Research Article

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Effect of certain indigenous technical knowledge on the management of red spider mite (*Oligonychus coffeae*) in tea

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Abstract

An investigation was carried out at Deha Tea Estate, Jorhat, Assam during 2015-16 by using different indigenous technical knowledge (ITK) prevalent among different small tea growers. Fish extract at (0.25, 0.5 and 1%), *Polygonum hydropiper* at (2.5, 5 and 7.5%) and Azadirachtin (Neemazal-F 5%) were evaluated in field conditions against tea mite. The result showed that fish extract in combination with cow dung, cow urine and water when sprayed at one per cent concentration, significantly reduced red spider mite population (96.5%), percentage of leaves infestation (5.2%) and leaf area infested by the mite (11.6%). *P. hydropiper* in combination with cow urine and water when sprayed at 7.5 per cent concentration significantly reduced red spider mite population (87.5%), percentage of infestation (9.1%) and leaf area infested by the mite (12.9%). Among all the ITKs, fish extract at one per cent caused higher reduction of infestation of red spider mite followed by *P. hydropiper* extract at 7.5 per cent. Influence of both the treatments on the management of red spider mite was at par with that of commercial Azadirachtin.

Keywords: Camellia sinensis, fish extract, management, *Oligonychus coffeae*, *Polygonum hydropiper*

Introduction

Tea is an export oriented, perennial, evergreen plantation crop cultivated as monoculture on large and small holdings in hilly tracts of south and north-eastern parts of India, Assam being a major state. Tea is attacked by many insects pests. In Asia, 230 species of insect attack including mites were observed in tea (Muraleedharan, 1992) and in North-East India, 173 arthropods and 16 nematodes were reported to be major and minor pests of tea (Hazarika *et al*.,1994).

Red spider mite (*Oligonychus coffeae*) causes considerable crop loss in South India (Muraleedharan *et al*., 2005), Terai, Dooars and Assam regions (Sharmah *et al*., 2009). Damage is caused by larvae, nymphs and adult mites which feed on the sap of the leaves (Das, 1959). They feed on the upper surface of the mature leaves and gradually spread to the entire surface of leaf, thereby change in colour of the leaf to ruddy bronze, which results in crop loss upto 46 per cent (Roy *et al.,* 2014). In severe infestation, it damages the younger and older leaves and ultimately leads to defoliation and debilitation of the tea bush. In North East India, red spider mite is active and breeds on tea throughout the year (Mukhopadhyay and Roy, 2009). Their population increases from early March and reach highest density by April. During May and June injury becomes most severe until the monsoon rains wash off the active forms from the leaves. From July onwards, the pest virtually disappears except for a few mites which usually persist on the middle and lower part of the bushes. A mild attack may develop in September or October. During winter, rate of multiplication is greatly reduced and the number of mites present on bushes is small but this small population is primarily responsible for damage in the season.

Chemical control has been used for a long time, as the primary mode, to manage mites and other

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pests in tea. To control these pests, different acaricides and insecticides currently being used have serious drawbacks such as toxicity to non-targeted organisms, pesticide induced resistance, health hazard and presence of pesticide residues in tea (Sharaby, 1988).

To overcome such crisis in the tea industry, it is essential to go for practices that are based on the use of non-chemical methods and are easily adoptable, cost effective and easily available. Use of traditional pest control agents like plant extracts, oil and wood ash that farmers are using over several decades provide a clue to indigenous use of pest control strategies. Traditional knowledge based practices including indigenous plant extracts and plant products would be a better option. These practices are more prevalent in remote, isolated and inaccessible areas where the modern innovations and technologies have not been adopted (Saikia *et al*., 2008). Different plants and plant parts have been reported to have insecticidal properties (Mahmood *et al*., 1984) while some plant extracts possess significant oviposition deterrence, antifeedent and toxic effects on tea pests (Hazarika *et al*., 2008). Keeping in view the above facts, a research programme was initiated to look into the benefits of these practices scientifically and to improve them where necessary.

Materials and methods

The hybrid of Assam-China type tea clone, TV_1 was used for this study. The experiment was laid out in randomized block design (RBD) with nine treatments including control which were replicated thrice. Individual plot size was 38.9 m^2. The plant spacing was maintained at 120 cm x 60 cm with single hedge planting pattern.

The treatments were fish extract (0.25, 0.5 and 1%), *Polygonum hydropiper* extract (2.5, 5.0 and 7.5%), Azadirachtin (Neemazal-F5%) and control. The fish extract was prepared by mixing 80 kilograms of fish waste like scales, fins, intestine *etc.* along with 50 litres cow urine, 15 kg cow dung and 100 litres of water. The mixture was kept for 7 days in a plastic drum installed underground and then the filtrate was sprayed in the experimental plots as shown in Figure 1. Aqueous extract of the plant *P. hydropiper* (Order-Polygonaceae), collected from nearby places of Deha Tea Estate, Jorhat, was prepared by crushing 30 kilograms of *P. hydropiper* and mixed with 10 litres cow urine and 100 litres of water. The extract was kept in a cement tank for 10 days and then filtration was done before spraying in the experimental plots as shown in Figure. 2. Neemazal 5 per cent is a neem extract concentrate insecticide manufactured by Parry India Limited, which is used to control different pests of tea.

The spraying was done at monthly interval starting from May 2015. The plant extracts were prepared and were diluted with water. Spraying was done during morning hours. Pre-treatment observations were recorded on red spider mite population, percentage of leaves infested and infested leaf area on plants selected randomly from each plot. The observations were made before and after imposing the treatments. For calculating percentage of infested leaves by red spider mite,fifty leaves were collected from five plants selected randomly in each plot and the number of infested leaves were counted and converted into percentage infestation. The leaf area infested by red spider mite was assessed by taking ten leaves randomly from each plot. Percentage of infested leaf area was measured using a leaf area meter and was calculated with the following formula.

$$\text{Infested leaf area} = \frac{\text{whole leaf area - remaining leaf area}}{\text{whole leaf area}} \times 100$$

To determine the number of mites per leaf, twenty leaves were collected randomly from each plot. The leaves were pressed on white paper and then red spots present on the paper were counted and average number of mites per infested leaf was recorded.

All the data were analyzed statistically. Significance of variance due to treatment effect was determined by calculating the respective 'F' values (Panse and Sukhatme, 1995).The standard error (SE) of difference of mean was calculated using the formula:

$$SEd\pm = \sqrt{\frac{2 \times \text{Error mean square}}{\text{Number of replications}}}$$

To find out the significance of mean difference amongst the treatments critical difference (CD) was calculated by multiplying the standard error of

difference of means with appropriate table value of 't' at 5 per cent and 1 per cent level of probability (Panse and Sukhatme, 1995).

CD = SED ± x 't' (at 5% or 1%) for error degree of freedom.

Results and discussion

During pretreatment, it was observed that red spider mite population, percentage of leaves infested and infested leaf area were not significant (Table 1). However, data on the percentage of leaves infested during the experimental period under different treatments are summarized in Table 2. Significant variations in infestation of leaves by red spider mite were noticed with the treatments under ITKs. Fish extract in combination with cow dung, cow urine and water, when sprayed at 1 per cent concentration, recorded highest reduction in leaves infested, followed by *P. hydropiper* in combination with cow urine and water at 7.5 per cent concentration. Influence of both the treatments was at par with that of Azadirachtin (5%).

Data on percentage of leaf area infested by red spider mite during the experimental period in different treatments are presented in Table 3. Significant variations in respect of percentage of leaf area infested were observed from May to December. The highest percentage of leaf area infested was in the month of May and October and was least during November-December. Application of fish extract at one per cent concentration recorded highest reduction in infested leaf area followed by

Table 1. Pre-treatment observation (May, 2015)

Treatments	Dilution (HV)	Percentage of leaves infested by red spider mite	Percentage of leaf area infested by red spider mite	No. of mites per leaf
Fish extract-0.25%	1:400	46.0	42.6	53.0
Fish extract-0.5%	1:200	46.4	37.2	53.5
Fish extract-1%	1:100	45.0	41.1	49.4
P. hydropiper extract-2.5%	5:200	46.0	40.7	49.8
P. hydropiper extract-5%	10:200	46.7	38.6	50.3
P. hydropiper extract-7.5%	15:200	47.3	39.5	50.0
Azadirachtin-5%	1:1500	45.6	37.0	49.1
Control	Water spray	45.6	37.7	50.8
F test		N.S	N.S	N.S

NS= Non Significant

Table 2. Effect of ITKs on percentage of leaves infested by red spider mite

Treatments	Dilution (HV)	May	June	July	August	September	October	November	December
T_1 (Control)	Water spray	56.7	55.3	46.6	31.4	47.5	56.1	37.2	19.1
T_2 (Fish extract-0.25%)	1:400	51.1	45.5	37.8	28.4	43.8	51.0	32.1	17.4
T_3 (Fish extract-0.5%)	1:200	47.3	42.1	35.6	22.1	41.6	48.8	31.2	15.8
T_4 (Fish extract-1%)	1:100	22.5	21.8	9.7	5.7	16.2	12.3	7.5	4.7
T_5 (*P. hydropiper* extract-2.5%)	5:200	52.9	48.0	40.3	29.6	45.6	53.7	33.3	18.7
T_6 (*P. hydropiper* extract-5%)	10:200	49.2	43.9	38.7	25.3	42.2	49.6	32.1	17.0
T_7 (*P. hydropiper* extract-7.5%)	15:200	26.5	23.8	16.8	9.1	20.2	15.3	10.5	8.2
T_8 (Azadirachtin-5%)	1:1500	29.1	26.2	18.5	10.6	24.6	18.1	14.1	9.9
S.Ed (±)		7.8	7.3	7.8	5.9	7.3	11.0	6.9	3.2
C.D. (P=0.05)		13.8	12.8	13.7	10.4	12.9	19.4	12.1	5.6
(P=0.01)		20.5	19.1	20.3	15.5	19.1	28.9	18.0	8.3

Table 3. Effect of ITKs on percentage of leaf area infested by red spider mite

Treatments	Dilution (HV)	May	June	July	August	September	October	November	December
T_1 (Control)	Water spray	58.2	51.8	45.2	43.9	51.3	60.6	49.6	32.2
T_2 (Fish extract-0.25%)	1:400	49.2	45.8	37.8	36.3	47.8	58.0	44.6	29.9
T_3 (Fish extract-0.5%)	1:200	46.6	40.2	34.5	34.1	43.5	55.9	41.9	24.2
T_4 (Fish extract-1%)	1:100	15.2	13.1	11.8	11.6	14.9	23.2	15.5	9.2
T_5 (*P. hydropiper* extract-2.5%)	5:200	52.9	48.0	41.8	40.7	48.2	58.5	46.2	31.3
T_6 (*P. hydropiper* extract-5%)	10:200	48.2	42.5	35.4	38.5	46.3	56.3	43.7	28.1
T_7 (*P. hydropiper* extract-7.5%)	15:200	21.0	18.7	14.9	12.9	18.1	27.3	19.6	11.7
T_8 (Azadirachtin-5%)	1:1500	23.8	21.9	18.2	17.6	21.7	31.1	21.4	12.3
S.Ed (±)		9.6	8.6	7.5	7.6	8.9	9.3	8.0	5.6
C.D. (P=0.05)		16.9	15.2	13.2	13.4	15.6	16.3	14.2	9.9
C.D. (P=0.01)		25.1	22.6	19.7	20.0	23.2	24.3	21.1	14.7

P. hydropiper extract at 7.5per cent concentration. Influence of both the treatments was at par with that of Azadirachtin (5%).

Number of mites per leaf as affected by various treatments was recorded at different months (Table 4). Number of mites per leaf was found to be significantly influenced by different treatments in different months during the period of investigation. It was observed that the number of mites per leaf in control plants increased gradually from the month of May and highest number of mites was recorded during May-June and thereafter the number declined gradually. Among all ITKs, fish extract at one per cent concentration was more effective followed by *P. hydropiper* extract at 7.5 per cent concentration and influence of both the treatments was at par with that of Azadirachtin (5%).

Per cent reduction in number of mites per leaf as influenced by different treatments is presented in Table 5. The highest reduction in number of mites (80.8-96.5%) was observed with fish extract at one per cent concentration followed by *P. hydropiper* extract at 7.5 per cent concentration (76.1-88.2%) and Azadirachtin 5 per cent (73.4-87.4%).

Traditional practices were evaluated in the field condition at different dilutions to check their efficacy against red spider mite and go for validation. Though there are many studies and scholarly articles on evaluation of different traditional practices and plant products against tea pests, the efficacy of fish extract or any fish product have not been studied till date. Fresh fish extract was found effective in managingthe red spider mite in tea fields. Mixing fish extract in combination with cow dung, cow urine and water at one per cent

Table 4. Effect of ITKs on red spider mite population (mites/leaf)

Treatments	Dilution (HV)	May	June	July	August	September	October	November	December
T_1 (Control)	Water spray	51.7	41.7	38.8	18.2	23.0	36.7	15.2	9.4
T_2 (Fish extract-0.25%)	1:400	33.6	21.5	20.5	9.5	12.8	18.8	6.6	4.0
T_3 (Fish extract-0.5%)	1:200	30.7	19.5	16.2	8.3	11.0	18.2	5.4	4.0
T_4 (Fish extract-1%)	1:100	8.8	5.9	3.3	1.1	3.6	3.6	1.0	0.3
T_5 (*P. hydropiper* extract-2.5%)	5:200	32.4	22.6	16.8	7.4	14.7	20.0	8.0	3.3
T_6 (*P. hydropiper* extract-5%)	10:200	30.6	20.5	14.7	6.6	12.7	18.5	7.4	3.2
T_7 (*P. hydropiper* extract-7.5%)	15:200	10.0	6.3	5.3	1.8	4.2	5.7	1.4	0.8
T_8 (Azadirachtin-5%)	1:1500	13.5	7.2	7.4	2.3	4.6	9.5	1.9	0.8
S.Ed (±)		5.7	3.9	3.3	1.8	2.5	3.2	1.5	0.6
C.D. (P=0.05)		10.1	6.9	5.8	3.1	4.3	5.5	2.7	1.0
C.D. (P=0.01)		15.0	10.3	8.6	4.6	6.4	8.3	4.0	1.5

Table 5. Per cent reduction of red spider mite population

Treatments	Dilution (HV)	May	June	July	August	September	October	November	December
T_1 (Control)	Water spray	+1.7	+1.8	+1.9	+1.8	+2.7	+3.1	+2.6	+1.2
T_2 (Fish extract-0.25%)	1:400	38.5	40.2	42.1	44.6	38.7	41.2	47.1	51.3
T_3 (Fish extract-0.5%)	1:200	40.3	43.1	43.1	47.4	41.6	44.7	52.2	52.5
T_4 (Fish extract-1%)	1:100	81.6	82.6	87.4	90.1	80.8	86.5	91.4	96.5
T_5 (*P. hydropiper* extract-2.5%)	5:200	35.6	39.4	40.5	43.7	35.2	39.7	45.3	51.7
T_6 (*P. hydropiper* extract-5%)	10:200	39.2	41.6	43.0	46.5	39.7	43.6	48.2	52.2
T_7 (*P. hydropiper* extract-7.5%)	15:200	79.8	80.8	82.9	85.1	76.1	80.5	87.5	88.2
T_8 (Azadirachtin-5%)	1:1500	74.5	76.7	78.3	82.6	73.4	73.3	85.7	87.4
S.Ed (±)		16.5	16.5	17.2	17.6	16.1	16.7	18.0	18.1
C.D. (P=0.05)		29.0	29.1	30.2	31.0	28.3	29.5	31.7	31.9
C.D. (P=0.01)		43.2	43.3	45.0	46.1	42.1	43.8	47.2	47.5

+ Represents the per cent increase

concentration significantly reduced red spider mite population (96.5%), percentage of leaves infestation (5.2%) and leaf area infested by the mite (11.6%). Azadirachtin was at par with this combination. This might be due to presence of pesticidal properties of these extracts. Mukhopadhyay and Roy (2009) reported that in North East India, red spider mite was active and breeds on tea throughout the year. Their populations increase from early March and reach their highest density during April.

P. hydropiper in combination with cow urine and water, when sprayed at 7.5 per cent concentration, significantly reduced red spider mite population upto 87.5 per cent, percentage of leaves infested was 9.1 per cent and leaf area infested by the mite was 12.9 per cent. The present finding sare in agreement with the observations of Sarmah *et al*. (2009) and Mamun *et al*. (2015). This combination was at par with Azadirachtin (5 per cent) and corroborated by many other workers (Devi *et al.,* 2008; Sharmah and Bhola, 2015). The reduction in the percentage damage of tea leaves might be due to antifeedant and repellent properties of these products (Mahmood *et al*., 1984).

Conclusion

From the present investigation, it can be concluded that highest reduction was achieved by fish extract at 1 per cent followed by *P. hydropiper* extract at 7.5 per cent, while Azadirachtin (5 per cent) was at par with fish extract and *P. hydropiper* extract.

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