International Journal of Agriculture Innovations and Research
Volume 6, Issue 3, ISSN (Online) 2319-1473
Manuscript Processing Details (dd/mm/yyyy):
Received: 01/07/2016 | Accepted on: 08/07/2016 | Published: 31/12/2017

Bio-Efficacy of Modern Synthetic Pesticides Against Red Spider Mite, Oligonychus Coffeae (Nietner) (Tetranychidae: Acarina), Infesting Tea

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Abstract **– A field experiments were conducted at Kamalpur Tea garden, Upper Bagdogra, Siliguri, West Bengal. India, during May-June, 2012-13 and October-November, 2012-13, to evaluate the bio-efficacy Etoxazole 10% EC along with Hexythioxy 5 EC against red spider mite, *Oligonychus coffeae,* infesting tea. Keeping a no treatment control, Propargite 57 EC was also used as a standard check. Etoxazole 10% EC was used at 0.50 ml/lt, 0.75ml/lt and 1.00 ml/lt; Hexythioxy 5 EC 1.00ml/lt and Propargite 57 EC 2.5 ml/lt. Of all the pesticides tested Etoxazole 10% EC at 0.75 ml/lt and 1.00 ml/lt significantly reduced the population build up (100%) of red spider mite followed by 94% in Hexythioxy 5 EC 1.00 ml/lt and 70% in Propargite 57 EC 2.5 ml/lt. Regardless of the doses and type of the pesticide molecules used in the experiments no phototoxic effect such as epinasty, hyponasty, scorching, Chlorosis and wilting were observed in tea plants.**

Keywords **– Bio-efficacy, Modern pesticides, *Oligonychus coffeae*.**

I. INTRODUCTION

Tea (Camellia *sinensis*) being natures precious gift is considered as an important beverage as well as health drink all over the world. It is a perennial monoculture plantation crop, grown in more than 45 countries world over (Barua, 1989). In the total Indian tea production, major portion of the produce is exported to countries like Germany, UK, Japan, and USA, both as bulk exports as well as value added products. The perception that "Assam tea and Darjeeling tea" is a premium tea acknowledged by consumers, or a quality product, or the very fact that it is special, is the subject matter of an intellectual property. There is a steady increase in the production over the years since its day of first cultivation, which is due to extensive cultivation, improved technology, nutrition and fertility management (Saraswathy et al., 2007), introduction of high yielding clones and longer pruning cycle. These factors, on the other hand, have encouraged biotic stresses like insect pests and diseases to limit the productivity of this crop (Gurusubramanian, 2005). Because of being a permanent monoculture, the microclimatic conditions in and around the crop canopy favour the multiplication & development of various pests, causing damage to the crop. Further, the compact nature of tea plants adds to this situation. Among insect enemies, the red spider mite, *Oligonychus coffeae* (Nietner) (Tetranychidae: Acarina), has got the status of a key pest of tea in a number of tea growing areas in West Bengal and as a major pest in the entire North Eastern tea plantation. This mite has also reported to occur in some packets of South Indian tea gardens (Ramarethinam, *et.al.* 2001).

Both the adults and nymphs cause damage to tea by taking plant sap, mainly from leaves, thereby developing ruddy bronze coloration in them. This leads to loss in quality tea production.

Due to non-available of effective alternatives to synthetic pesticides against this mite pest, the planters have no options left but to depend so far on solo function of such pesticides like thiodan, Dicofol and ethion etc. the repeated use of these pesticides for a long time has given birth to many fold problems including pests' resistance to pesticides, their resurgence, death of natural pest control agents and pesticide residue in tea.

The problem of pesticide residue in tea has been posing serious proportion in the international markets for a couple of years. This emphasizes the need for growing tea free of chemical pesticides. Accordingly, the plant protection specialists have been trying to develop effective but eco-friendly pesticide molecules which may provide appropriate check against the major pests of tea in general and red spider mite in particular.

To satisfy the need of the day, the present study was undertaken to evaluate the bio-efficacy of **Etoxazole 10% EC**, a new generation acaricide developed from fermented metabolite of *Streptomyces hygroscopecius* sub. Sp. *aureolarcrimosus*; and **Hexythioxy 5 EC** against tea red spider mite during 2012 and 2013. **Propargite 57 EC**, being widely used against the mite, was used as a standard check besides keeping a no treatment control.

This paper focuses the results achieved through the experiments conducted for a period of two years on the population build up of red spider mite, *O. coffeae* causing appreciable damage to tea.

II. MATERIALS AND METHODS

Following Randomized Block design, the two field experiments were conducted on tea at Kamalpur Tea garden, Upper Bagdogra, Siliguri, West Bengal. India, during May-June, 2012-13 and October-November, 2012-13, to evaluate the bio-efficacy of **Etoxazole 10% EC** and **Hexythioxy 5 EC** against red spider mite, *O. coffeae*. Besides keeping a no treatment control, **Propargite 57 EC** was used as a standard check. There were three concentrations for each of the compounds which were replicated for three times. The concentrations for each of the pesticides used in the experiments comprised of 0.50 ml/lt, 0.75 ml/lt and 1.00 ml/lt for **Etoxazole 10% EC** and

for **Hexythioxy 5 EC** and **Propargite 57 EC** 1.00 ml/lt and 2.5 ml/lt. With the help of a high volume Knapsack Sprayer these were sprayed for three times at an interval of 45 days, during May-June, 2012-13 and October-November, 2012-13.

Observation population build up of the mite was recorded at one day before spray (Pre-spray) and 1, 3, 5, 7, 10, 14, 21, 28, and 35 days after each spray. For this purpose, 10 plants in each treatment replication were selected randomly and using a hand lens the population of mite was recorded from 10 top leaves of each selected plant. Phytotoxicity of the test chemicals was studied following protocol framed by Central Insecticide Board. The results thus obtained on the three sprayings in a year were pooled together and were subjected to Square Root transformation for statistically ascertaining the test of significance. The per cent reduction in infestation was calculated using the formula postulated by Henderson and Tilton (1955) which reads as:

Percentage reduction = {1 – (Ta x Cb / Tb x Ca)} x 100

Where –

Ta = Population in treated plants after treatment.
Tb = Population in treated plants before treatment.
Ca = Population in control plants after treatment.
Cb = Population in control plants before treatment.

III. Results and Discussion

The results on the mortality vis-a-vis population reduction in red spider mite, *O. coffeae* as achieved through spraying of various concentrations of **Etoxazole 10% EC**, **Hexythioxy 5 EC** and **Propargite 57 EC** have been presented in Table1, 2, 3 & 4 separately as representatives for 2012 and 2013. During 2012, **Propargite 57 EC** at doses failed to produce impressive reduction in the population build up of red spider mite. The population reduction in different doses of **Propargite** formulation was found to range from 23% to 67% at 35 days after spraying (DAS). However, the modern pesticide molecules like **Etoxazole 10% EC** in different doses were able to reduce the population build up of red spider mite appreciably which ranged from 95.20% to 100%, (Table-1-2), whereas **Hexythioxy 5 EC** at doses resulted in a little less reduction in population build up, the range being 83% to 93.30%. Achieving moderate efficacy of the test pesticide molecules may possibly be explained in the light of sudden change in micro-climatic conditions due to heavy pre-monsoon down poorer as experienced during the experimental period in May-June, and October-November, 2012.

The same pesticide molecules with same concentrations were evaluated for their biocidal activity against the same pest during May-June, and October-November, 2013, the results achieved were observed to be quite encouraging in reducing the populations build up of red spider mite. The reduction in population build up was found to range from 70% to 80% in Propargite **57 EC**, 95% to 100% in Etoxazole **10% EC** and 91% to 94% in **Hexythioxy 5 EC** (Table-3-4) at 35 DAS over control.

Som Choudhury *et al.* (1999) observed Fenazaquin to be most effective acaricide against red spider mite, which is more or less in conformity with the findings of the present workers who found Fenazaquin to produce appreciably higher reduction in the population build up of the same pest. In contrary to the observations recorded by Rahaman *et al.* (2006) on the bio-efficacy of **Propargite** against red spider mite in tea, the present workers found **Propargite** to be less effective than **Etoxazole** against red spider mite. The order of efficacy was recorded as **Etoxazole 10% EC** > **Hexythioxy 5 EC** > **Propargite 57 EC**.

Regardless of concentrations and type of the pesticide molecules used in the experiments no phytotoxic effect such as epinasty, hyponasty, scorching, Chlorosis and wilting were observed in tea plants (Table 5).

On the basis of the results as obtained through the present study, it is concluded that **Etoxazole 10% EC** at 0.75 ml/lt and 1.00 ml/lt doses may provide effective check against population build up of red spider mite, *Oligonychus coffeae,* infesting tea.

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International Journal of Agriculture Innovations and Research
Volume 6, Issue 3, ISSN (Online) 2319-1473

Table 1. Bio-efficacy of modern pesticide molecules against *O. coffeae* on tea during May-June, 2012 (Mean of 3 replication).

Name of Treatment	Dose gm/ml/lt.	Before spray Population	Mean no. of population at								% reduction over control
			1 DAT	3 DAT	7 DAT	10 DAT	14 DAT	21 DAT	28 DAT	35 DAT**	
Etoxazole 10% EC	0.50	90 (9.51)	88 (9.41)	84 (9.19)	56 (7.52)	20 (4.53)	0 (0.71)	0 (0.71)	0 (0.71)	4 (2.12)*	98.00
	0.75	92 (9.62)	88 (9.41)	82 (9.08)	40 (6.36)	0 (0.71)	0 (0.71)	0 (0.71)	0 (0.71)	0 (0.71)	100.00
	1.00	94 (9.72)	86 (9.30)	80 (8.97)	34 (5.87)	0 (0.71)	0 (0.71)	0 (0.71)	0 (0.71)	0 (0.71)	100.00
Hexythioxy 5 EC	1.0	92 (9.62)	88 (9.41)	80 (8.97)	68 (8.28)	30 (5.52)	8 (2.92)	0 (0.71)	0 (0.71)	12 (3.54)	93.30
Propargite 57 EC	2.50	90 (9.51)	10 (3.24)	3 (1.87)	3 (1.87)	5 (2.35)	7 (2.74)	25 (5.05)	40 (6.36)	58 (7.65)	67.00
Untreated Control	----	90 (9.51)	95 (9.77)	105 (10.27)	110 (10.51)	125 (11.20)	135 (11.64)	146 (12.10)	152 (12.35)	175 (13.25)	-------
S. Em ±		0.4977	0.4493	0.5803	0.6675	0.5220	0.4170	0.3854	0.5379	0.5052	
C.D at 5%level		NS	1.4157	1.8286	2.1034	1.6449	1.3141	1.2146	1.6950	1.5919	

* Figures in parenthesis are square root transform values.
**DAS means Days after Treatment.

Table 2. Bio-efficacy of modern pesticide molecules against *O. coffeae* on tea during October-November, 2012 (Mean of 3 replication).

Name of Treatment	Dose gm/ml/lt.	Before spray Population	Mean no. of population at								% reduction over control
			1 DAT	3 DAT	7 DAT	10 DAT	14 DAT	21 DAT	28 DAT	35 DAT**	
Etoxazole 10% EC	0.50	30 (5.52)	30 (5.52)	28 (5.34)	20 (4.53)	4 (2.12)	0 (0.71)	0 (0.71)	0 (0.71)	3 (1.87)*	95.20
	0.75	28 (5.34)	26 (5.15)	22 (4.74)	8 (2.92)	0 (0.71)	0 (0.71)	0 (0.71)	0 (0.71)	0 (0.71)	100.00
	1.00	25 (5.05)	22 (4.74)	18 (4.30)	4 (2.12)	0 (0.71)	0 (0.71)	0 (0.71)	0 (0.71)	0 (0.71)	100.00
Hexythioxy 5 EC	1.0	25 (5.05)	25 (5.05)	23 (4.85)	22 (4.74)	18 (4.30)	7 (2.74)	0 (0.71)	0 (0.71)	12 (3.54)	83.00
Propargite 57 EC	2.50	30 (5.52)	12 (3.54)	4 (2.12)	0 (0.71)	4 (2.12)	11 (3.39)	18 (4.30)	32 (5.70)	63 (7.97)	23.00
Untreated Control	----	30 (5.52)	35 (5.96)	40 (6.36)	42 (6.52)	42 (6.52)	50 (7.11)	60 (7.78)	70 (8.40)	82 (9.08)	-------
S. Em ±		0.5588	0.4820	0.6054	0.4166	0.3945	0.4458	0.3993	0.3257	0.5557	
C.D at 5%level		NS	NS	1.9075	1.3126	1.2432	1.4047	1.2582	1.0264	1.7510	

* Figures in parenthesis are square root transform values.
**DAS means Days after Treatment.

Table 3. Bio-efficacy of modern pesticide molecules against *O. coffeae* on tea during May-June, 2013 (Mean of 3 replication).

Name of Treatment	Dose gm/ml/lt.	Before spray Population	Mean no. of population at								% reduction over control
			1 DAT	3 DAT	7 DAT	10 DAT	14 DAT	21 DAT	28 DAT	35 DAT**	
Etoxazole 10% EC	0.50	75 (8.69)	72 (8.51)	70 (8.40)	50 (7.11)	20 (4.53)	4 (2.12)	0 (0.71)	0 (0.71)	4 (2.12)*	97.00
	0.75	78 (8.86)	75 (8.69)	70 (8.40)	45 (6.75)	0 (0.71)	0 (0.71)	0 (0.71)	0 (0.71)	0 (0.71)	100.00
	1.00	80 (8.97)	75 (8.69)	65 (8.09)	30 (5.52)	0 (0.71)	0 (0.71)	0 (0.71)	0 (0.71)	0 (0.71)	100.00
Hexythioxy 5 EC	1.0	85 (9.25)	80 (8.97)	75 (8.69)	50 (7.11)	30 (5.52)	0 (0.71)	0 (0.71)	0 (0.71)	10 (3.24)	94.00
Propargite 57 EC	2.50	82 (9.08)	15 (3.94)	5 (2.35)	3 (1.87)	8 (2.92)	15 (3.94)	25 (5.05)	35 (5.96)	45 (6.75)	70.00
Untreated Control	----	80 (8.97)	85 (9.25)	90 (9.51)	94.5 (9.75)	102 (10.12)	108 (10.42)	115 (10.75)	125.5 (11.22)	145.5 (12.08)	--------
S. Em±		1.2434	0.8351	0.8214	0.5347	0.4002	0.3879	0.3163	0.3199	0.5824	
C.D at 5%level		NS	2.6314	2.5882	1.6848	1.2610	1.2224	0.9966	1.0080	1.8352	

* Figures in parenthesis are square root transform values.
**DAS means Days After Treatment.

International Journal of Agriculture Innovations and Research
Volume 6, Issue 3, ISSN (Online) 2319-1473

Table 4. Bio-efficacy of modern pesticide molecules against *O. coffeae* on tea during October-November, 2013 (Mean of 3 replication).

Name of Treatment	Dose gm/ml/lt.	Before spray Population	Mean no. of population at								% reduction over control
			1 DAT	3 DAT	7 DAT	10 DAT	14 DAT	21 DAT	28 DAT	35 DAT**	
Etoxazole 10% EC	0.50	25.75 (5.12)	25.75 (5.12)	20.5 (4.58)	15.5 (4.00)	10 (3.24)	5 (2.35)	0 (0.71)	0 (0.71)	4 (2.12)*	95.00
	0.75	22.8 (4.83)	22.8 (4.83)	18.5 (4.36)	12.5 (3.61)	3.5 (2.00)	0 (0.71)	0 (0.71)	0 (0.71)	0 (0.71)	100.00
	1.00	30.25 (5.55)	30.25 (5.55)	20.1 (4.54)	10.5 (3.32)	0 (0.71)	0 (0.71)	0 (0.71)	0 (0.71)	0 (0.71)	100.00
Hexythioxy 5 EC	1.0	28.5 (5.39)	28.5 (5.39)	25 (5.05)	18.5 (4.36)	8.5 (3.00)	0 (0.71)	0 (0.71)	2 (1.58)	8 (2.92)	91.00
Propargite 57 EC	2.50	27.5 (5.29)	12 (3.54)	8 (2.92)	4 (2.12)	0 (0.71)	4 (2.12)	8 (2.92)	15 (3.94)	20 (4.53)	80.00
Untreated Control	----	25 (5.05)	30 (5.52)	35 (5.96)	45 (6.75)	52.5 (7.28)	62.1 (7.91)	68.5 (8.31)	75 (8.69)	78.5 (8.89)	--------
S. Em±		0.4471	0.4669	0.5291	0.5335	0.3464	0.2483	0.2723	0.2749	0.3145	
C.D at 5%level		NS	NS	1.6672	1.6809	1.0915	0.7824	0.8580	0.8662	0.9911	

* Figures in parenthesis are square root transform values.
**DAS means Days after Treatment.

Table 5. Effect of organic formulation synthetic pesticides of Phytotoxicity in Tea

Treat-ment	Dose gm/ml/lt.	Parameters																											
		Chlorosis (DAS)					Necrosis (DAS)					Wilting (DAS)					Scorching (DAS)					Hyponasty (DAS)					Epinasty (DAS)*				
		1	3	5	7	10	1	3	5	7	10	1	3	5	7	10	1	3	5	7	10	1	3	5	7	10	1	3	5	7	10
Etoxazole 10% EC	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hexythioxy 5 EC	1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Propargite 57 EC	2.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

*DAS means Days After Spraying.