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RESEARCH ARTICLE

Toxicological study of commonly used acaricides of tea (*Camellia sinensis* L. var. *assamica*) red spider mite (*Oligonychus coffeae* Nietner) of North East Assam under field conditions

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ABSTRACT

An experiment was conducted in the experimental garden for plantation crops, Assam Agricultural University (AAU), Jorhat during *Kharif* season, 2011 and 2012 to study the efficacy of different acaricides *viz.*, etoxazole, bionol, spiromesifen and propargite against the red spider mites of tea. Spiromesifen 240 SC (100g.*a.i*/ha) gave the best result reducing the mite population at 1, 3, 7 and 10 days, after 1st spraying. Propargite 57EC@ 570 g.a.i/ha was second best treatment in order of effectiveness after 1st spraying. A similar trend of results existed after the second spraying of acaricides against the red spider mite, *O. coffeae*. In case of eggs again spiromesifen 240 SC (100g. a.i/ha) was found most effective acaricides after 1st spraying. The next best treatment was etoxazole 10 SC (80 g.*a.i.*/ha) after 1st spraying. Likewise, after the second spraying, similar results were observed.

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INTRODUCTION

Tea (*Camellia sinensis* L.) is grown as a major cash crop in India. The tea industry is one of the oldest organized industries in India. India produces three specialist teas – Darjeeling, Assam and Nilgris, which are exported world over. Tea is grown in 13 states in 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). Red spider mite (*Oligonychus coffeae*, Nietner: Tetranychidae) is one of the most destructive pests in all the tea growing regions of North East India (Das, 1959 and 1963). Loss in tea crop due to red spider mite attack in India may be as much as 75 per cent (Subramaniam, 1995). Larvae, nymphs and adults of *O. coffeae* cause damage to the mature leaves of tea by sucking from the upper surface. Reddish spots develop at the sucking sites, which subsequently unite to form large brown patches thus reducing the photosynthesis rate of the maintenance leaves. This species breeds throughout the year in Northeast India, and its reproductive rate increases with temperature (Das, 1959). Spherical and reddish eggs are laid on the upper surface of the mature leaves, which hatch in 4 – 6 days during the summer months. The application of pesticide programmers in tea in Northeast India is largely guided by the recommendations of Tea Research Association (Das *et al.*, 1992).

Farmers depend mostly on synthetic acaricides for managing mites problem, because of instant spectacular knock down effect which often leads to many problems. Spider mites

have developed resistance to all major groups of insecticides such as organochlorines, organophosphates, carbamates and synthetic pyrithroids (Onkarappa *et al*., 2007).

There is a need to evaluate the newer chemicals to manage mites pest and replace ineffective ones. Keeping this in view, the present study was undertaken to evaluate the different newer acaricides *viz.*, etoxazole, bionol, spiromesifen and propargite.

MATERIAL AND METHODS

The field experiment was conducted on tea (cv. TV 23) during *Kharif* 2011 and 2012 to assess the efficacy of different concentrations of etoxazol, bionol, spiromeifen and propergite. The experiment was laid out in a Randomized Block Design with twelve treatment *viz*., T_1: Etoxazol 10 SC @ 25g *a.i.* / ha,T_2 : Etoxazol 10 SC @ 40g *a.i.* / ha,T_3 : Etoxazol 10 SC @ 55g *a.i.* / ha, T_4 : Etoxazol 10 SC @ 80g *a.i.* / ha, T_5 : Bionol (5 ml / lit), T_6 : Bionol (10 ml / lit), T_7 : Bionol (15 ml / lit), T_8 : Spiromesifen 240 SC @ 60 g *a.i.* / ha, T_9 : Spiromesifen 240 SC @ 80 g *a.i.* / ha, T_{10} : Spiromesifen 240 SC @ 100 g *a.i.* / ha , T_{11}: Propargite 57 EC @ 570 g *a.i.* / ha (check), T_{12}: Control (untreated). The plot size was 5 m × 2 m replicated thrice with spacing 105 to 60 cm.

First spray was done when the incidence of mite crossing the ETL of 4 mites/cm^2 leaf area. The acaricides were sprayed on tea plants with hand sprayer. The sprayer was washed thoroughly prior to the application of the each treatment. Second spray was done at 15 days after first spray.

To evaluate the effect of foliar spray of various treatments on the population of mites, mite counts were made on three randomly selected plants from each plot. Three randomly selected leaves from each selected plant were plucked and held in separate properly labeled polythene bags and brought to the laboratory for counting mite population (live) under a binocular microscope at 4X magnification. The red spider mite density was recorded from whole leaf. Pre-treatment count at one day before and post treatment count at 1, 3, 7 and 10 days after spraying (DAS) were recorded. The data so obtained on mite count were summed up and converted to numbers per leaf basis.

To estimate the reduction or increase in red spider mite population, data observed on one day, three days, seven days and ten days after spraying were deducted from the pre-treatment count data and converted into percentage by the formula given below :

$$\frac{\text{Reduction}(-)}{\text{Increase}(+)} = \frac{\text{Number of mites at pre treatment count} - \text{Numbers of mites at 1,3,7 and 10 das}}{\text{Numbers of mites at pre treatment count}} \times 100$$

The data so obtained were statistically analyzed using Fisher test after arcsine transformation so as to compare the effectiveness of acaricides against the red spider mite, *O. coffeae*.

RESULTS AND DISCUSSION

The efficacy of different acaricides *viz.*, etoxazole, bionol, spiromesifen and propargite against the red spider mites of tea was evaluated. Spiromesifen 240 SC (100g.*a.i*/ha) gave the best result reducing 66.59, 83.34, 91.08 and 98.93 per cent of mite population at 1, 3, 7 and 10 days, respectively after 1st spraying. Propargite 57EC@ 570 g.a.i/ha was second best treatment in order of effectiveness which gave 63.57, 79.89, 90.26 and 96.61 per cent reduction at 1, 3, 7 and 10 days,

Table 1 : Efficacy of certain acaricides against the motile stages of red spider mite, *O. coffeae* infesting tea after 1st spraying 2011and 2012

Treatments	Dose (g a. i. /ha)	Number of mites/leaf (one day before spraying)	Per cent reduction of mites at different days after spraying			
			1DAS	3DAS	7DAS	10DAS
T_1 Etoxazole 10 SC	25 g.ai/ha	25.39	50.92 (45.52)	56.08 (48.50)	84.65 (66.97)	93.62 (73.35)
T_2 Etoxazole 10 SC	40 g.a.i/ha	28.27	53.40 (46.95)	70.43 (57.04)	83.47 (66.03)	93.58 (73.35)
T_3 Etoxazole 10 SC	55 g.a.i/ha	21.77	53.67 (47.12)	78.24 (62.17)	82.25 (65.12)	93.89 (75.70)
T_4 Etoxazole 10 SC	80 g.a.i/ha	18.11	55.36 (48.10)	78.79 (62.58)	88.37 (70.09)	95.67 (78.03)
T_5 Bionol	5ml/lit	26.22	26.72 (31.11)	54.53 (47.58)	78.85 (62.65)	92.03 (73.57)
T_6 Bionol	10 ml/lit	30.10	47.09 (43.34)	73.15 (58.82)	86.17 (68.19)	89.55 (71.09)
T_7 Bionol	15 ml/lit	24.5	51.70 (45.97)	78.07 (62.10)	86.42 (68.36)	93.20 (74.88)
T_8 Spiromesifen 240SC	60 g.a.i/ha	21.44	57.01 (49.02)	75.45 (60.33)	86.32 (68.28)	93.66 (75.46)
T_9 Spiromesifen 240SC	80 g.a.i/ha	23.72	61.69 (51.77)	69.30 (56.35)	82.55 (65.27)	95.02 (77.08)
T_{10} Spiromesifen 240SC	100 g.a.i/ha	23.22	66.59 (54.70)	83.34 (65.88)	91.08 (72.64)	98.83 (83.71)
T_{11} Propargite 57 EC	570 g.a.i/ha	18.72	63.57 (52.89)	79.89 (63.36)	90.26 (71.85)	96.61 (79.37)
T_{12} Water spray	Control	26.53	+23.61 (29.06)	+44.24 (41.67)	+44.60 (41.90)	+32.75 (34.94)
S.Ed±			2.75	7.65	2.68	4.02
C.D. (P=0.05)			5.92	16.45	5.76	8.66

Data are pooled mean of two years experiment. Figures in parenthesis are angular transformed values. + Represents the per scent increase and other values represent percent reduction in population. DAS indicates days after spraying.

respectively after 1st spraying. Bionol was the least effective against the red spider mite which showed 51.70, 78.07, 86.42 and 93.20 per cent reduction at 1, 3, 7 and 10 days, respectively after 1st spraying (Fig. 1).

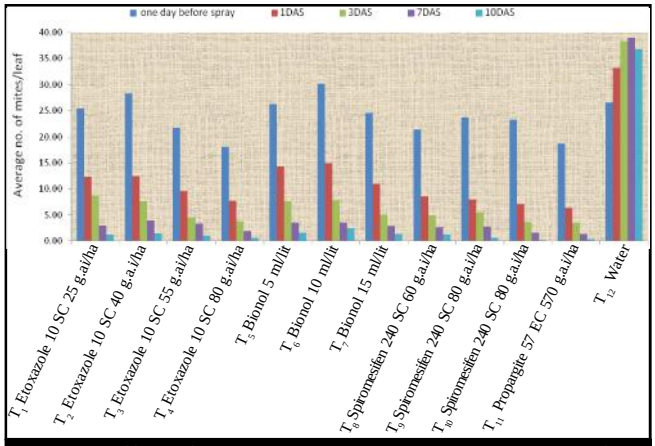

Fig. 1 : Effect of certain acaricides on red spider mite of tea after 1st spraying, 2011 and 2012

A similar trend of results existed after the second spraying of acaricides against the red spider mite, *O. coffeae*. Spiromesifen 240 SC (100g.a.i/ha) maintained its superiority by recording the highest reduction of 77.53, 92.89, and 100 per cent mite population at 1, 3 and 7 days, respectively after 2nd spraying followed by the treatment propargite 57EC (570 g.a.i/ha) with 69.57, 91.09, 91.55 and 93.85 per cent reduction at 1, 3, 7 and 10 days, respectively after 2nd spraying. Bionol (15ml/lit) gave the lowest reduction of 61.79, 75.92, 86.15 and 89.06 per cent of mite population at 1, 3, 7 and 10 days, respectively after 2nd spraying (Table 2 and Fig. 2).

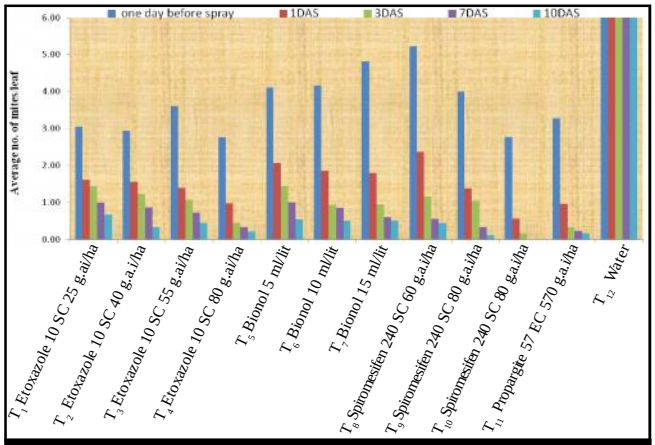

Fig. 2 : Effect of certain acaricides on red spider mite of tea after 2nd spraying, 2011 and 2012

In case of eggs again spiromesifen 240 SC (100g.a.i/ha) was most effective acaricide which resulted 25.81, 37.50, 76.15 and 96.62 per cent reduction at 1, 3, 7 and 10 days, respectively after 1st spraying.The next best treatment was etoxazole 10 SC (80 g.*a.i.*/ha) which gave 20.43, 33.67, 70.09 and 91.89 per cent reduction at 1,3,7 and 10 days, respectively after 1st spraying. Propargite 57 EC (570g.a.i/ha) gave the lowest reduction in egg population of red spider mite which was found to be 13.87, 23.21, 64.67 and 89.61 per cent at 1, 3.7 and10 days, respectively after 1st spraying (Table 3, 4 and Fig. 3, 4).

In the present investigation Spiromesifen 240 SC (100g.a.i/ha) was significantly superior to remaining treatment. The result of present finding corroborates with the work of Kalita *et al*. (2007) who reported that application of spiromesifen gave the highest (99.23 %) reduction of red

Table 2 : Efficacy of certain acaricides against the motile stages of red spider mite, *O. coffeae* infesting tea after 2nd spraying 2011 and 2012

Treatments	Dose (g a. i. /ha)	Number of mites/leaf (one day before spraying)	Per cent reduction of mites at different days after spraying			
			1DAS	3DAS	7DAS	10DAS
T_1 Etoxazole 10 SC	25 g.ai/ha	3.05	46.28 (42.88)	50.97 (45.52)	64.64 (53.49)	75.79 (60.53)
T_2 Etoxazole 10 SC	40 g.a.i/ha	2.94	45.74 (47.53)	57.71 (49.43)	68.03 (55.55)	87.01 (68.87)
T_3 Etoxazole 10 SC	55 g.a.i/ha	3.61	59.65 (50.59)	67.20 (55.00)	75.89 (60.60)	88.17 (69.91)
T_4 Etoxazole 10 SC	80 g.a.i/ha	2.75	64.57 (53.49)	81.38 (64.45)	87.05 (68.95)	91.53 (73.05)
T_5 Bionol	5ml/lit	4.10	47.25 (43.45)	61.50 (51.65)	72.08 (58.12)	85.27 (67.45)
T_6 Bionol	10 ml/lit	4.16	53.52 (47.01)	69.90 (56.73)	72.74 (58.50)	86.53 (68.36)
T_7 Bionol	15 ml/lit	4.81	61.79 (51.83)	75.92 (60.60)	86.15 (68.19)	89.06 (70.72)
T_8 Spiromesifen 240SC	60 g.a.i/ha	5.22	47.53 (43.57)	71.46 (57.73)	82.28 (65.12)	85.47 (67.62)
T_9 Spiromesifen 240SC	80 g.a.i/ha	4.00	64.88 (56.61)	71.29 (57.61)	93.78 (75.58)	94.84 (76.82)
T_{10} Spiromesifen 240SC	100 g.a.i/ha	2.77	77.53 (61.68)	92.89 (74.45)	100 (90.00)	100 (90)
T_{11} Propargite 57 EC	570 g.a.i/ha	3.27	69.57 (55.54)	91.09 (72.64)	91.55 (73.05)	93.85 (75.58)
T_{12} Water spray	Control	37.72	+14.06 (22.06)	+23.15 (28.79)	+28.85 (32.46)	+35.57 (36.63)
S. Ed ±			3.05	3.77	5.97	5.77
C.D. (P=0.05)			6.56	8.12	12.84	12.04

Data are pooled mean of two years experiment. Figures in parenthesis are angular transformed values. + Represents the per cent increase and other values represent per cent reduction in population. DAS indicates days after spraying.

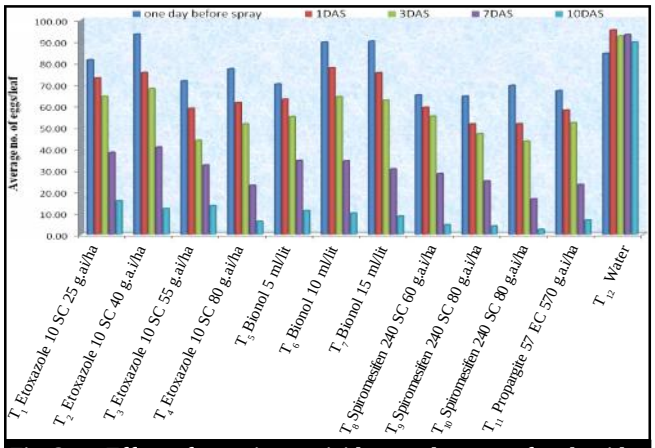

Fig. 3 : Effect of certain acaricides on the eggs of red spider mite after 1st spraying, 2011 and 2012

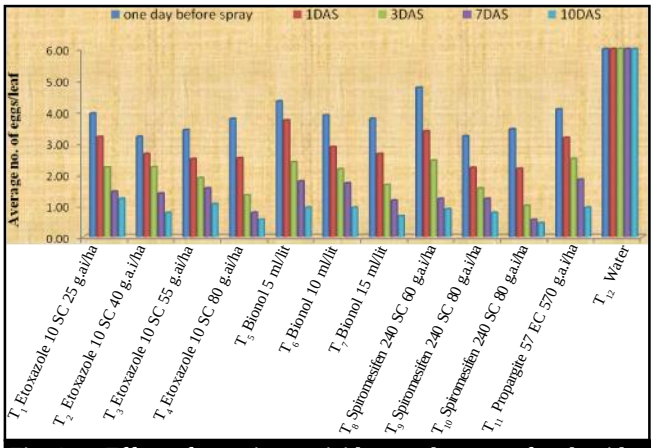

Fig. 4 : Effect of certain acaricides on the eggs of red spider mite after 2nd spraying, 2011 and 2012

Table 3 : Efficacy of certain acaricides on the eggs of red spider mite, *O. coffeae* infesting tea after 1st spraying 2011 and 2012

Treatments	Dose (g a. i. /ha)	Number of eggs/leaf (one day before spraying)	Per cent reduction of egg at different days after spraying			
			1DAS	3DAS	7DAS	10DAS
T_1 Etoxazole 10 SC	25 g.ai/ha	81.33	10.60 (19.00)	20.59 (26.99)	53.01 (46.72)	79.98 (63.36)
T_2 Etoxazole 10 SC	40 g.a.i/ha	93.27	17.14 (24.43)	24.53 (29.67)	56.43 (48.68)	86.90 (68.78)
T_3 Etoxazole 10 SC	55 g.a.i/ha	71.49	15.93 (23.50)	25.92 (30.59)	54.93 (47.81)	81.31 (64.33)
T_4 Etoxazole 10 SC	80 g.a.i/ha	77.14	20.43 (26.85)	33.67 (35.49)	70.09 (56.85)	91.89 (73.46)
T_5 Bionol	5ml/lit	70.05	10.26 (18.72)	22.14 (28.04)	51.04 (45.57)	83.95 (66.34)
T_6 Bionol	10 ml/lit	89.60	13.47 (21.56)	28.55 (32.27)	61.49 (51.65)	88.23 (69.91)
T_7 Bionol	15 ml/lit	89.99	16.36 (23.69)	30.78 (33.71)	65.89 (54.27)	90.83 (72.34)
T_8 Spiromesifen 240SC	60 g.a.i/ha	64.94	15.45 (23.11)	22.39 (28.25)	56.46 (48.73)	93.19 (74.88)
T_9 Spiromesifen 240SC	80 g.a.i/ha	64.44	20.26 (26.78)	26.97 (31.24)	61.46 (51.65)	94.02 (75.85)
T_{10} Spiromesifen 240SC	100 g.a.i/ha	69.39	25.81 (30.53)	37.50 (37.76)	76.15 (60.80)	96.62 (79.37)
T_{11} Propargite 57 EC	570 g.a.i/ha	66.94	13.87 (21.89)	23.21 (28.79)	64.67 (53.55)	89.61 (71.19)
T_{12} Water spray	Control	84.30	+12.81 (20.96)	+10.03 (18.53)	+11.39 (19.73)	+6.34 (14.65)
S. Ed ±			2.86	5.20	5.88	3.71
C.D. (P=0.05)			6.14	11.19	12.65	7.99

Data are pooled mean of two years experiment. Figures in parenthesis are angular transformed values. + Represents the per cent increase and other values represent per cent reduction in population. DAS indicates days after spraying.

Table 4 : Efficacy of certain acaricides on the eggs of red spider mite, *O. coffeae* infesting tea after 2nd spraying 2011and 2012

Treatments	Dose (g a. i. /ha)	Number of eggs/leaf (one day before spraying)	Per cent reduction of egg at different days after spraying			
			1DAS	3DAS	7DAS	10DAS
T_1 Etoxazole 10 SC	25 g.ai/ha	3.94	18.70 (25.62)	35.46 (36.57)	63.91 (53.07)	70.33 (56.98)
T_2 Etoxazole 10 SC	40 g.a.i/ha	3.2	23.92 (29.27)	44.82 (42.02)	64.03(53.13)	70.94 (57.35)
T_3 Etoxazole 10 SC	55 g.a.i/ha	3.41	26.98 (31.24)	45.15 (42.25)	55.04 (47.87)	69.61 (55.54)
T_4 Etoxazole 10 SC	80 g.a.i/ha	3.77	32.90 (35.00)	64.71 (53.55)	79.46 (63.08)	85.42 (67.54)
T_5 Bionol	5ml/lit	4.33	14.28 (22.22)	44.91 (42.07)	59.06 (50.24)	78.24 (62.17)
T_6 Bionol	10 ml/lit	3.88	25.96 (30.59)	44.29 (41.73)	55.79 (48.33)	75.71 (60.47)
T_7 Bionol	15 ml/lit	3.77	29.60 (32.96)	55.92 (48.39)	69.19 (56.29)	82.37 (65.20)
T_8 Spiromesifen 240SC	60 g.a.i/ha	4.76	29.07 (32.65)	48.7 (44.25)	74.38 (59.60)	81.34 (64.33)
T_9 Spiromesifen 240SC	80 g.a.i/ha	3.22	31.42 (34.08)	51.57 (45.92)	62.07 (52.00)	75.90 (60.60)
T_{10} Spiromesifen 240SC	100 g.a.i/ha	3.44	36.83 (37.35)	71.07(57.48)	83.91 (66.34)	87.16 (69.04)
T_{11} Propargite 57 EC	570 g.a.i/ha	4.07	13.39 (21.47)	38.69 (38.47)	55.04 (47.87)	76.86 (61.27)
T_{12} Water spray	Control	19.29	+19.94 (26.49)	+30.79 (33.71)	+27.45 (31.56)	+31.87 (34.39)
S. Ed ±			2.10	5.99	6.27	4.40
C.D. (P=0.05)			4.52	12.89	13.48	9.46

Data are pooled mean of two years experiment. Figures in parenthesis are angular transformed values. + Represents the per cent increase and other values represent per cent reduction in population. DAS indicates days after spraying.

spider mite of tea, *O. coffeaea* in comparison to the conventional acaricide dicofal (18.5 EC), ethion (50 EC), endosulfan (35 EC) and sulphur (80 WP), Elbert *et al.* (2005) reported effectiveness of Spiromesifen 240 SC @ 72-96 g.a.i./ ha gave an excellent result for the control of red spider mite, *O. coffeae* in tea. Kumari *et al.* (2012) reported the efficacy of propergite propargite 57 EC (@1 lit. /ha which resulted 84–86 per cent reduction in red spider mites, *O. coffeae* population. Asheley *et al.* (2006) reported that the etoxazole and propargite imparted cent per cent eggs mortality of *Tetranychus urticae* on peanut.

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