with maximum temperature (°C)

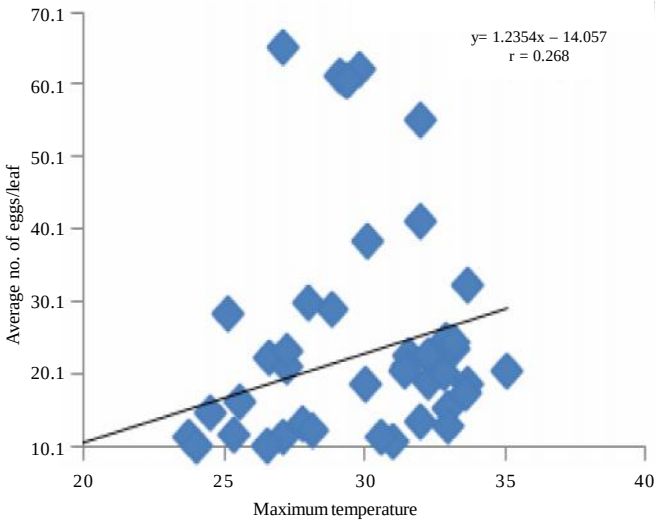

Fig. 3 : Relationship of number of eggs/leaf with maximum temperature (°C)

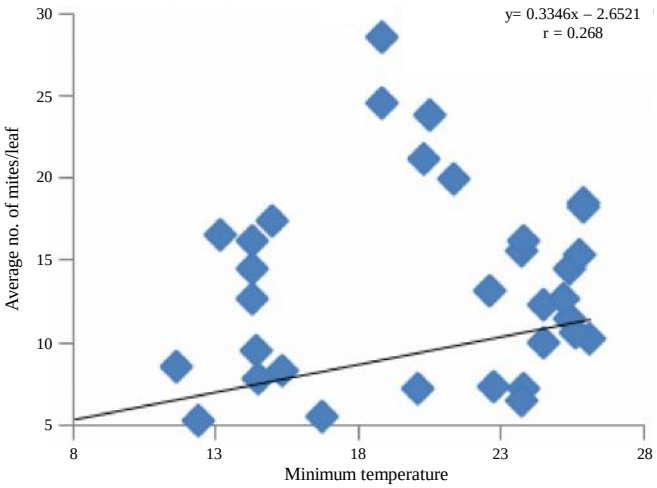

Fig. 4 : Relationship of number of mites/leaf with minimum temperature (°C)

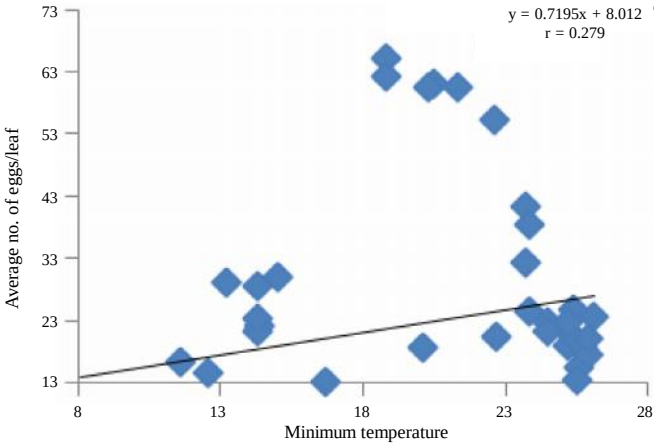

Fig. 5 : Relationship of number of eggs/leaf with minimum temperature (^{0}C)

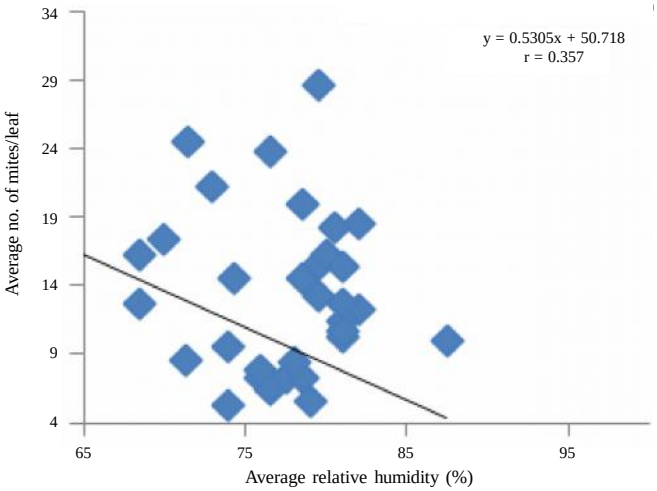

Fig. 6 : Relationship of number of mites/leaf with average relative humidity (%)

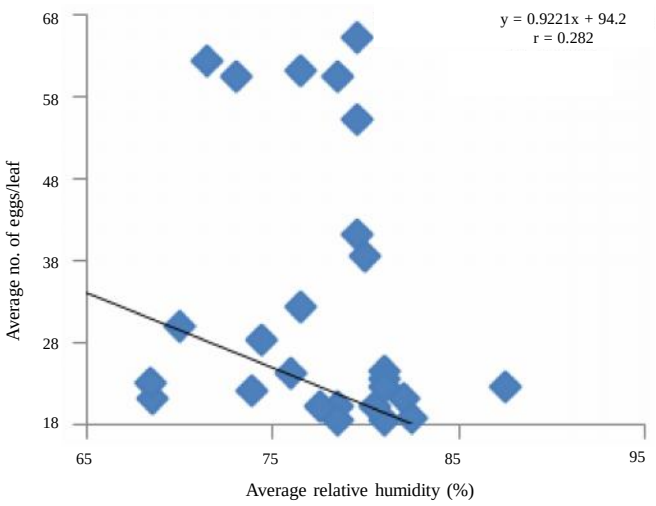

Fig. 7 : Relationship of number of eggs/leaf with average relative humidity (%)

of August. Again population of eggs was increased during September and October with 18.65 eggs/leaf in the 1st week of September and 13.22 eggs/leaf in the last week of October. Very minimum population of eggs was observed from November to January with 11.55 eggs/leaf in the 1st week of November to 10.22 eggs/leaf during last week of January (2012). Population of eggs was started increasing again from 1st week of February (16.23 eggs/leaf) to 4th week of March (30.00 eggs/leaf) (Table 1) (Fig. 1).

Results of the present studies showed that the build up of the red spider mite, *O. coffeae* population, as well as the number of eggs had a significantly positive correlation with the maximum temperature (r =0.320 and r= 0.286 for the mites and eggs, respectively) (Fig. 2 and 3) and minimum temperature (r=0.268 and r=0.279 for mites and eggs, respectively) (Fig. 4 and 5). Whereas, the motile stage of red spider mite, *O. coffeae* and eggs had a negative and significant correlation with average relative humidity (r = -0.357 and r = -0.282 for mites and eggs, respectively) (Fig. 6 and 7). Thus, there was a significant impact of abiotic factors on the build up of mite and eggs population during 2011 and 2012. Similarly Rajkumar *et al.* (2005) reported that, the incidence of mite, *Tetranychus urticae* on Jasmine was maximum during the first week of November and there after no mite population was observed during the third week of November to last week of January. Further, they reported that, maximum and minimum temperature had positive while, rainfall, morning and evening relative humidity recorded negative significant relationship with mite population.

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